

June 2022

Progress in reducing emissions

2022 Report to Parliament

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Climate Change Committee
June 2022

Presented to Parliament pursuant to Section 36(1) of the Climate Change Act 2008.

This report was laid before Parliament on 29 June 2022 and is available online at:
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ISBN 978-1-5286-3372-7
E02752095 06/22

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Acknowledgements

The Committee would like to thank:

The team that prepared this report and its analysis: This was led by Chris Stark, Mike Thompson, David Joffe and Emily Nurse, and included Sasha Abraham, Rose Armitage, Jo Barrett, Owen Bellamy, Marili Boufounou, Victoria de la Cruz, Eoin Devane, Tom Dooks, Brendan Freeman, Adam Gardiner, Aaron Goater, Ruth Gregg, Mohammed Haq, Jenny Hill, Daisy Jameson, Jaya Jassi, Miriam Kennedy, Ewa Kmietowicz, Cara Labuschagne, James Lees, Bianca de Farias Letti, Ruth Lyons, Luke Maxfield, Richard Millar, Bea Natzler, Chloe Nemo, Helen Price, Simon Rayner, Jake Reynolds, Alasdair Robertson, Cristiane Scaldaferri, Kate Scott, Vivian Scott, Penny Seera, Marcus Shepheard, Zosia Staniaszek, David Style, James Tarlton, Sean Taylor, Abi Thomas, Emily Van de Koot, Colm Williams, and Louis Worthington.

A number of Government departments for their support, including the Department for Business, Energy & Industrial Strategy; the COP Unit; the Department for Environment, Food & Rural Affairs; the Department for Transport, the Department for Levelling Up, Housing and Communities; and the Northern Ireland Executive and the Scottish and Welsh Governments.

A wide range of stakeholders, including public and private bodies who engaged with us or met with the Committee bilaterally.

Our design and digital agencies: Pali Palavathanan and Anoushka Rodda (TEMPLO) and Mat Burhouse (Slingshot).

Dedication to Ewa Kmietowicz



This report is dedicated to the memory of our much-loved colleague Ewa Kmietowicz, who died earlier this year. Ewa led our work on land use, agriculture and surface transport for over a decade. We miss her deeply.

A skilled economist, Ewa spent almost 20 years working across Government, including roles with the Department for Work and Pensions and the former Department for Energy and Climate Change, before arriving at the CCC in 2012. Her contribution to our work was immense.

In transport, she was integral to CCC recommendations for a phase-out of petrol and diesel cars and vans by the early 2030s. Now a core UK Government policy. Ewa was an early adopter of zero-emission vehicles herself, often arriving at work on her electric moped.

She was probably best known for her analysis on land use and agriculture. In 2018 and 2020 she led ground-breaking reports, building the case for low-carbon farming and a transformation of UK land to reach Net Zero. Ewa's vision will see widespread peatland restoration and an increase in tree cover from 13% of UK land area to 18% by 2050.

And Ewa provided so much more. She was a warm and generous colleague, who nurtured younger staff, and brought fun into the office. We'll miss her wry sense of humour and her infectious laugh. She was passionate about making the world a better place. She made us a better team.

Thank you, Ewa, for your extraordinary contribution. This report – which aims to hold the Government to account to deliver on its climate promises – is for you.

Foreword

Every year, before the end of June, the CCC has to report to Parliament on our assessment of the Government's performance in combatting climate change. We measure its actions, overall and Department by Department, against the national and international legal obligations to which Britain is committed. This year, the UK's presidency of COP26, has driven world-class leadership backed not only in our 2050 Net Zero target but in signing up to a 68% cut in our emissions by 2030 and 78% by 2035, compared to 1990 levels. It is to the Government's credit that the significant successes of the COP were possible only because of British commitments.

In targets, the UK is indeed a world leader. However, this Progress Report reveals that, despite important achievements in renewable energy and electric vehicles, the Government is failing in much of its implementation. Sharply rising fuel costs should have given added impetus to improving energy efficiency, yet the necessary programmes are not in place. We are still building new homes that do not meet minimum standards of efficiency and will require significant retrofitting. Not only are we waiting for the promised Future Homes Standard but there is as yet no sign of the changes in the planning system necessary to reflect Britain's legal obligations for climate mitigation.

The UK's international leadership in commitments will only be effective if the world also knows that we will keep our word and that we have programmes in place that are clearly capable of delivering those commitments. Both issues must be put beyond question. For that reason the CCC will in future be concentrating even more centrally upon the delivery and implementation of the targets which are now enshrined in statute and international agreements. The Government has set the right course. It has now to deliver on the scale and urgency that is required.



Lord Deben
Chairman, Climate Change Committee

The Committee



**The Rt. Hon John Gummer, Lord Deben,
Chairman**

Lord Deben was the UK's longest-serving Secretary of State for the Environment (1993 to 1997). He has held several other high-level ministerial posts, including Secretary of State for Agriculture, Fisheries and Food (1989 to 1993). Lord Deben also runs Sancroft, a corporate responsibility consultancy working with blue-chip companies around the world on environmental, social and ethical issues.



Professor Keith Bell

Keith Bell is a co-Director of the UK Energy Research Centre (UKERC), a Chartered Engineer and a Fellow of the Royal Society of Edinburgh. He has been at the University of Strathclyde since 2005, was appointed to the Scottish Power Chair in Smart Grids in 2013 and has been involved in energy system research in collaboration with many academic and industrial partners.



Professor Nick Chater

Nick Chater is Professor of Behavioural Science at Warwick Business School. He has particular interests in the cognitive and social foundations of rationality, and applying behavioural insights to public policy and business. Nick is Co-founder and Director of Decision Technology Ltd, a research consultancy.



Professor Michael Davies

Michael Davies is Professor of Building Physics and Environment at the UCL Institute for Environmental Design and Engineering (IEDE). At UCL his research interests relate to the complex relationship between the built environment and human wellbeing. He is also Director of the Complex Built Environment Systems Group at UCL and a member of the Scientific Advisory Committee of 'Healthy Polis'.



Professor Piers Forster

Piers Forster is Director of the Priestley International Centre for Climate and Professor of Physical Climate Change at the University of Leeds. He has played a significant role authoring Intergovernmental Panel on Climate Change (IPCC) reports, and is a coordinating lead author role for the IPCC's sixth assessment report.



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Paul Johnson is Director of the Institute for Fiscal Studies and a visiting professor at University College London (UCL). He is widely published on the economics of public policy, and he co-wrote the 'Mirrlees review' of tax system design. He was previously Chief Economist at the Department for Education (2000 to 2004).



Professor Corinne Le Quéré FRS

Corinne Le Quéré is a Royal Society Research Professor at the University of East Anglia (UEA), specialising in the interactions between climate change and the carbon cycle. She was lead author of several assessment reports for the UN's Intergovernmental Panel on Climate Change (IPCC) and she currently Chairs the French Haut Conseil pour le Climat.



Pete Betts
Expert Adviser to the Committee

Pete was a career civil servant and until 2018 led UK policy on international climate change and energy. He was also Lead Negotiator for the European Union in the UNFCCC negotiations. His current portfolio includes roles at the European Climate Foundation; Willis Towers Watson; IRENA; Grantham School and Chatham House.



Executive Summary

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This is a pivotal point in the UK's journey to Net Zero. The UK is one of the few countries with emissions targets in line with the long-term temperature goal of the Paris Agreement. Policy ambition has also moved substantially with the publication of the UK's Net Zero Strategy. In most areas, these ambitions are credible, in line with the required pace and scale of change. It is now time to deliver the promised action.

This report marks a change in the CCC approach, with a new monitoring framework focused on delivery against the Net Zero Strategy.

Emissions in 2021 bounced back to some extent after COVID-19 but remain 10% below 2019 levels.

This report also marks a change in the CCC approach. We have increased our focus on tangible changes in the economy and across society, monitoring key indicators of progress against a new model of change in each sector. We track progress against the Government's own Net Zero Strategy, but we also highlight risks to its delivery.

Emissions rose 4% in 2021 compared with those in 2020 as the economy began to recover from the COVID-19 pandemic. Emissions in surface transport, electricity generation and manufacturing rose in 2021, following substantial reductions in 2020, while emissions from aviation remained depressed. Overall, 2021 emissions were still 10% below pre-pandemic 2019 levels and 47% below 1990 levels.

Our key messages in this report are:

- **The UK Government now has a solid Net Zero strategy in place, but important policy gaps remain.** The UK has emissions targets that are internationally recognised as being compliant with the Paris Agreement and has published a credible strategy to meet them. The Government has raised ambition across the board, although policies are not yet fully in place to drive the large programme of delivery required this decade. It is imperative that the Government completes the policy framework in the next year, for consideration in our 2023 progress report to Parliament. Policy gaps must be closed, notably on land use – potentially enabled by new legislation on the environment – and on energy efficiency of buildings. Strategies and detailed plans are still needed for waste management, land use and agriculture, and achieving full electricity decarbonisation by 2035.
- **Tangible progress is lagging the policy ambition.** With an emissions path set for the UK and the Net Zero Strategy published, greater emphasis and focus must be placed on delivery. This is needed for the UK's climate ambitions to be credible. Recent uptake of electric cars is very positive – as with renewable electricity, the combination of cost reductions over the last decade and the policy framework now in place provide confidence that the necessary progress will be made in deployment. However, outside these bright spots, we are not seeing the necessary progress across a wide range of areas.
- **Successful delivery of changes on the ground requires active management of delivery risks.** Not all policies will deliver as planned. Some may be more successful than expected, while others will fall behind. The Net Zero Strategy sets a pathway to deliver the necessary emissions reductions, but takes an approach that does not include significant ambition to reduce consumer demand for high-carbon activities (e.g. through healthier diets, or curbs to growth in aviation demand). Given the range of delivery risks highlighted in this report and the lack of progress seen in many areas to date, the Net Zero Strategy is not fully credible until the Government develops and begins to implement contingency plans. These should broaden the Government's approach, in particular by including demand-side policies. It would be particularly risky to compensate shortfalls in delivery with extra engineered CO₂ removals, given the already high reliance on these in the Strategy.

- **Action to address the rising cost of living should be aligned with Net Zero.**

Following Russia's invasion of Ukraine, the UK Government's response to heightened energy security concerns has been to double down on Net Zero. This is welcome, but the new Energy Security Strategy (ESS) is almost entirely supply-focused and many of its commitments may not be delivered until well after the immediate crisis. There remains an urgent need for equivalent action to reduce demand for fossil fuels to reduce emissions and limit energy bills.

 - Further support to help people with their energy bills should be aligned with Net Zero, in line with the Government's commitment to delivering a fair transition. The Committee would support moving the policy costs due to historical subsidies off electricity bills and onto general public spending, which would improve energy affordability and, by lowering electricity prices relative to those of fossil fuels, improve the incentive to switch heating from fossil fuels to electricity.
 - There remain further opportunities to reduce fossil fuel consumption on a timescale that will help people cope with current very high prices. These include a sustained push for both energy efficiency improvements and electrification, especially in the buildings sector, as well as deployment of onshore wind and solar, which can occur significantly quicker than offshore wind deployment. Experience from the Green Homes Grant suggests that local authorities could play a significant role in near-term delivery.
 - Widespread concern about consumers' exposure to high fossil fuel prices has created a window to encourage even faster decarbonisation. The Government's planned energy advice service this summer must be a major and urgent undertaking, advising millions of people on energy efficiency, low-carbon heat and how to reduce the environmental impact of travel. It should include an objective of driving the uptake of heat pumps through the Boiler Upgrade Scheme. The success of the advice service should be measured by actions to improve energy efficiency and install heat pumps, and in emissions reductions. Policy action will be required to ensure that supply chains are scaled up with support for development of the necessary skills, and maintained through sustained deployment.
- **Slow progress on wider enablers.** The Net Zero Strategy contained warm words on many of the cross-cutting enablers of the transition, but there has been little tangible progress. The transition to Net Zero will bring a range of benefits and opportunities, but the Government needs to make it easy for everyone to contribute. We are yet to see a public engagement strategy from the Government, three years since Net Zero was placed in legislation. The Treasury has not set out how the full range of costs and benefits of the transition will be shared fairly. It remains unclear how central, devolved and local government will operate coherently towards the Net Zero goal. The Government must take a proactive approach to tackling bottlenecks, such as skills gaps and planning consent for infrastructure, and integrate adaptation into action to reduce emissions.
- **The UK must build on a successful COP26.** The UK presidency of the UN COP26 climate summit in Glasgow last November successfully strengthened long-term global ambition and introduced new mechanisms to support delivery. It should prioritise making those new mechanisms work in practice and strengthening global 2030 ambition, while preparing for a focus on climate finance and adaptation at this year's COP27 and COP28 in 2023.

That should include better transparency and reporting, while strengthening the delivery aspects of the UK's Nationally Determined Contribution (NDC) 2030 emissions reduction commitment. Across the remainder of the UK presidency, and beyond as an international climate leader, it is vital that the UK maintains its credibility by taking effective action at home, on both reducing emissions and adapting to climate change, and in its response to the international fossil fuel price crisis.

The rest of this executive summary is set out in five sections:

1. Emissions in 2021
2. Delivery of emissions reductions
3. Adequacy of plans and policies
4. Major risks to delivery
5. The year ahead

We provide a set of priority recommendations immediately following this executive summary and our full recommendations, department by department, covering all aspects of the Net Zero challenge, in an annex at the end of this report.

1. Emissions in 2021

UK greenhouse gas emissions were 447 MtCO₂e in 2021, including the UK's share of international aviation and shipping emissions, and were 47% below 1990 levels. This was a decrease of 10% on 2019 emissions but an increase of 4% on 2020, as emissions in 2020 had been significantly impacted by the response to the COVID-19 pandemic (Figure 1).

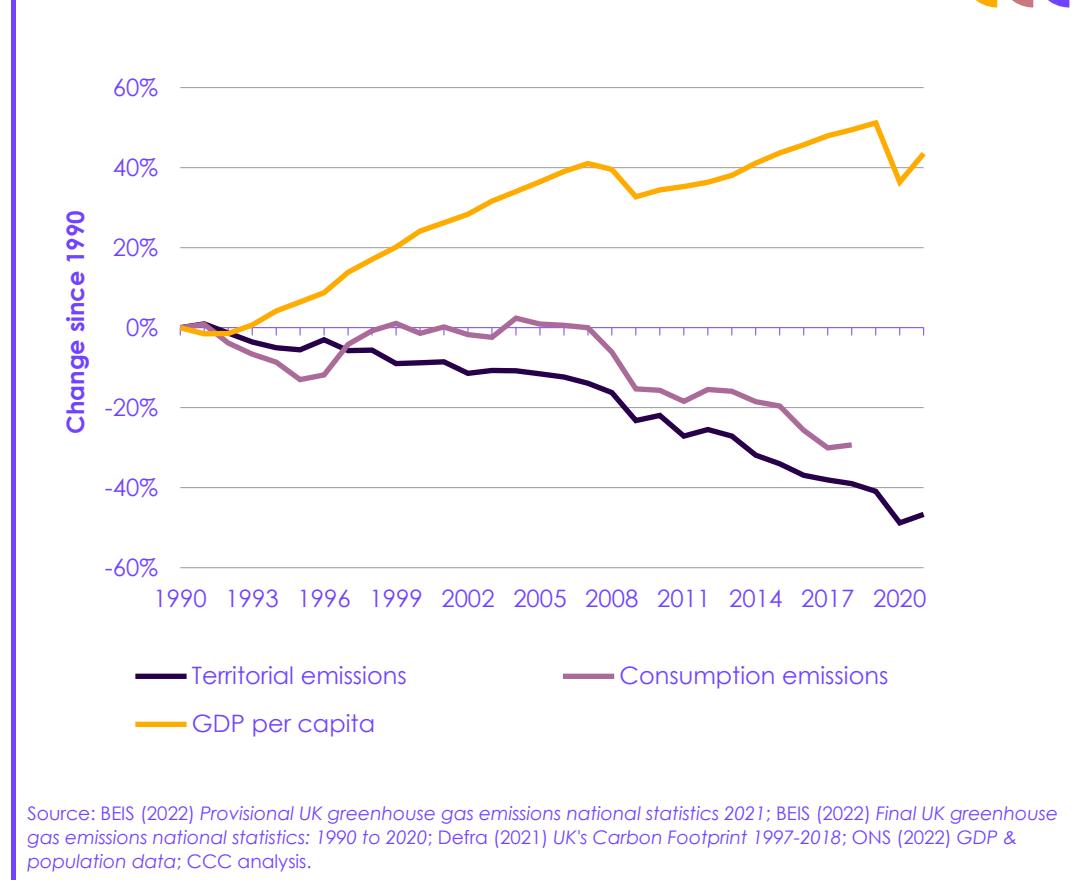
The rebound in emissions in 2021 occurred primarily in surface transport, electricity generation and manufacturing, each of which had significant reductions in 2020 due to the response to the pandemic (Figures 2 and 3).

Emissions in 2021 were still affected by the impacts of COVID-19, most obviously in aviation where emissions remained down 60% on 2019 levels, but also in surface transport. It remains unclear what the long-term impact of the pandemic will be across a range of sectors.

UK 'consumption' emissions, which estimate the amount of emissions that result from UK consumption of goods and services wherever in the world they are produced, are not available yet for the most recent years but also fell, by 29%, from 1990 to 2018.

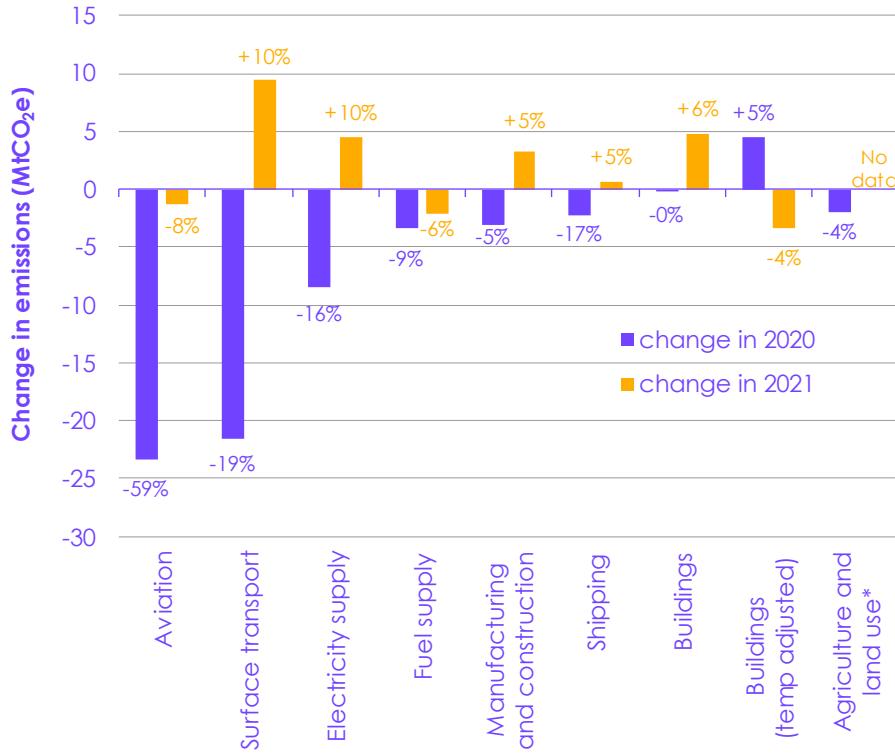
The UK has cut its territorial and consumption emissions footprints while growing the economy.

Figure 1 The UK's historical emissions and GDP



While emissions have rebounded to some extent, there were still some COVID-19 effects on 2021 emissions.

Figure 2 Change in UK emissions 2019-2021

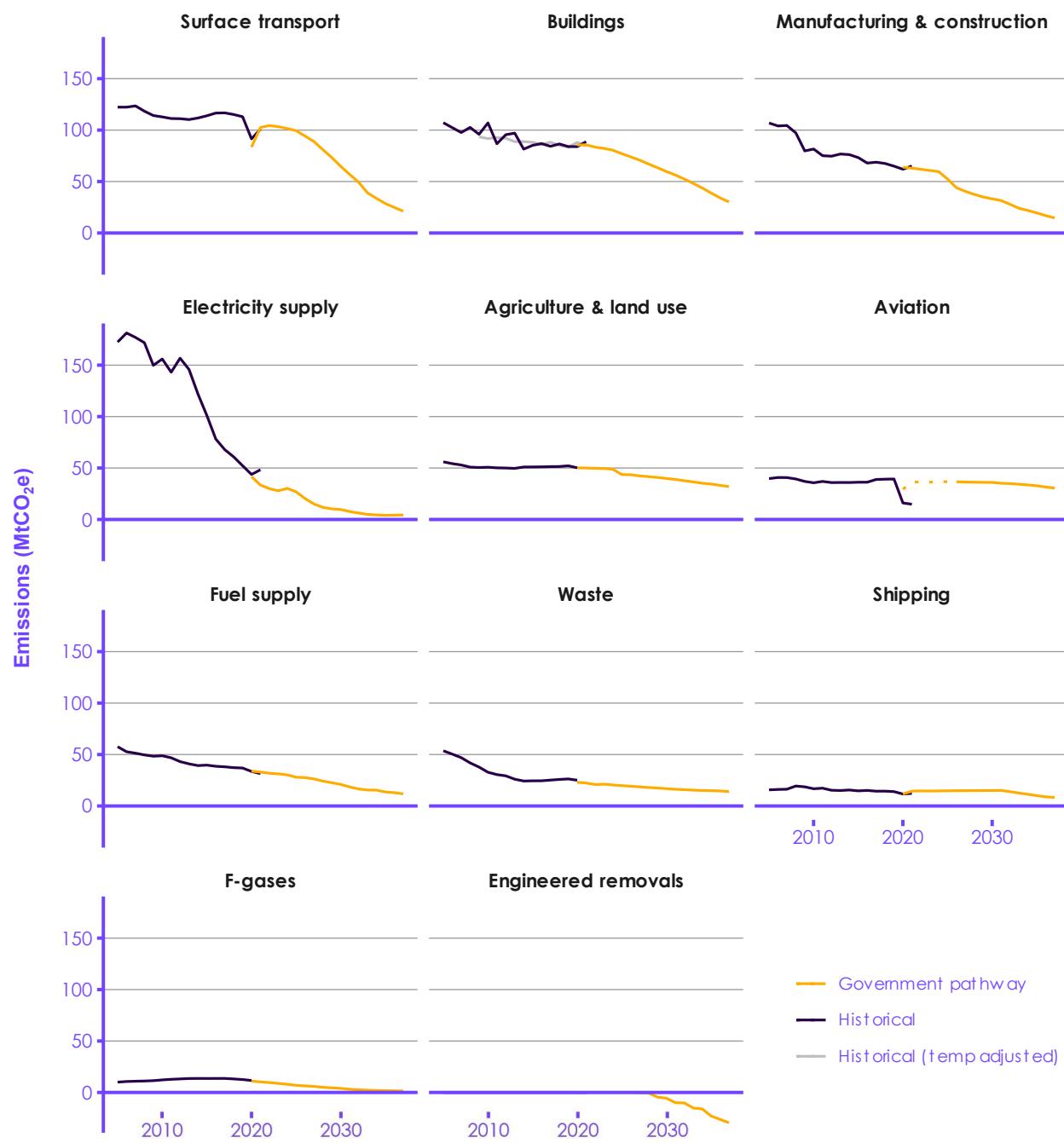


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics; BEIS (2022) Energy Trends: UK oil and oil products March 2022; CCC analysis.

Notes: Global warming potentials from the IPCC Fifth Assessment Report (AR5) without feedback are used.

*Provisional 2021 estimates are not made for non-CO₂ greenhouse gases, so the change in 2021 agriculture and land use emissions is not shown.

Figure 3 UK historical emissions compared to the Government's pathway by sector



Source: CCC analysis.

Global warming potentials from AR5 without feedbacks are used. The aviation pathway published by the Government starts in 2025 but the earlier years were estimated in order to get a total emissions pathway. We show this estimation as a dashed line.

2. Delivery of emissions reductions

Outside the bright spots of electric car sales and renewable electricity deployment, we have not seen the necessary tangible progress in a host of areas.

The period 2019 to 2021 saw the setting of ambitious emissions reduction targets – the 2050 Net Zero target, the 2033-2037 Sixth Carbon Budget and the 2030 NDC – followed by the Net Zero Strategy that set out how the Government plans to meet them. The emphasis must now be on action to scale up and roll out low-carbon solutions and to deliver the necessary emissions reductions.

Monitoring progress is a pre-requisite to successful delivery. In this report we refresh our monitoring framework, aiming to improve our ability to assess whether sufficient progress is being made in delivering the UK's path to Net Zero. Outside the bright spots of electric car sales and renewable electricity deployment, we have not seen the necessary tangible progress in a host of areas. In some areas, it is still too early to say whether progress is sufficient, while for others insufficient data are available (Table 1):

- **Surface transport.** Our indicators show clear progress in sales of electric cars, although electric van sales are lagging behind. However, car travel rebounded much more quickly and completely following the lifting of lockdown restrictions than public transport did, and van and heavy goods vehicle (HGV) traffic has rebounded to above pre-pandemic levels. Development of charging infrastructure for electric vehicles is not making fast enough progress.
- **Electricity supply.** Deployment of renewable electricity capacity, especially offshore wind, has been strong. We will set out a broader range of indicators in a separate report later this year, once we have undertaken further analysis on the Energy Security Strategy.
- **Buildings.** Rates of improvement in energy efficiency continue to be well below the necessary level, as they have been over the last decade. The Government proposes to scale up the market for heat pumps over the 2020s to achieve at least 600,000 installations a year, up from around 54,000 in 2021. Indicators of supply chain build-up will be needed to track whether this is progressing as planned, but at present data limitations make this difficult to assess.
- **Manufacturing and construction.** Progress in this sector is hard to ascertain, due to the poor availability of relevant data across the various sub-sectors which critically limits monitoring and evaluation of policy implementation. As such, the Government should review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting.
- **Agriculture and land use.** Our indicators show a lack of progress in low-carbon farming and productivity measures needed to decarbonise the agriculture sector. Land-use changes that are necessary to reduce greenhouse gas emissions from degraded peatlands and to promote carbon sequestration via tree planting have yet to meet delivery targets. While meat consumption is reducing at an encouraging rate, there are no policies in place to capitalise on this momentum.

The Government will also publish a regular report that tracks progress. It should use this to correct course as necessary.

The Government has committed to an annual monitoring report, in which it will check progress against its key commitments. It will summarise key areas of progress and comment on any contextual changes that may affect its pathway.

The Government should use this to set out plans for how barriers or issues will be resolved, and shortfalls addressed.

Table 1

Summary of progress against key indicators

Surface transport	Electricity supply	Buildings	Manufacturing and construction	Agriculture and land use
BEV car sales	Offshore wind, installed	Energy demand	Sector territorial emissions	Agriculture CH ₄
EV cars sales	Onshore wind, installed	Energy efficiency retrofits	Sector consumption emissions	Agriculture N ₂ O
BEV van sales	Solar PV, installed	Non-res buildings energy intensity	Carbon intensity of energy	New woodland
EV van sales	Grid emissions intensity	Low-carbon heat supply	Material and product use	Woodland management
ICE car intensity	Unabated gas generation	Heat pump installations	Steel: energy efficiency	Peat restoration
ICE van intensity	Low-carbon flexible capacity	Heat pump costs	Paper: energy efficiency	Energy crops
Charge points	Nuclear	Electricity to gas price ratio	Low-carbon energy use	Farmer action
Car km	Flexible demand	Heat networks	Industrial hydrogen project pipeline	Crop yields
Van km	Onshore networks	Retrofit coordinators	Industrial CCS project pipeline	Livestock numbers
HGV km	Offshore networks	Willingness to replace boiler	Average embodied carbon of buildings	Meat consumption
Key:				
 On track  Slightly off track  Significantly off track		 Too early to say  Data not reported  No benchmark or target		
<small>Notes: An indicator is on track if it is going in the right direction at an appropriate rate. This is determined either by comparing to a quantified pathway/benchmarks using data from 2019, 2020 and 2021, where available. <small>EV = electric vehicle, BEV = battery-electric vehicle, ICE = internal combustion engine.</small></small>				

3. Adequacy of plans and policies

The Net Zero Strategy sets a clear and credible range for emissions reduction in each sector of the economy.

In October 2021, the Government published the Net Zero Strategy, which sets out its intended pathway for decarbonisation over the period until 2037, the end of the Sixth Carbon Budget period, on the way to Net Zero by 2050. It sets a clear and credible range for emissions reduction in each sector of the economy and highlights choices on how the emissions targets can be achieved, dependent on developments over the next decade.

It is quite proper that plans for near-term emissions reduction are more certain than those for the longer term. Meeting the carbon budgets is an evolving task, requiring constant evaluation of policy effectiveness and real-world change. We do not, therefore, expect full and final plans to be in place for all emissions reductions to 2037. However, progress in the next few years is essential and must take due account of uncertainty.

If delivered in full, the Government's pathway would slightly outperform the Sixth Carbon Budget in part due to accounting changes since the budget was recommended. This is an appropriate aim, given possible future changes in emissions estimation methods and uncertainties on future macroeconomic trends affecting the pathway, as highlighted in the range presented in the Net Zero Strategy.

In this report, we assess the risks relating to delivery of the Government's pathway and the Sixth Carbon Budget, tracking progress against the Government's stated objectives, informed by the CCC's independent analysis of potential pathways. We find a mixed picture, with either significant risks or a policy gap for 38% of the required emissions reduction to meet the Sixth Carbon Budget (Figure 4):

- **Credible plans exist for 39% of the required emissions reduction**, with funding, enablers and timelines in place. This comes predominantly from the zero-emission vehicle mandate and renewable electricity supply.
- **There are some risks attached to 24% of the required emissions reduction**, where changes are needed to mitigate delivery risks. These include policies to address price disparity in car charging, zero-emission HGVs, flexible low-carbon electricity generation, decarbonising new homes, and policies for industrial CCS and hydrogen, especially for dispersed sites.
- **There are significant risks attached to 33% of the required emissions reduction**, where plans are either under development without a clear timeline for next steps or need further work to mitigate a significant delivery risk. These include, in particular, policies for a market-based mechanism for low-carbon heat in homes, industrial resource efficiency, peatland restoration, and for the necessary infrastructure, CO₂ storage sites and funding mechanisms for engineered removals.
- **Plans are either completely missing or currently clearly inadequate for 5% of the required emissions reduction**. This is a particular problem for low-carbon farming practices, the UK's strategy for biomass, energy efficiency in non-fuel-poor homes, and industrial electrification.

There are currently significant risks in the plans for meeting the UK's 2030 NDC under the Paris Agreement process (which has greater ambition than the Fifth Carbon Budget for 2028-32), and for the Sixth Carbon Budget (2033-37).

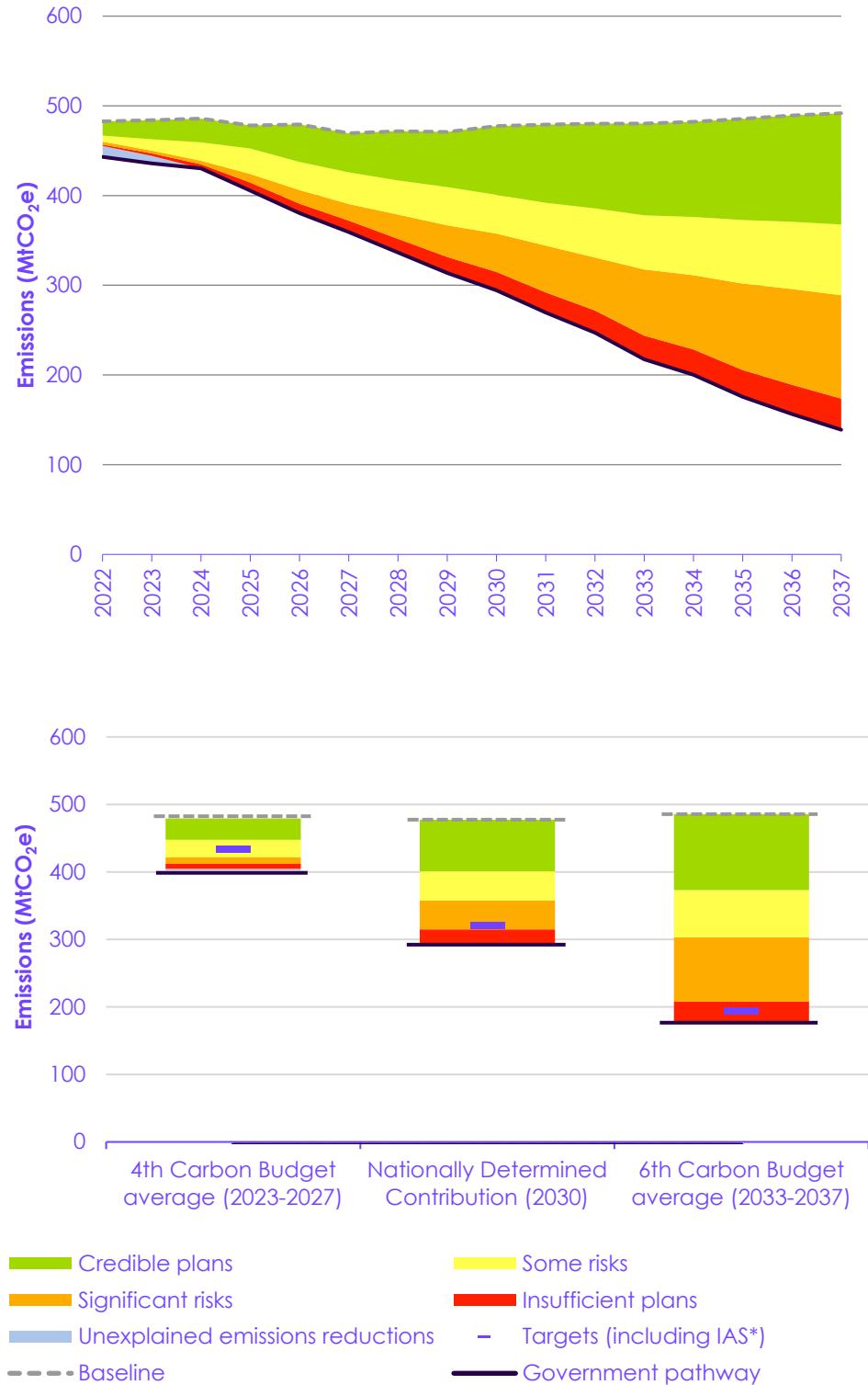
Prospects for meeting the Fourth Carbon Budget (2023-27) are better although this will depend to some extent on near-term macroeconomic trends and the extent to which emissions rebound following the COVID-19 pandemic. At present, that is uncertain.

It is imperative that the Government completes the policy framework in the next year.

The view of the Committee is that the policy framework is not yet fully in place to drive the large programme of delivery required within this decade. There is time to complete this, but it is imperative that the Government does so in the next year, as implied by the Net Zero Strategy.

Plans will need to be strengthened for the UK's carbon budgets and pledge under the Paris Agreement to be met.

Figure 4 Assessment of policies and plans



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. *International aviation and shipping (IAS); for comparability, we added the Net Zero Strategy IAS pathway values to CB4 and the NDC. The baseline is an adjustment to the Government's Net Zero Strategy baseline, with the impact of some policies removed so that they can be assessed. The unexplained emissions reduction is emissions reduction that could not be attributed to a plan published by the Government.

Within this overall picture, some key sectors are well placed in terms of policy frameworks to deliver the necessary emissions reductions, while in others there are more substantial risks to delivering the Government's emissions pathway (Figure 5):

Surface transport and electricity supply are relatively well placed to reduce emissions over the period to 2035.

The buildings sector has important policy gaps, and significant risks over many proposed and existing policies.

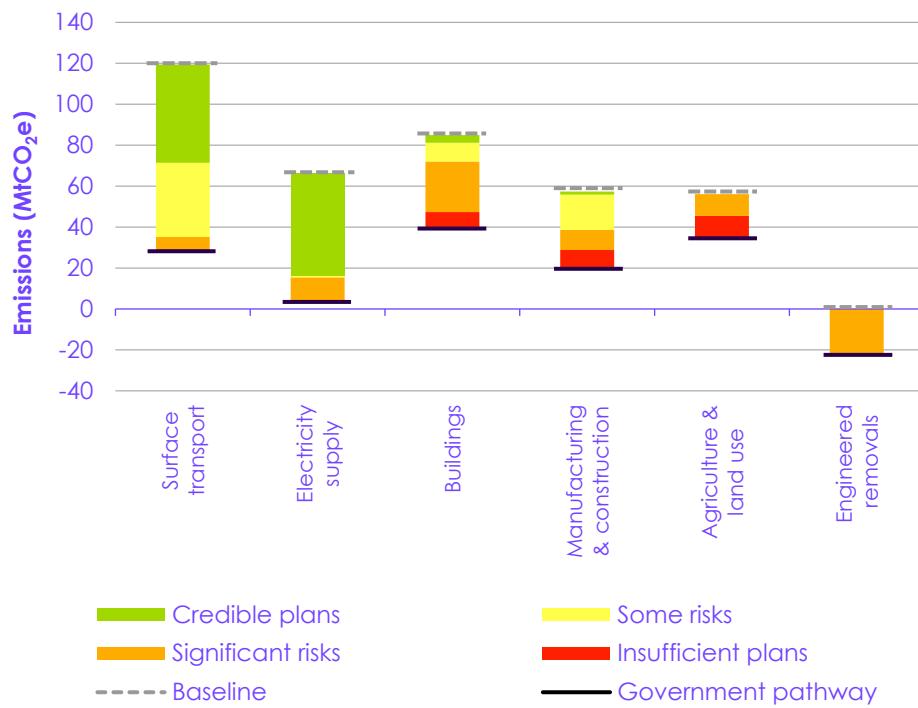
There are major risks to delivering the necessary emissions reductions from agriculture and to freeing up land needed for UK-based greenhouse gas removals.

- **Surface transport and electricity supply** are relatively well placed to reduce emissions over the period to 2035, with emissions reductions from renewable electricity generation and electric vehicles covered by policies that are credible or rated as having 'some risks'. In addition, it will be necessary to address some significant risks that remain, including on transport demand and on delivery of the full electricity decarbonisation objective for 2035.
- **Buildings.** There are significant emissions reductions we assess to be at risk in this sector. There remains a particular policy gap on energy efficiency for owner-occupiers, while more detailed plans need to be finalised on roll-out of low-carbon heating in general.
- **Industry.** There is an emerging set of policies to cap emissions via the UK emissions trading scheme (UK ETS), to upgrade the least-efficient operations, and to support innovation and early deployment. However, there are several policy gaps including on resource efficiency, electrification, off-road mobile machinery and decarbonisation of the 40% of emissions from smaller operations that are outside the UK ETS. It is not clear whether energy efficiency policy is strong enough. There are also some risks in the fuel supply sector, although these are more limited given the relatively low ambition the Government has targeted.
- **Agriculture and land use.** Diet and demand are not addressed in the Net Zero Strategy. Instead, the Government's plans are reliant on innovation and productivity improvements, which appear highly optimistic and are not yet backed by credible policies. Many policy details on the UK's successor to the Common Agricultural Policy are still in development. Together these imply major risks to delivering the necessary emissions reductions from agriculture and to freeing up land needed for UK-based greenhouse gas removals. Present plans would also miss out on the health benefits of lower meat diets and could see conflicts with other objectives such as biodiversity.
- **Engineered greenhouse gas removals.** Action to create a policy framework for removals is underway, but market design, support mechanisms and governance must now be set out in a timely manner. The Government's upcoming Biomass Strategy must include robust plans on sustainability frameworks and increased domestic biomass production to underpin the role of bioenergy with carbon capture and storage (BECCS) in future UK decarbonisation. The lack of a credible long-term plan for cutting aviation emissions risks greater reliance on removals.

Outside of these sectors, there are also significant delivery risks in many areas (Table 2). Delivery will be required across all sectors to meet the NDC and Sixth Carbon Budget, on the way to Net Zero.

There are delivery risks in all sectors for the Sixth Carbon Budget period, with some notably larger.

Figure 5 Assessment of policies and plans in 2035 for key sectors



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: The baseline is an adjustment to the Government's Net Zero Strategy baseline, with the impact of some policies removed so that they can be assessed. Global warming potentials from AR5 without feedback are used.

Table 2

Summary policy scorecard for sectors up to the Sixth Carbon Budget

Sector	Change in emissions: 2019-2035	Delivery mechanism and responsibilities	Funding and other incentives	Enablers in place / barriers overcome	Timeline for future policies	Overall sector assessment
Surface transport	-84 MtCO ₂ e	G	Y	O	G	Y
Electricity supply	-48 MtCO ₂ e	G	G	Y	Y	G
Manufacturing & construction	-45 MtCO ₂ e	O	O	O	O	O
Buildings	-45 MtCO ₂ e	O	O	O	O	O
Fuel supply	-23 MtCO ₂ e	Y	Y	O	Y	Y
Engineered removals	-23 MtCO ₂ e	N/A	Y	O	O	O
Agriculture & land: sources	-18 MtCO ₂ e	R	O	R	O	R
Agriculture & land: sinks		O	O	O	O	O
Waste	-11 MtCO ₂ e	O	O	O	O	O
F-gases	-11 MtCO ₂ e	G	G	G	G	G
Aviation	-7 MtCO ₂ e	O	Y	Y	O	O
Aviation (in 2050)	-23 MtCO ₂ e (2019-2050)	R	O	R	O	R
Shipping	-4 MtCO ₂ e	O	Y	O	Y	O

 Credible plans
  Some risks
  Significant risks
  Insufficient plans
  Not applicable

4. Major risks to delivery

The UK's emissions reduction targets are ambitious and require coordinated action by government, business and the public as well as successful innovation in key technologies and their costs.

Our assessment of the policy framework finds that there are considerable risks to the delivery of the Government's emissions reduction pathway. In some cases, the risks result from the inherent reliance on new technologies and new ways of doing things. In others, there may be fewer inherent risks, but the policy framework does not yet provide confidence that full delivery will ensue.

The lack of a public engagement strategy could undermine emissions reductions and miss opportunities for co-benefits of climate action.

Clear roles and responsibilities are needed between central Government and other actors. Without these, the necessary changes will not happen at the pace required, if at all.

The Government has been reluctant to target shifts to lower-carbon behaviours, resulting in an over-reliance on technology.

- **Public engagement.** The public are increasingly concerned about climate change and supportive in general of the need to tackle it. However, there is lower awareness of how individuals can best contribute. The Net Zero Strategy recognised the need for public engagement, but it is unclear how commitments will be implemented for public-facing advice, supporting businesses, increasing awareness and making green choices affordable and easy. This could undermine emissions reductions in a range of areas as well as missing opportunities for people to see the co-benefits of climate action (see Chapter 14, section 2).
- **Governance.** Embedding and integrating Net Zero and climate adaptation properly across the policy landscape is vital to the delivery of the Government's Net Zero Strategy, having been largely missing from key documents such as the Levelling Up White Paper. Clear roles and responsibilities are needed between central Government departments, the regulators, devolved and local government, and industry for the actions and interactions on the path to Net Zero. Effective accountability mechanisms to translate these into practice will also be necessary. Without these, the required changes will not happen at the pace required, if at all (see Chapter 14, section 1).
- **Skills.** Workers will need to develop new skills to fill the needs of new low-carbon markets. However, evidence on skills requirements and current employment in key growth occupations (e.g. home retrofit coordinators) is limited. Availability of skilled workers therefore poses a risk for the Net Zero transition. The Government must now follow up on its commitment to produce an Action Plan for Net Zero skills. It should include a comprehensive assessment of when, where, and in which sectors there might be skill gaps specific to Net Zero, and how Government policy (along with other actors) will support the filling of these gaps.
- **Reliance on aviation innovation.** The Government's pathway for aviation relies heavily on very nascent technology scaling up quickly for commercial use. There is no policy framework ready to mitigate demand growth if these technologies cannot be deployed as planned (see Chapter 9).
- **Reliance on greenhouse gas removals.** The Government's scenarios for achieving Net Zero have a higher dependence on engineered removals than the CCC's Balanced Pathway, seeing around 20 MtCO₂ more removed per year in 2050. Given the greater reliance on removals and the challenge to their delivery in a sustainable way, there are significant risks around the delivery of necessary removals even without the further reliance

on them that could arise if there is under-delivery of emissions reductions across the economy (see Chapter 13).

- **Reliance on untested approaches for buildings.** The Government is proposing a market-based mechanism for heat pumps (via an obligation on boiler manufacturers to sell a rising number of heat pumps) and is relying on the market to drive delivery in other areas, such as heat networks. This is an untested approach and if market participants do not respond to incentives as expected, low-carbon heat roll-out will not take off. The Government should develop contingency plans in case this approach does not deliver as required. Public understanding and consent for the transition process and what it will entail for their homes and businesses is a prerequisite for the buildings transition, and a lack of trusted information is a barrier to energy efficiency improvements. There is a significant risk that the transition will stall if this is not adequately addressed in the Government's plans (see Chapter 4).
- **Adaptation.** Without consideration of the future weather and climate conditions, aspects of the UK's Net Zero transition are at risk of failure. For example, increased carbon sequestration in peatlands and woodlands will only be possible if protected from emerging climate hazards such as drought, floods and wildfires. The larger renewable-dominated electricity system required for Net Zero must be resilient to the range of weather extremes expected in future. Significant gaps in adaptation policy remain, with most of our recommendations from our 2021 Progress Report not yet implemented. A step-change in ambition and delivery is urgently needed now to fully prepare the UK for current and future climate change. It is vital that the next National Adaptation Programme (due in 2023) delivers this, together with climate resilience being fully integrated within all aspects of planning and delivery for the Net Zero transition.

Without consideration of the future weather and climate conditions, aspects of the UK's Net Zero transition are at risk of failure.

Engineered removals must not be seen as cover for a failure to deliver on emissions reduction.

Given these risks, it is important to consider how shortfalls in some areas can be compensated for by extra emissions reductions elsewhere. Challenges on sustainability and delivery at scale mean that it would not be appropriate to respond to shortfalls in reducing sectoral emissions with ever-growing reliance on deployment of engineered removals.

In many cases, compensatory measures are available within the same sector, e.g. with more action on demand compensating for less progress than planned on technology deployment. More widely, there are several ways to reduce emissions included in the CCC's pathways that go beyond what is in the Net Zero Strategy:

- **Aviation demand.** While the Government's pathway for aviation has similar emissions in 2035 to those in our Balanced Pathway, the Net Zero Strategy assumes higher demand and has high ambition on use of sustainable fuels and efficiency improvements. Action to limit aviation demand can mitigate the risks relating to technology developments in aviation, as well as providing an option to balance under-delivery elsewhere in the economy.
- **Diet change.** The Government has not set out any ambition for UK consumption of meat and dairy to be reduced. Cutting back can contribute to healthier diets, reduce direct emissions from food production in the agriculture sector and also free up land that can be used for carbon sequestration. While meat consumption is reducing at an encouraging rate, there are no policies in place to capitalise on this momentum.

- **North Sea oil and gas production.** The North Sea Transition Deal and Net Zero Strategy committed to a 50% reduction in emissions from offshore oil and gas production by 2030, well short of the 68% we assessed as being feasible in our Balanced Pathway. Even with some additional North Sea fossil fuel production as part of the Energy Security Strategy, it should be possible to outperform the Government's pathway.
- **A faster shift away from fossil fuels.** Current high fossil fuel prices give a greater incentive to accelerate the transition away from fossil fuels, beyond what was in the Net Zero Strategy or the CCC's pathways for the advice on the Sixth Carbon Budget. While the Government has set out plans to do this for energy supply as part of the Energy Security Strategy, there is the potential to push harder, in particular on energy efficiency and heat pump roll-out in the buildings sector. It is important that efforts to ameliorate consumer costs do not entrench existing use of fossil fuels.

The Government should develop and implement contingency plans in areas where further action is feasible, notably on the demand side.

The Government should develop and implement contingency plans in these areas where further action is feasible. Overall, we estimate that demand-side changes on aviation and diet, plus greater action on emissions from North Sea oil and gas production could reduce emissions by around a quarter of the emissions reductions we assess as having a policy gap or significant risks. It is therefore also imperative to address those gaps and risks in order to deliver the large majority of those planned reductions.

5. The year ahead

The coming year should see completion of the UK's policy framework under the Net Zero Strategy. It presents opportunities to combine action on climate change with efforts to improve energy affordability, as part of the UK's global climate leadership and Presidency of the UN climate negotiations through to November 2022.

Energy affordability

In 2021, the Government has acted on energy affordability through two large financial packages for energy consumers and the new Energy Security Strategy.

Action to encourage a more rapid move away from fossil fuels can offer near-term reductions in energy and fuel bills, with wider societal benefits.

However, these interventions were not designed to help consumers reduce their underlying demand for fossil fuels, nor to sharpen the incentives for energy efficiency. Action to encourage a more rapid move away from fossil fuels can offer near-term reductions in energy and fuel bills, with wider societal benefits including cleaner air and more comfortable buildings, as well as necessary reductions in greenhouse gas emissions.

In its Net Zero Review in 2021, HM Treasury acknowledged the risk that some of the costs of decarbonisation may fall unfairly on those individuals and businesses who can least afford them. The current pressures on the cost of living only increase the importance of actions to ensure that the costs – and the significant benefits – of the Net Zero transition are distributed fairly. Changes to taxes will be central to securing a fair outcome. The Government, specifically HM Treasury, should consider a Net Zero Tax Review to establish how the tax system can best support the transition to Net Zero, by correcting distortions that often penalise low-carbon technologies and ensuring that the significant consumer savings from using many low-carbon technologies are also widely enjoyed.

The Committee will be exploring longer-term issues over the allocation of costs and benefits of the transition in the coming months, as we develop our own assessment of distributional impacts on households and the Exchequer from the transition to Net Zero.

Key actions towards Net Zero

Our recommendations to each department for the next year are available as an Annex to this report and in sortable and filterable tables in our accompanying webpage. Here we provide a summary of the priority recommendations by department, which are shown in brief in Table 3 and in full following this Executive Summary.

There is a need for a strong lead from the centre, on coordination and delivery, contingency planning and international policy.

- **The Cabinet Office, Number 10 and BEIS.** Alongside BEIS, as the primary department responsible for the delivery for Net Zero, central coordination is needed for delivery of emissions reduction and contingency planning.
 - **Co-ordination and delivery.** The Government needs to develop an annually updated document, setting out its vision of how the Net Zero Strategy will be delivered, clarifying roles and responsibilities. It should ensure the Local Net Zero Forum addresses coordination and responsibility between local and central government.

Similar means of coordination and cooperation should be established with the devolved administrations.

- **Contingency planning.** Given the range of delivery risks highlighted in this report and the lack of progress seen in many areas to date, the Government – led by BEIS – should develop and begin to implement contingency plans, broadening its approach, in particular to include demand-side policies.
 - **International policy.** The Government should outline how its 2030 international climate strategy will be resourced across the Government. It should strengthen its 2030 NDC by updating information on delivery. The UK should push for inclusion of a 2050 Net Zero target in shipping within the 2023 update of the International Maritime Organisation's initial greenhouse gas strategy.
- **The Department for Business, Energy and Industrial Strategy (BEIS).** As the lead delivery department for Net Zero, we have a number of priority recommendations for BEIS.
- **Buildings.** Plans for decarbonising buildings need to be strengthened. Policy details for the market-based approach to low-carbon heat need to be finalised urgently, and new policies must be developed for home efficiency improvements of owner-occupied homes. To ensure energy users start to make low-carbon choices, the planned public energy advice service needs to provide effective guidance and advice.
 - **Manufacturing and construction.** BEIS should consult on mechanism(s) to support early deployment of electrification. It should create a clear incentive for the approximately 40% of emissions from small emitters outside the UK ETS to switch to low-carbon energy sources. It must also invest in and reform collection and reporting of industrial decarbonisation data to enable effective monitoring and evaluation.
 - **Electricity supply.** With a welcome commitment to a fully low-carbon electricity supply by 2035, BEIS must now publish a comprehensive, long-term strategy to achieve this. A strategy for market design and a framework for timely delivery of network requirements for Net Zero are also needed to ensure not just low emissions but also sufficiently resilient access to electricity.
 - **Fuel supply.** With an ambitious commitment of 10 GW of low-carbon hydrogen production, funding mechanisms must now be put in place to deliver. Clear plans to electrify oil and gas platforms are needed to ensure that emissions from oil and gas production are minimised.
 - **Engineered removals.** There is high ambition for the role of engineered removals in the Net Zero Strategy. Plans for monitoring, reporting and verification systems that ensure sustainability and a proposal for the funding model for deployment at scale are now needed.

BEIS is the lead delivery department, with action required on decarbonisation across buildings, manufacturing, energy supply and engineered removals.

HMT should consider a Net Zero Tax Review and lead on design and implementation of carbon-border policies.

- **Her Majesty's Treasury (HMT).** HMT should consider a Net Zero Tax Review to establish how the tax system can best support the transition to Net Zero. As part of addressing energy affordability and incentivising electrification, the Committee would support moving policy costs due to historical subsidies onto general public spending. To avoid carbon leakage as the UK decarbonises, HMT and BEIS should consult on plans to implement, by 2030, Carbon Border Adjustment Mechanisms (CBAMs) and mandatory minimum climate-related standards on imports of selected manufactured goods and energy. HMT should also increase the multi-year funding commitments for decarbonisation in public buildings up to 2025, as well as supporting the necessary funding requirements across all areas of the Net Zero Strategy.
- **The Department for transport (DfT).** While DfT has been making good progress, action is needed in some key areas:
 - **Surface transport.** The uptake of electric cars is progressing well. To ensure this continues a confirmation of the zero-emission vehicle (ZEV) mandate in regulation is needed as well as continued improvements to public charging infrastructure. The Government has acknowledged the need to limit traffic growth, shifting travel to public transport and active travel, but action is now required to ensure this. Alongside these, regulations are needed to ensure efficiencies of new conventional vehicles improve.
 - **Aviation.** DfT has extremely ambitious plans for sustainable aviation fuel and so the Sustainable Aviation Fuel Mandate must be implemented as soon as possible.
- **The Department for Levelling Up, Housing and Communities (DLUHC).** DLUHC must embed sustainable transport within the upcoming Levelling Up and Regeneration Bill. It is also essential to ensure that the Future Homes and Buildings Standards are implemented successfully by 2025, and to support the actions outlined for BEIS on buildings decarbonisation, such as through planning, measurement, standards enforcement and compliance. More generally DLUHC has a key role in supporting local government to play its full role in the Net Zero transition and climate adaptation and ensuring these are embedded in planning reforms and Levelling Up.
- **The Department for Environment, Food & Rural Affairs (Defra).**
 - **Agriculture and land use strategy.** Agriculture and land use urgently need a decarbonisation strategy to match those for other sectors. It must cover the multiple objectives for land, including adapting to climate change, food security, biodiversity, and wider environmental goals. And it must identify how the UK and devolved governments will work together effectively to deliver coherent, coordinated policy and to tackle the shared barriers to action.
 - **Agriculture and land use policy.** Defra needs to ensure that funding and incentives are set at the correct levels to ensure wide take-up of low-carbon farming practices and a fast ramp-up in tree-planting and peat restoration. To release land and to provide a low-cost route to reduce agricultural emissions, steps must be taken to encourage a shift to healthier diets with reduced consumption of meat and dairy.

- **Waste and resources.** A detailed plan needs to be published for the decarbonisation of the waste sector, including Energy from Waste and wastewater. Clarity on the Government's resource efficiency ambition is also required, with policies to deliver this.
- **Adaptation.** The Government, led by Defra, urgently needs to take steps to ensure the UK is ready for our changing climate. The next National Adaptation Programme, due in 2023, should be framed around the principles outlined in the Third Climate Change Risk Assessment (CCRA3) Advice Report, showing how the top eight priority risks identified have been addressed. It should set out how adaptation is being integrated into policy across all departments and should include a detailed monitoring and evaluation framework.

Table 3

Brief list of priority recommendations (these recommendations are set out in full after the Executive Summary)

Cross-cutting	Electricity supply	Buildings
<ul style="list-style-type: none"> Contingency plans in case of delivery slipping Move historical policy costs from electricity bills to general taxation Net Zero Tax Review Roles and responsibilities for delivering Net Zero An effective Local Net Zero Forum Plans to implement carbon-border mechanism / standards 	<ul style="list-style-type: none"> Plan for 2035 full decarbonisation Market arrangements Connecting offshore wind & interconnectors to grid Strategic framework for networks 	<ul style="list-style-type: none"> Comprehensive public energy advice service Energy price reform Finalise low-carbon heat market mechanism Policies for owner-occupied energy efficiency Increase funding commitments for public buildings decarbonisation
Manufacturing & Construction	Fuel supply	International
<ul style="list-style-type: none"> Funding mechanism for electrification Incentives for non-ETS decarbonisation Improve industrial decarbonisation data Resource efficiency policies 	<ul style="list-style-type: none"> Plans/responsibilities for platform electrification Minimum emissions-intensity standards Funding and support for extra hydrogen production capacity 	<ul style="list-style-type: none"> NDC annex to feature Net Zero Strategy and wider approach Resourcing of Government's international climate strategy
Surface transport	Other sectors	Adaptation
<ul style="list-style-type: none"> Confirm ZEV mandate Embed sustainable transport within the planning reforms Regulations on efficiency of new conventional vehicles 	<ul style="list-style-type: none"> Aviation: Sustainable fuels mandate Waste: Detailed sector decarbonisation plan Shipping: Lead internationally for ambitious emissions goal Removals: Proposed business model for deployment at scale 	<p>Next National Adaptation Plan:</p> <ul style="list-style-type: none"> Detailed monitoring/evaluation framework Top priority risks Integration of adaptation into policy Principles for good adaptation
Agriculture and land use		
<ul style="list-style-type: none"> Sectoral delivery strategy for Net Zero Funding and incentives for tree-planting 		

The UK contribution to COP27

The new commitments made at the UN COP26 climate negotiations in Glasgow last November marked an overall advance in global ambition to reduce emissions, particularly through the widespread adoption of Net Zero ambitions. These and other commitments brought the possibility of limiting end-of-century warming to around 2°C into view, but only if all countries deliver their commitments in full.

However, there remain major gaps in 2030 emissions reduction targets and in delivery which threaten the credibility of the Net Zero ambitions. The Glasgow Climate Pact requests countries to strengthen their 2030 targets by the end of 2022 to align them with the Paris Agreement temperature goal. In particular, it puts more focus on aiming to limit temperature increase to 1.5°C, recognising that climate impacts are increasingly severe at higher levels of warming.

As a recognised leader in climate action the UK's continued commitment to delivering Net Zero will strengthen the global effort. This will in turn benefit the UK transition by reducing costs.

As a recognised leader in climate action the UK's continued commitment to delivering Net Zero will strengthen the global effort. Correspondingly, stronger global progress in the transition will benefit the UK's domestic effort through creating opportunities to grow markets and reduce the costs of key low-carbon technologies.

- Implementing the Net Zero Strategy and Energy Security Strategy can continue to demonstrate how the low-carbon transition can reduce emissions and increase energy security by reducing exposure to fossil fuel markets.
- Follow-up policies on demand reduction would send a strong global signal and bring immediate economic benefit. This would further strengthen the UK's credibility as a leader and highlight this key area as an immediate opportunity internationally.
- The UK should strengthen its 2030 NDC by focusing on delivery of its target to reduce emissions by at least 68% from 1990 levels and set out in detail how this will be achieved in its revised submission to the UN.
- As President of the UN climate negotiations until November 2022, the UK has a key role to continue to coordinate international progress, including on climate finance, especially for adaptation, and formalising the sector pledges made at COP26.
- And as a global leader, including through fora such as the G7 and G20, the UK should support a continued strengthening of the global focus on tackling climate change and dealing with climate impacts.

Having led by example in setting its Net Zero target the UK can now demonstrate that ambitious targets can be delivered successfully.

The UK was the first country to introduce legally-binding emissions targets and the first in the G20 to set a Net Zero target. Others have now followed across the world. The Intergovernmental Panel on Climate Change reported this year that the UK is now one of at least 18 countries that have consistently cut emissions for over a decade. The UK now has an opportunity to be one of the first countries to complete its Net Zero policy package and demonstrate that ambitious targets can be followed by successful delivery.

Sector	Topic	Priority recommendations	Timing
Cross-cutting	Governance	<p>Develop a document setting out Government's vision of how its Net Zero Strategy will be delivered. This should clarify roles and responsibilities across central and local government, devolved administrations, regulatory agencies and the wider public sector, and business, how approaches will be coordinated, and how Net Zero interacts with other Government priorities. This document will need to be flexible and some aspects will be uncertain, so it should be updated annually.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10</p>	2022
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; Scotland; Wales; N. Ireland</p>	2022
Cross-cutting	Governance	<p>Develop and begin to implement contingency plans to address the range of risks to meeting carbon budgets. These should broaden the set of emissions reductions pursued, in particular by including demand-side policies, and avoid increasing reliance on engineered removals.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Cross-cutting; Manufacturing & construction; Buildings	Electrification	<p>As part of reforms to electricity pricing, remove legacy policy costs associated with the historical deployment of less mature low-carbon electricity generation from electricity prices. These legacy costs create a market distortion.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Electricity supply	Overall strategy	<p>Publish a comprehensive long-term strategy for achieving 95% low-carbon electricity by 2030, on the path to full decarbonisation by 2035. Ensure this sets out how the low-carbon flexibility options required to replace unabated gas by 2035 will be delivered, and identifies contingencies for addressing key risks (e.g. nuclear, hydrogen, carbon capture and storage).</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Electricity supply	Electricity market design	<p>Through the Review of Electricity Market Arrangements, develop a strategy as soon as possible on market design for the medium- to long-term for a fully decarbonised, resilient electricity system in the 2030s and onwards.</p> <p>Primary responsibility: BEIS</p>	2023
Electricity supply	Networks	<p>Publish a strategy to coordinate the development of interconnectors and connections for offshore wind farms to the onshore network, taking prompt action to ensure efficient implementation of the detailed regulatory and legislative changes necessary for their timely delivery.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022

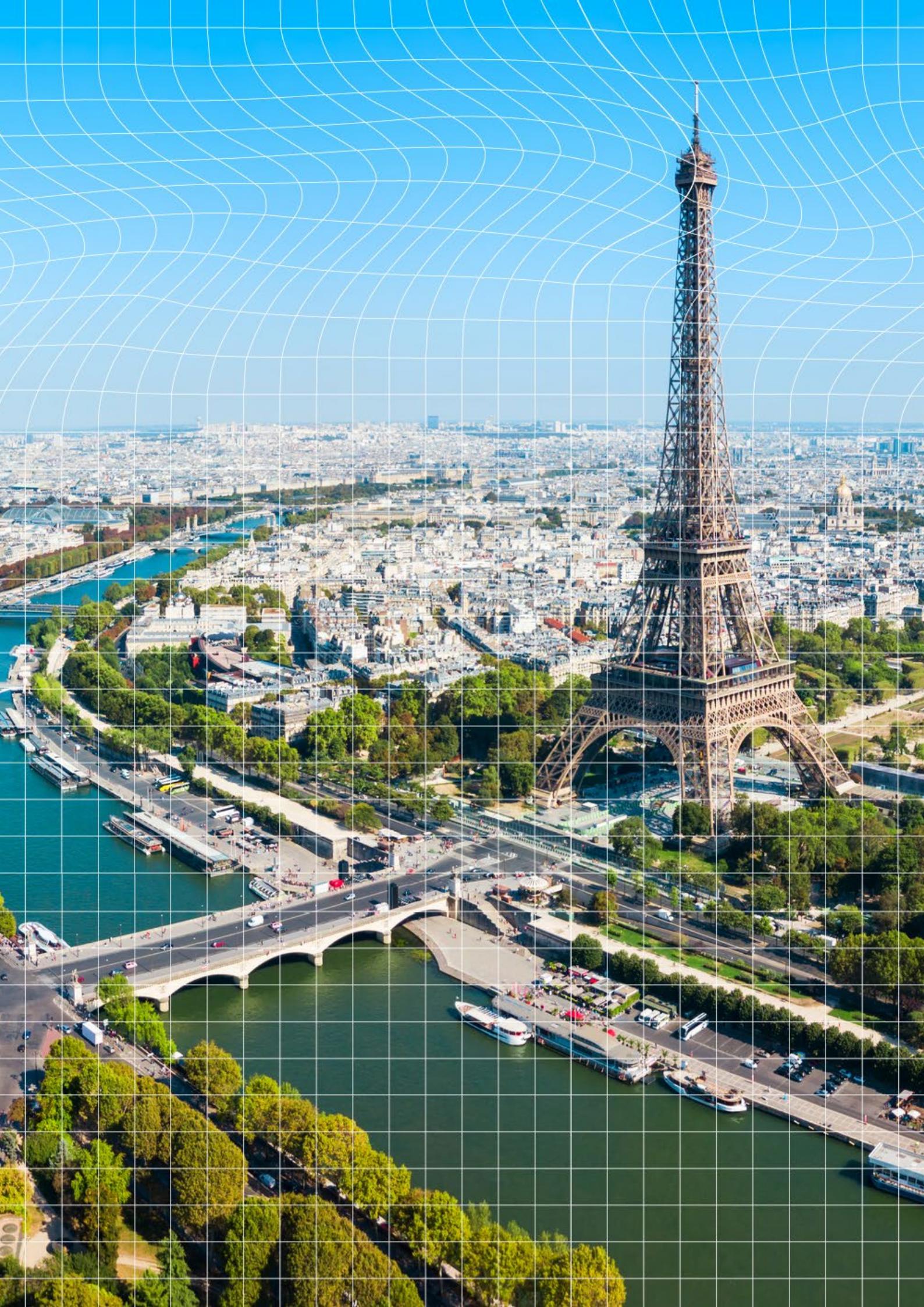
Sector	Topic	Priority recommendations	Timing
Electricity supply	Networks	<p>Publish a strategic framework identifying the network requirements for Net Zero, and the changes needed to ensure investments in resilient infrastructure are identified, planned, consented and built in sufficient time to accommodate increased demand and generation.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022
Manufacturing & construction; Fuel supply; Electricity supply	Trade and consumption emissions	<p>The Government should consult on plans to implement, by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy.</p> <p>Primary responsibility: HMT Supporting actors: BEIS; DIT; Defra</p>	2022
Buildings	Public engagement	<p>Create a public energy advice service to provide households with guidance on decarbonising and adapting their homes to climate change by this summer, as committed in the Energy Security Strategy. This should include an online platform including high-level trusted information and advice (including on Government schemes), a link to local providers who can undertake assessments of home energy performance, and bespoke support for households wishing to undertake more complex retrofits.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Low-carbon heat	<p>Launch the delayed Fairness and Affordability Call for Evidence and follow on by implementing plans for energy price reform which remove market distortions (i.e. that historical policy costs are primarily placed on electricity prices) and consider the role of carbon pricing. Plans should ensure that heat pumps will be cheaper to run than gas boilers.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022
Buildings	Low-carbon heat	<p>Publish a final policy plan for the market-based approach to low-carbon heat. This must include a clear explanation of how the obligation on manufacturers or energy suppliers will work, whether enabling legislation is required, and a timeline for implementation. It should also include details on how the Government will track whether the policy is driving the required market growth, and identify trigger points for further intervention (e.g. funding, regulation) if progress falls behind.</p> <p>Primary responsibility: BEIS</p>	2022
Buildings	Energy efficiency	<p>Develop and publish new policies (with a clear implementation timeline) to ensure that owner-occupied homes reach a minimum energy performance of EPC C by 2035, through incentives or regulation. This should be stronger than the current proposed voluntary minimum requirement for mortgage lenders to improve the efficiency of the homes they lend to, and could include a policy requiring EPC C from 2028 at the point of sale and/or a mandatory minimum requirement for mortgage lenders.</p> <p>Primary responsibility: BEIS</p>	H1 2023

Sector	Topic	Priority recommendations	Timing
Buildings	Public buildings	<p>Increase the multi-year funding commitments for decarbonisation in public buildings up until 2025 to match the Government's ambition for public sector decarbonisation and commit to continuing similar levels of funding beyond 2025.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	H1 2023
Manufacturing & construction	Data	<p>Review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting to enable effective monitoring and evaluation, and policy implementation. This will require additional data collection and reporting to allow for effective tracking of energy efficiency, material efficiency, fuel switching, CCS, including progress developing these measures, and more holistic measurement on a product or whole life cycle carbon basis. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; ONS</p>	Q1 2023
Manufacturing & construction	Electrification	<p>Consult on a funding mechanism(s) to support the additional operational and capital costs of electrification in manufacturing. Support for electrification may be combined with reforms to electricity pricing. In combination, these should incentivise early deployment of new electrification. The mechanism should aim to allow hydrogen and electrification to compete on a level playing field in the medium term.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Manufacturing & construction	Fuel switching	<p>Create a clear incentive for manufacturing facilities not currently covered by the UK ETS to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include changing the Climate Change Levy rates for electricity and gas.</p> <p>Primary responsibility: HMT</p>	Q1 2023
Manufacturing & construction; Waste	Resource efficiency	<p>Publish the Government's ambition for annual abatement from resource efficiency, by year, up to 2030, and clarify or set out the policies to deliver the ambition up until at least 2027.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2022
Fuel supply	Fossil fuel supply	<p>Clarify plans and responsibilities for electrification of oil and gas infrastructure through integration with the offshore wind planning process and/or onshore grid, so that by 2027 new oil and gas platforms can achieve zero emissions from operational energy use.</p> <p>Primary responsibility: BEIS</p>	Q3 2023
Fuel supply	Fossil fuel supply	<p>Develop minimum emissions-intensity standards for domestic oil and gas production by the next licensing round. In development, seek to ensure a consistent measurement approach with emerging international measurement standards.</p> <p>Primary responsibility: BEIS</p>	Q1 2023

Sector	Topic	Priority recommendations	Timing
Fuel supply	Hydrogen	<p>Establish funding mechanisms to support the development of 10 GW of low-carbon hydrogen production by 2030, ensuring these are designed to limit residual and upstream emissions, but also reflect hydrogen costs in a way that does not bias towards hydrogen where electrification is competitive.</p> <p>Primary responsibility: BEIS</p>	2023
International	UK NDC	<p>Update the technical annex (the Information to facilitate Clarity, Transparency and Understanding) of the enhanced 2030 NDC the UK resubmits in 2022 for COP27 to expand on the role of the Net Zero Strategy in meeting the 2030 target. If there is a policy gap to 2030, Government should bring forward more policy and address how the gap will be closed in the enhanced 2030 NDC. The enhanced 2030 NDC should also explain the UK's approach to the Just Transition, public engagement and participation, governance and reporting.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO</p>	2022
International	UK pledges and commitments; Funding	<p>In line with the Glasgow Climate Pact commitment to phase out inefficient fossil fuel subsidies, undertake a review of the role of tax policy in delivering Net Zero, building on the recent Net Zero Review to develop a systematic assessment of taxation and carbon pricing across the economy and addressing distortions from post-tax subsidies that stem from a disproportionately low carbon price.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2023
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals. Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO; DIT; HMT; Defra; DfT</p>	2022
Surface transport	Car demand	<p>Embed sustainable transport within the upcoming planning reforms in the upcoming Levelling Up and Regeneration Bill. This should recognise the role that place-shaping, active travel, public transport, and shared mobility can combine to play in reducing car dependence and realising a range of co-benefits. These factors should be required to be considered from the outset of all development planning.</p> <p>Primary responsibility: DLUHC Supporting actors: DfT</p>	2022
Surface transport	Conventional vehicle efficiency	<p>Introduce regulations to sit alongside the ZEV mandate to ensure that efficiencies of new conventional vehicles continue to improve and manufacturers reverse the trend towards larger vehicles. These need to be suitably ambitious to deliver the efficiency improvements and share of hybrid sales that are required to realise the necessary emissions reductions from these segments of the market.</p> <p>Primary responsibility: DfT</p>	Q1 2023

Sector	Topic	Priority recommendations	Timing
Surface transport	Electric cars and vans	<p>Confirm the details of the ZEV mandate in regulation. As set out in the consultation, this should impose targets on manufacturers that are at least as ambitious as those in the Transport Decarbonisation Plan and should drive consistent growth in sales of EV cars and vans through the 2020s to meet the 2030 phase-out date.</p> <p>Primary responsibility: DfT</p>	Q1 2023
Agriculture & land use	Agriculture and land use strategy	<p>Set out a Net Zero delivery strategy for the agriculture and land use sectors that brings together how land can deliver its multiple functions including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, domestic biomass production and wider environmental goals. The strategy must clearly outline the relationships and interactions between the multiple action plans in development (e.g. including those for peat, trees, nature, plant biosecurity and biomass), be spatially and temporally targeted, and aligned with action in the devolved administrations.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Trees and woodland	<p>Ensure that funding and incentives are set at the correct level to meet the UK Government afforestation target of 30,000 hectares per year by 2025, and illustrative Net Zero Strategy targets of 40,000 hectares and 50,000 hectares by 2030 and 2035 respectively. Further clarity is required regarding funding beyond 2025. This should also address wider objectives for land such as climate adaptation and nature conservation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Aviation	Sustainable aviation fuel	<p>Implement the Sustainable Aviation Fuel Mandate as soon as possible this year with a strong set of criteria for the fuels included in the mandate.</p> <p>Primary responsibility: DfT</p>	2022
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: BEIS; Wales; Scotland; N. Ireland</p>	2023
Shipping	Demand; Low-carbon fuel	<p>Take a leadership role in pushing for inclusion of a Net Zero 2050 target within the 2023 update of the International Maritime Organisation's initial greenhouse gas strategy.</p> <p>Primary responsibility: DfT Supporting actors: CO & Number 10</p>	2023
Engineered removals	Funding	<p>Publish a proposal on the business model for deployment of large-scale (>1 MtCO₂/year) engineered removals.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in the Third Climate Change Risk Assessment.</p> <p>Primary responsibility: Defra</p>	2023

Sector	Topic	Priority recommendations	Timing
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should report how departments have addressed the top eight priority risks set out in the Third Climate Change Risk Assessment Advice Report for urgent action between 2021 and 2023.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the Third Climate Change Risk Assessment Technical Report for the period 2023-2028.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the Third Climate Change Risk Assessment Advice Report.</p> <p>Primary responsibility: Defra</p>	2023



Chapter 1: The global picture

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Introduction and key messages

The past year saw key developments in international climate negotiations, assessment of climate science, and the continued worldwide roll-out of key low-carbon technologies. The invasion of Ukraine has led to record highs in fossil fuel prices and highlighted the role of the low-carbon transition in providing long-term energy security. In response, new policies are being announced in many countries.

The increasing global coverage of national Net Zero commitments has advanced global ambition on longer-term emissions reductions. Current commitments have the potential to limit warming to around 2°C. However, most of these commitments are not yet backed by credible plans and Paris Agreement-aligned 2030 targets. With global emissions falling far slower than required, the 1.5°C target risks slipping out of reach.

The UK can provide a powerful example by backing up its Net Zero pathway and plans with delivery. The UK must also continue to support international efforts by strengthening the implementation of agreements made at COP26 in Glasgow such that there is clear progress by COP27 in 2022.

Our key messages on the global picture are:

- **Climate.** The climate has continued to warm due to human activity. Major heatwaves, droughts and forest fires in many regions linked to the changing climate were seen in 2021.
 - The new reports of the UN Intergovernmental Panel on Climate Change (IPCC) show that climate change has caused widespread impacts to ecosystems and people. These will become more severe as global temperatures continue to increase. The impacts at even 1.5°C of warming will be serious, but adaptation can help. Adaptation will be more challenging above 1.5°C.¹
 - The IPCC finds that limiting temperature increases to 1.5°C will require peaking of global greenhouse gas (GHG) emissions as soon as possible and no later than 2025, with rapid and deep reductions towards Net Zero thereafter.²
- **Global emissions.** The ongoing global economic recovery from COVID-19 has resulted in a strong rebound in GHG emissions, with 2021 emissions back to around 2019 levels. Further increases can be expected if aviation demand returns to pre-pandemic levels and supply chain issues no longer limit global production.
- **International climate policy.** The new commitments made at COP26 in Glasgow last November marked an overall advance in global emissions reduction ambition. These commitments bring the possibility of limiting end-of-century warming to around 2°C into view, but only if they are delivered in full and on time.
 - However, the major gap in 2030 ambition and delivery threatens the credibility of countries' Net Zero targets. The Glasgow Climate Pact requests countries to strengthen their 2030 targets to align with the Paris Agreement temperature goal by the end of 2022.

- **Low-carbon technologies.** There is continuing progress in the adoption of key low-carbon technologies with sustained global growth in renewable power. Electric cars and heat pumps are becoming more established and cheaper in major markets.
- **Forests.** Estimated global tree cover loss has stayed broadly constant at around 25 Mha/year from 2018-2021. The Glasgow Leaders' Declaration on Forests and Land Use was launched at COP26 in November 2021, committing to collectively halt and reverse forest loss by 2030. Its signatories cover 90% of the world's forests.
- **Ukraine.** The invasion of Ukraine by Russia, and resulting record highs in fossil fuel prices, reinforce the case for a rapid transition away from fossil fuels. The high prices also highlight the benefits of reducing energy demand for both the Net Zero transition and continued economic growth. At the time of writing, the overall effect of the shift in global energy priorities and dynamics on future emissions remain unclear, though moves towards expanding fossil fuel production and pausing reductions in coal use risk increasing near-term global emissions.
- **UK as a climate leader.** As a recognised leader on climate action, the UK's continued commitment to delivering Net Zero strengthens the global effort.
 - Implementing the Net Zero Strategy³ and Energy Security Strategy⁴ can continue to demonstrate how the low-carbon transition can reduce emissions, reduce consumer costs, and increase energy security by reducing exposure to fossil fuel markets.
 - Follow-up policies on demand reduction would send a strong global signal and bring immediate economic benefit. This would further strengthen the UK's credibility as a leader and highlight this area as an immediate opportunity internationally.
 - The UK should focus on delivery of its 2030 emissions reduction target (a 68% reduction on 1990 levels by 2030) and set out in detail how this will be achieved in its revised submission to the UN.
 - As President of the UN COP process until November 2022, the UK has a key role in continuing to coordinate international progress, including on climate finance (especially for adaptation) and formalising the sector pledges made at COP26.

The rest of this chapter is laid out as follows:

1. International context in 2022
2. Global climate, emissions and adaptation
3. Global progress towards Net Zero
4. Progress in international climate policy
5. The UK's international role in 2022 and beyond

1. International context in 2022

The invasion of Ukraine has shifted global energy priorities and dynamics.

The invasion of Ukraine, in addition to the rise in energy resource demands as the global economy recovers from the COVID-19 pandemic, has shifted global energy priorities and dynamics. Alongside the UK, the EU, its member states and the US have set out policies to reduce dependence on energy resources from Russia and address rising energy prices (Box 1.1).

The overall effect on emissions in the near and longer-term remains unclear at this stage with some responses potentially decreasing emissions in some regions and sectors, and others leading to a likely increase.

High fossil fuel price increases are making some low-carbon technologies more cost competitive.

- The sharp increase in fossil fuel prices improves the cost advantages of renewable power generation, electric cars and investment in energy efficiency. Alongside commitments to accelerate the roll-out of renewables, this has led to greater consumer demand for end-use electrification (e.g. in transport and heating) and energy efficiency measures. These actions have the potential to lead to faster roll-out and greater emissions reductions for these sectors in some regions.
- The EU and some European countries are also advising their populations and businesses on immediate measures they can take to reduce their energy demand, such as reducing heating and using public transport.
- However, in some countries, concerns around energy prices and security have resulted in consideration of temporarily pausing coal power reduction/phase-out programmes and possibly building additional new coal capacity. This could result in higher-than-forecast global power sector emissions.
- High fossil fuel prices, and policy commitments from Europe to reduce imports of fossil fuels from Russia, are leading to investment in new fossil fuel production and fossil fuel infrastructures. This includes export and import terminals for liquified natural gas (LNG) which, due to the energy required for liquefaction, could also be more carbon-intensive. This risks lock-in as these new assets might operate for many decades.
- The steep rise in gas prices is also leading to reassessment of the role of gas in the low-carbon transition, including the cost and resulting availability of low-carbon blue hydrogen produced from gas using carbon capture and storage (CCS).

Energy security concerns may lead to new fossil fuel investments risking lock-in.

The EU has set out plans to reduce its dependence on fossil fuels from Russia through accelerating the low-carbon transition and diversifying fossil fuel supply.

Box 1.1

Initial international responses to the invasion of Ukraine

In 2021, Russia was the world's third largest exporter of coal, second largest exporter of oil and largest exporter of natural gas. The EU is a major importer of fossil fuels from Russia with these accounting for around 40% of natural gas (some EU countries import virtually all their gas from Russia), around a quarter of oil and around half of coal in the EU. Russia and Ukraine are also important global suppliers of non-energy resources including metals and grains.

As of the middle of May 2022, the EU, European countries and US have set out initial plans and policies to rapidly reduce energy imports from Russia. They have also reaffirmed their commitment to Net Zero and 2030 emissions targets. The UK's response as set out in the Energy Security Strategy is covered in Chapter 6.

- The EU and European countries plan to diversify their supplies of gas, oil and coal and accelerate the reduction in fossil fuel use through faster roll-out of renewables, end-use electrification and reducing demand.
 - The EU's REpowerEU plan sets up a new EU Energy Platform to coordinate joint purchase of gas (including LNG), and in the future hydrogen. It proposes increasing the EU's headline 2030 target for final energy consumption coming from renewable sources from 40% to 45% and sets out a recommendation to speed up permitting for large renewable projects. It also proposes increasing the binding 2030 energy consumption reduction target from 9% to 13% (relative to 2020).
 - To reduce demand, the EU suggests a number of approaches to Member States. These include behavioural actions that could be encouraged, for example turning down heating and reducing driving speeds, and fiscal measures such as reducing VAT on new building efficiency installations.
 - Some Member States have already introduced or are planning such demand reduction measures, for example turning down heating and air conditioning in public buildings and encouraging citizens to follow suit (Netherlands), introducing subsidies for public transport (Germany) and increased support for energy efficiency and heat pumps (France and Germany).
- In March 2022 the US introduced a ban on oil, gas, coal and any derived energy products from Russia. New US investment into the energy sector in Russia was also prohibited. Alongside, the US and EU created a joint task force planning to increase US LNG exports to the EU to displace gas from Russia and collaborate on reducing overall demand for gas.
- In a May 2022 leaders' statement, G7 countries have jointly committed to phasing out dependency on energy supplies from Russia including by phasing out or banning the import of oil (no specific timeline set) and working together to accelerate reduction of reliance on fossil fuels and transition to clean energy in accordance with climate objectives.

The G7 has reaffirmed its commitment to meeting climate objectives.

Other major importers of fossil fuels, notably China, which, after the EU, is the largest importer of fossil fuels from Russia, have at the time of writing not introduced supply restrictions.

Source: EU Commission (2022) *REpowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition*; The White House (2022) *Executive Order on Prohibiting Certain Imports and New Investments With Respect to Continued Russian Federation Efforts to Undermine the Sovereignty and Territorial Integrity of Ukraine*; The White House (2022) *FACT SHEET: United States and European Commission Announce Task Force to Reduce Europe's Dependence on Russian Fossil Fuels*; G7 (2022) *G7 Leaders' Statement May 2022*.

2. Global climate, emissions and adaptation

Despite widespread calls for a sustainable recovery from the COVID-19 pandemic, 2021 has seen a rebound in emissions, increasing use of coal and worsening climate impacts.

Global mean temperatures continue to rise due to continued global GHG emissions. Despite calls for a sustainable recovery from the COVID-19 pandemic and record levels of generation from renewable sources, fossil fuel usage rebounded strongly in 2021. This has resulted in a rebound in emissions, with initial estimates for 2021 suggesting that the pandemic-related drop in global GHG emissions in 2020 has largely been regained.

This section covers the key indicators of global climate change and adaptation in three subsections:

- (a) Global climate change
- (b) Global greenhouse gas emissions
- (c) Global progress on adaptation

(a) Global climate change

Strengthened evidence on the impact of human activity on our planet has been accompanied by sustained increases in global temperature and severe weather events. Despite cooling effects from a La Niña event in 2021, the past seven years have been the warmest seven years on record.⁵

The IPCC summarised the latest science on physical climate change in their Sixth Assessment Cycle Working Group I (WGI) report, presenting unequivocal evidence for the impact of human influence on the climate (Box 1.2).⁶ Human activity is warming the climate by around 0.25°C a decade and is identified as the main driver of unprecedented changes across our climate system, some of which are irreversible. Estimated human-induced global warming has reached 1.2°C above pre-industrial (1850–1900) temperatures (Fig. 1.1).

Human influence is warming the climate at rates unprecedented for thousands of years.

Box 1.2

IPCC Working Group I Report

The IPCC WGI report presents unequivocal evidence that human influence has warmed the atmosphere. Rapid and extreme changes across the entire climate system are evident today and will continue to increase in severity until global CO₂, followed by long-lived greenhouse gas, emissions reach Net Zero. Working Group II and III are detailed in Boxes 1.4 and 1.3 below respectively.

- **Warming at rates unprecedented for at least 2,000 years.** Global surface temperatures from 1970-2019 increased at a higher rate than any other 50-year period in the last 2,000 years. The likely range of increases in human-induced global surface temperature is 0.8°C-1.3°C from 1850-1900 to 2010-2019, accounting for all the observed 1.1°C warming over that period.
- **Evidence of human influence on weather and climate extremes has strengthened in the seven years since the IPCC's Fifth Assessment Report cycle.** The frequency and intensity of events such as heatwaves, heavy rainfall, and droughts increase in direct relation to global warming and evidence on attribution to human influence has strengthened since the Fifth Assessment Report cycle.

- **Impact of future emissions.** Changes for many aspects of the climate system will become more widespread and/or pronounced with additional warming associated with future emissions. Some of these changes are irreversible for centuries to millennia, even if future temperatures are reduced.
- **Narrowing of climate sensitivity.** The range of the estimated sensitivity of temperature to atmospheric concentrations of CO₂ has narrowed, reducing the likelihood of both the most optimistic and pessimistic climate futures being realised. This finding makes climate scientists' projections on future warming more robust.
- **Confidence in reaching Net Zero emissions preventing further warming.** Modelling scenarios suggest that reaching global Net Zero CO₂ emissions could result in stable or slightly declining global temperatures and that reaching global Net Zero greenhouse gas emissions could result in decreasing global temperatures. This lends support to the widespread adoption of national targets for Net Zero emissions.

Source: Intergovernmental Panel on Climate Change (2021) Working Group I Summary for Policymakers and Working Group I Technical Summary.

(b) Global greenhouse gas emissions

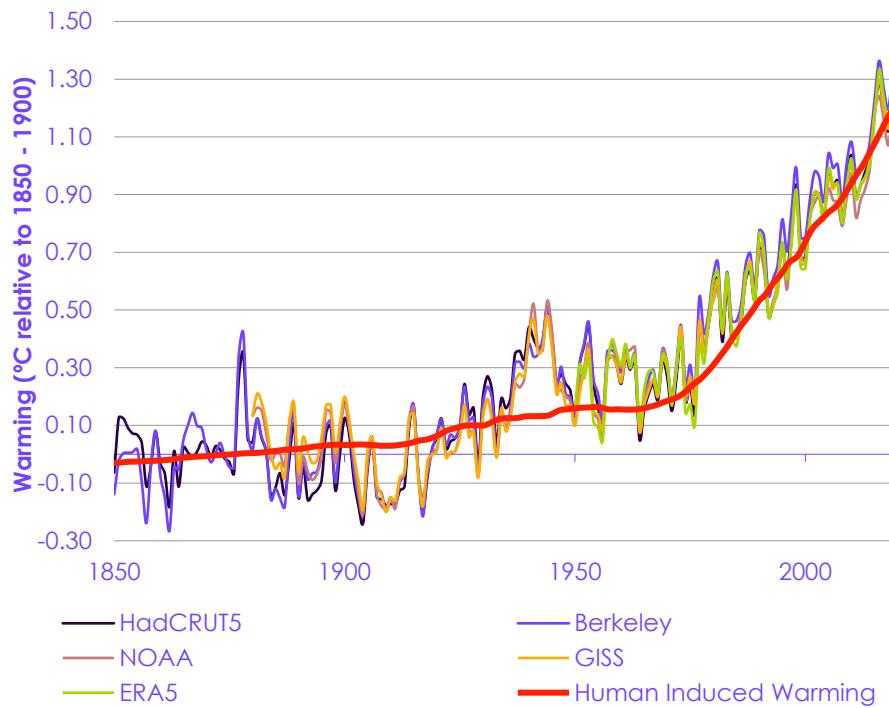
Rapid and deep emissions reductions on the path to Net Zero are required for the world to meet the Paris temperature goal of keeping warming well below 2°C above pre-industrial levels and closer to 1.5°C (Figure 1.1). The IPCC's Working Group III report provides updates to estimated paths consistent with the Paris temperature goals and considering recent evolution in GHG emissions (Box 1.3). The rest of this section assesses progress against these pathways.

A strong rebound in 2021 is estimated to have returned levels of fossil CO₂ emissions to around pre-pandemic levels.

- Estimates of the global rebound in emissions differ slightly, but they all suggest that fossil CO₂ emissions had returned to around 2019 levels by the end of 2021 (emissions estimates for all GHGs have not yet been calculated for 2020 and 2021 but are expected to have risen by a comparable amount).
 - The Global Carbon Project estimate that fossil CO₂ emissions fell by 5.4% in 2020 and increased by 4.8% (range of 4.4–5.4%) in 2021.⁷
 - Work led by RB Jackson recently published in the journal Environmental Research Letters estimates that a 5.4% fall in fossil CO₂ in 2020 has been followed by a 4.2% increase in 2021.⁸
 - The International Energy Agency (IEA) estimate that fossil CO₂ emissions fell by 5.8% in 2020 and have increased by 6% in 2021.⁹
- These estimates suggest that if emissions in this year (2022) and in coming years can be put onto a downward path, 2019 could represent the peak of global fossil CO₂ emissions.
- GHG emissions over 2010–2019 were higher than in any decade in history, albeit this decade saw a slowing in the rate of emissions growth compared to 2000–2009 (Figure 1.2).²
- Emissions growth varies widely across regions, with the Middle East and the Asia and Developing Pacific region showing the fastest growth over 2015–2019 (Figure 1.3). Over this period, the GHG emissions increase in Asia and the Developing Pacific was more than double the total increase in emissions from all other regions. However per capita emissions remain almost 50% lower than in developed countries in 2019.²

- The IPCC WGIII report found that at least 18 countries,* including the UK, have sustained reductions in both production and consumption emissions for longer than ten years, driven largely by power sector decarbonisation, energy efficiency and energy demand reduction.¹⁰

Figure 1.1 Global average surface temperature relative to pre-industrial levels



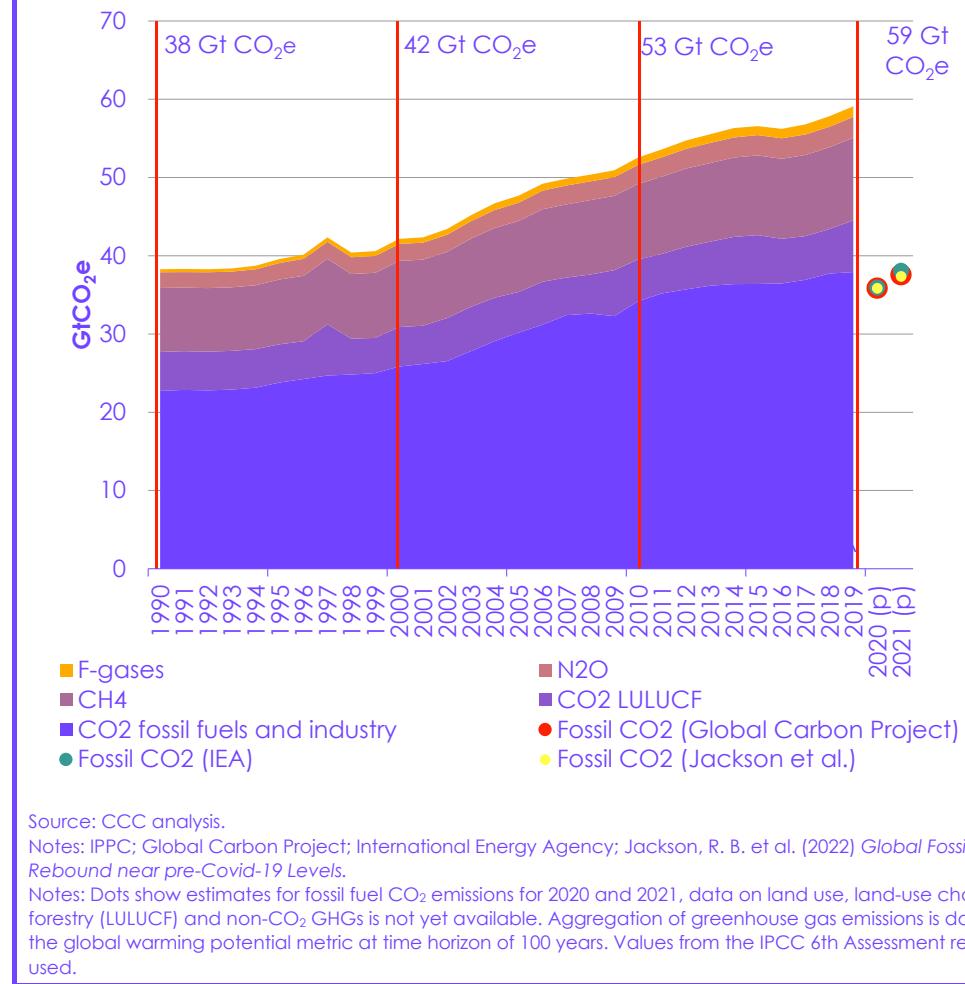
Source: CCC analysis.

Notes: Each thin line represents a different global temperature dataset. The US National Oceanic and Atmospheric Administration (NOAA), NASA Goddard Institute for Space Studies (GISS) and European Centre for Mid-Range Weather Forecasts ERA5 (ERA) datasets are expressed relative to 1850 - 1900 using the offset over the 1981-2000 period from the HadCRUT5 dataset. Human-induced warming is taken from data informing Chapter 7 of the IPCC's Working Group I report.

* The 18 countries are Sweden, Romania, France, Ireland, Spain, United Kingdom, Bulgaria, Netherlands, Italy, United States, Germany, Denmark, Portugal, Austria, Hungary, Belgium, Finland and Croatia.

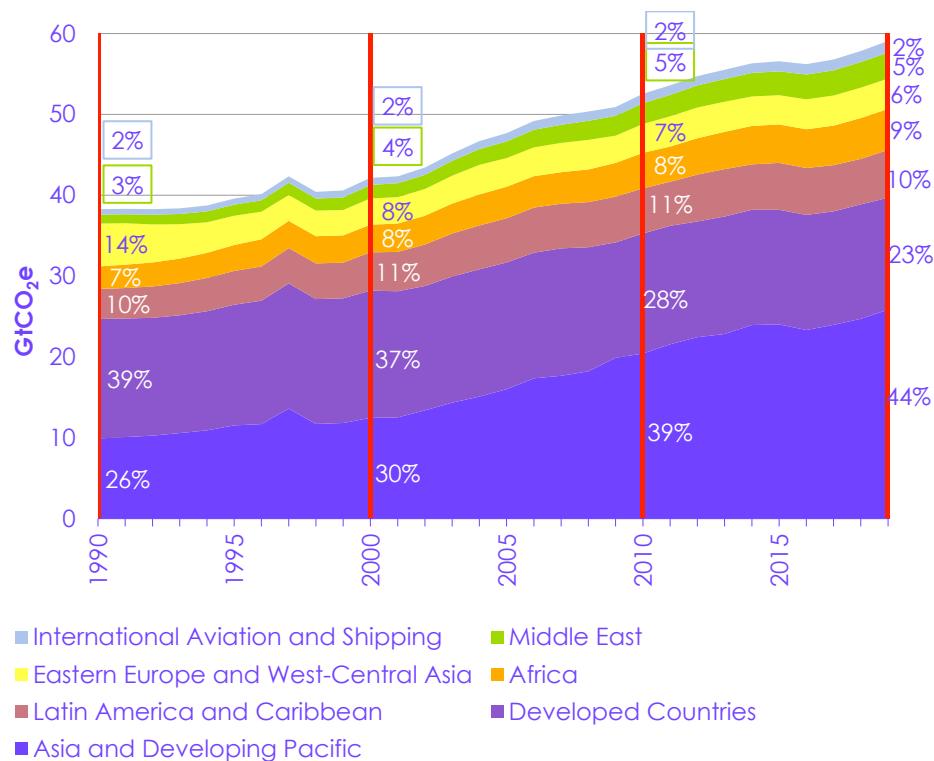
Record levels of greenhouse gas emissions were seen over the last decade, albeit with a decrease in the growth rate compared to the previous decade.

Figure 1.2 Global GHG emissions (1990–2019) and estimated fossil CO₂ emissions (2020-2021)



The Middle East and Asia and Developing Pacific countries saw the fastest rates of emissions growth over 2015–2019.

Figure 1.3 GHG emissions by region (1990–2019)



Source: IPCC (2022) *Climate Change 2022: Mitigation of Climate Change*.

Notes: Aggregation of greenhouse gas emissions is done using the global warming potential metric at time horizon of 100 years.

All sectors have options to reduce emissions this decade, with many of these at low cost or delivering cost savings.

Box 1.3

IPCC Working Group III Report

The IPCC Working Group III report tracks progress on mitigation, examines future emissions reduction scenarios and assesses the potential for emissions reductions. Temperatures stabilising at 1.5°C above pre-industrial levels by the end of the century will require deep decarbonisation in this decade and subsequent decades, reaching global Net Zero emissions for CO₂ around the middle of the century and for all greenhouse gases in the second half of the century.

- Current emissions.** Emissions are increasing across all sectors and emissions over 2010–2019 were higher than in any decade in history. However, the rate of emissions growth is beginning to slow, decreasing to 1.3% over 2010–2019 from 2.1% in 2000–2009.
- Emissions pathways.** Pathways implied by aggregated Nationally Determined Contributions (NDCs) submitted to COP26 (as set out before mid-October 2021) would make it likely that warming exceeds 1.5°C this decade, and that unprecedented rates of decarbonisation would be needed over the period 2030–2050 to keep end-of-century warming under 2°C.
- Enablers of mitigation.** Well-targeted climate policy, increased volume and quality of financial flows towards low-carbon investment and international cooperation are key enablers of a strengthened mitigation response. Cost is also an important enabler; significant cost reductions and increases in deployment have been seen across solar energy, wind energy and lithium-ion batteries, and the studies assessed by the IPCC identify potential to abate over half of 2019 emissions levels by 2030 at a cost of \$100/tCO₂e or less.

- **Cities.** Urban areas hold significant potential for improving resource efficiency and lowering GHG emissions. Mitigation strategies vary with city characteristics, but energy and resource efficiency, electrification and increasing the urban environment's carbon uptake and storage are likely to be effective for cities at different development stages if applied concurrently.
- **Mitigation, adaptation and development.** Accelerated action on mitigation and adaptation is required for sustainable development. Shifting development pathways to become more sustainable can increase the range of available mitigation options and accelerate low-carbon system transitions in society across energy, land use, industry and infrastructure.

Source: Intergovernmental Panel on Climate Change (2022) Working Group III Summary for Policymakers.

Notes: The Report's cut-off of mid-October 2021 preceded COP26, so not all NDCs were included in its assessment.

(c) Global progress on adaptation

More action on adaptation is needed globally. The Glasgow Climate Pact emphasises the urgent need for action and support to developing countries in adapting to climate change. It also launched the two-year 'Glasgow-Sharm el-Sheikh' work programme to better measure and implement the global goal on adaptation, running until COP28 in 2023.

Current global action on adaptation falls short of what is required to minimise the level of future climate impacts, with lack of financing a key barrier.

In February 2022, the IPCC released its Working Group II report¹ with the latest evidence on climate change impacts, adaptation and vulnerability (Box 1.4). It reported that while adaptation action is underway around the world, there remains a significant gap between the implemented actions and those needed to minimise the level of future climate impacts.

- The majority of current adaptation actions are generally valuable but relatively easier to implement, for example the creation of early warning systems to alert citizens to forecasted extreme weather enabling them to make preparations.
- There is only limited evidence of the large-scale transformation and adaptation of assets and systems to be resilient to future climate conditions such as the widespread retrofitting of buildings to adapt to future overheating risks.
- Financing remains a key barrier to adaptation action globally, particularly in developing countries, with support for exclusively mitigation focused activities making up two-thirds of total climate finance flows from developed countries for the most recent reported year (2019).¹¹

Box 1.4

IPCC Working Group II Report

The Working Group II report assesses the impacts of climate change, considering ecosystems, biodiversity, and people. It also discusses vulnerability, capacity and limits of societies and the natural world to adapt to climate change.

- Human-induced climate change has caused widespread impacts, losses and damage to people and ecosystems around the world. Risks are projected for near-term, mid-term and long-term projections.
 - The effects of climate change are not felt equally, with differences in vulnerability among and within regions; it is often the poorest who are the least able to adapt.
 - Climate change impacts are becoming increasingly complex and difficult to manage, with multiple climate hazards occurring simultaneously and interacting.
 - Even temporarily exceeding 1.5°C global warming will result in additional severe impacts, some of which will be irreversible.
- Adaptation to climate change is reducing climate risks and vulnerability, although adaptation progress is unevenly distributed.
 - Progress has been made in adaptation planning and implementation across sectors and regions, with multiple co-benefits.
 - There are feasible and effective adaptation actions which can reduce risks to people and ecosystems but there are also adaptation limits with increasing global warming.
- Climate-resilient development combines adaptation and mitigation measures to enable sustainable development.
 - Worldwide climate-resilient development action is more urgent than previously assessed in the Fifth Assessment Report Cycle.
 - Inclusive development choices that prioritise risk reduction, equity and justice can enable climate-resilient development.

Source: Intergovernmental Panel on Climate Change (2022) Working Group II Summary for Policymakers.

3. Global progress towards Net Zero

COVID-19 led to a temporary decrease in emissions. Achieving the Paris temperature goal requires rapid and sustained emissions reductions across the economy, which will require structural changes and transitions in all sectors.

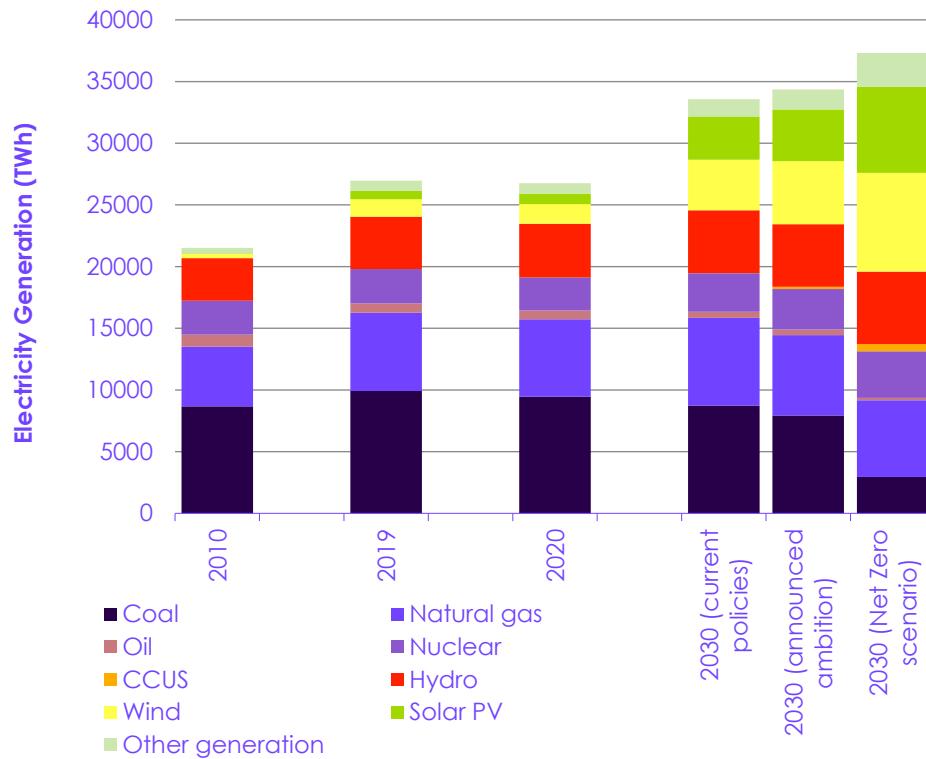
National and corporate commitments to Net Zero send a signal to stimulate innovation and demand in low-carbon technologies, which helps to drive cost reductions. This section presents trends in key aspects of the global transition, with a focus on those most relevant to the UK.

Progress is being made in key aspects of the global transition. This momentum must be sustained and increased throughout this decade.

- **Power.** Global progress in expanding renewable energy capacity (Figure 1.5) and policies to move away from coal and oil is accelerating but still insufficient to steer a course towards the Paris temperature goal, with gas use (pre-invasion of Ukraine) projected to continue along historical trajectories (Figure 1.4).
- **Cars.** Purchases of electric vehicles continue to soar, more than doubling between 2020 and 2021 (Figure 1.6). Continued growth relies on expanding charging infrastructure and access to sustainable supplies of critical minerals which are increasingly under strain. The full benefits of transitioning to electric vehicles requires deeper decarbonisation of the power sector (Figure 1.4).
- **Heating.** Installation of heat pumps continues to show steady growth of around 10% per year, with uptake particularly strong in North America, Europe and China. Heat pumps are increasingly established as the primary low-carbon heating solution globally, but considerable growth is needed through to 2030 to be on track towards Net Zero (Figure 1.7).
- **Forests.** As recognised in the Glasgow Leaders' Declaration on Forests and Land Use, preservation and restoration of global forests is critical to rapidly reducing global emissions. Tree cover loss in 2021 is estimated at around 25 Mha (not including gains), a level that has been broadly constant since 2018 (Figure 1.8).
 - The primary driver of tropical forest loss is direct human action, such as clearing for agriculture and forest commodities. While global tropical deforestation levels have stayed at a similar level, Indonesia has reduced deforestation levels for the fifth year running, demonstrating how international standards combined with national policies can deliver.
 - In boreal forests, 2021 had the highest recorded rate of tree cover loss. This was mostly due to wildfires which have increased in severity as a result of hotter and drier conditions linked to climate change.¹²

Global energy use is starting to transition but present and stated policies will not bring about the large-scale changes required in energy use to reach Net Zero.

Figure 1.4 Global electricity generation by fuel type 2010-2030 (historic data and IEA scenarios)

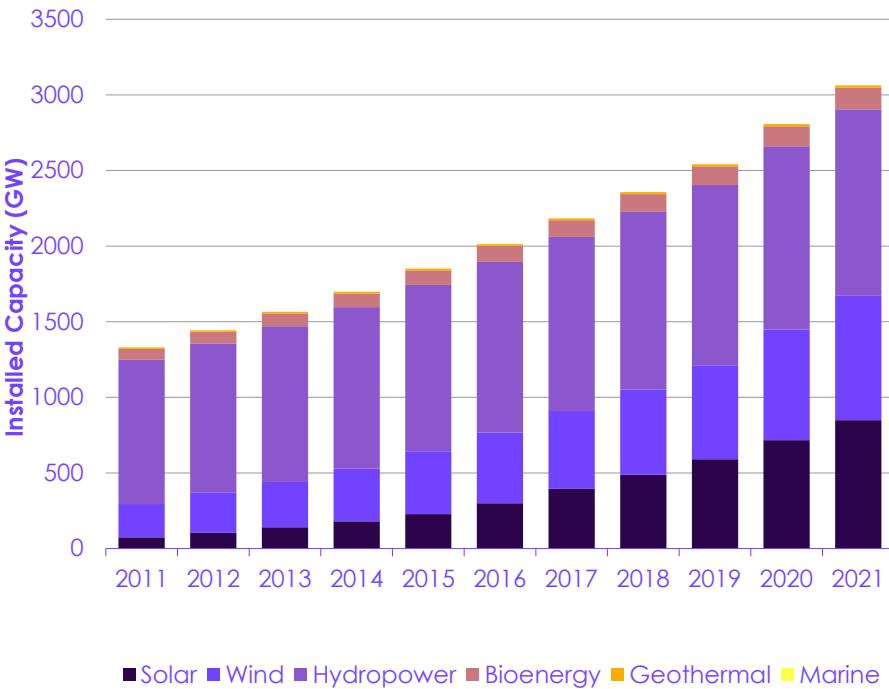


Source: IEA (2021) *World Energy Outlook 2021*.

Note: 2030 (Net Zero Scenario) shows the sources of electricity generation in 2030 in the IEA Net Zero Energy 2050 scenario which reaches Net Zero CO₂ for the Energy system and industry in 2050. 2030 (current policies) shows the sources of electricity generation in 2030 in the IEA Stated Policies scenario (STEPS). 2030 (announced ambition) shows the sources of electricity generation in 2030 in the IEA Announced Pledges scenario (APS).

Installed renewables capacity, particularly of solar and wind, continues to grow year on year.

Figure 1.5 Global renewables capacity 2011-2021



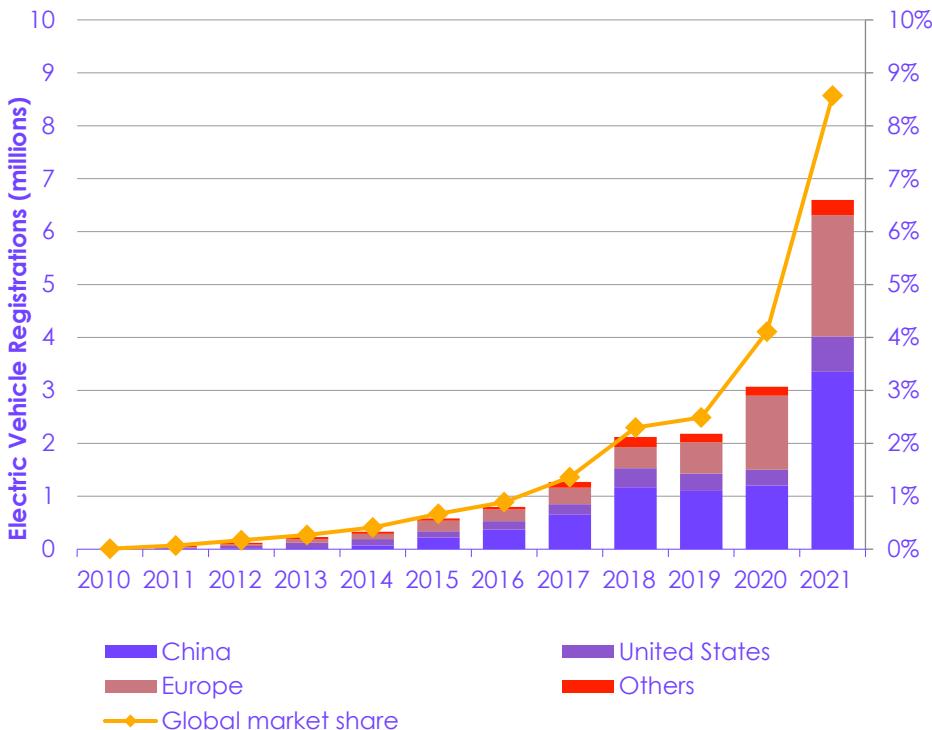
■ Solar ■ Wind ■ Hydropower ■ Bioenergy ■ Geothermal ■ Marine

Source: International Renewable Energy Agency (2022).

Notes: The figures for hydropower capacity exclude pumped storage hydropower capacity.

Sales of electric cars have tripled since 2019, reaching 9% of global car sales in 2021.

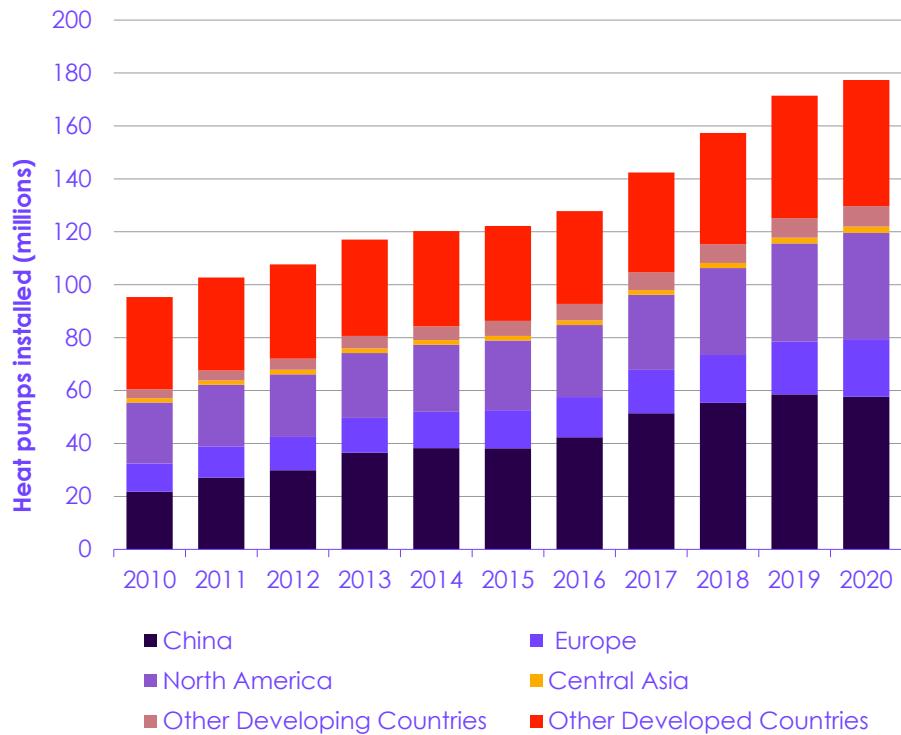
Figure 1.6 Global sales and global market share of electric cars 2010-2021



Source: International Energy Agency (2022) Electric cars fend off supply challenges to more than double global sales.

Heat pump installations are growing rapidly in many countries.

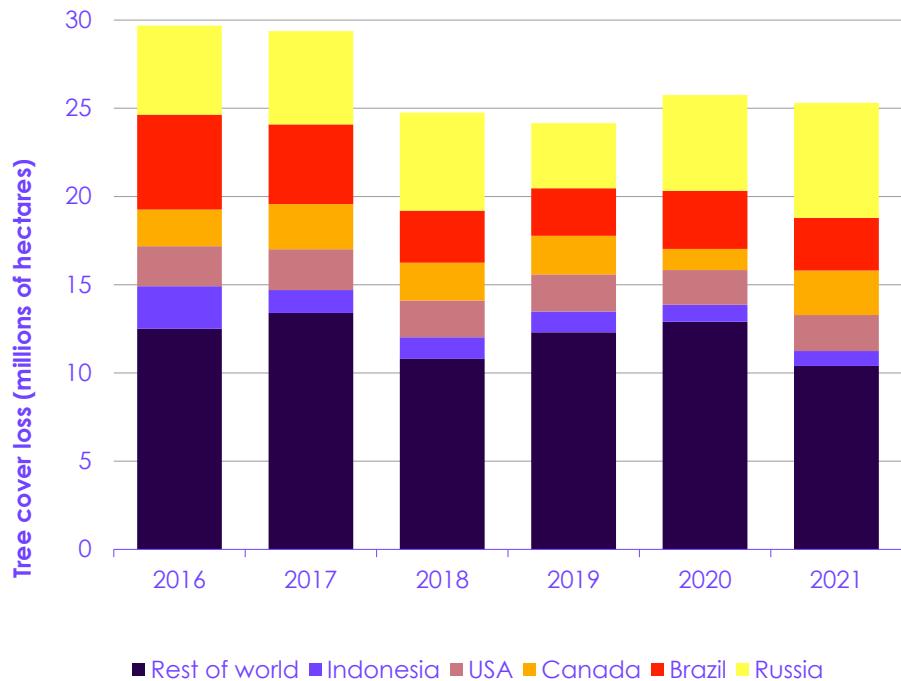
Figure 1.7 Global heat pump installations 2010 - 2020



Source: International Energy Agency (2021) *Tracking Report – Heat pumps*.

The global rate of tree cover loss has not slowed since 2018, but Indonesia has reduced its deforestation rate.

Figure 1.8 Global annual tree cover loss 2016-2021



Source: Global Forest Watch and University of Maryland (2022).
Note: Tree cover loss is gross not net as does not include gains.

4. Progress in international climate policy

International climate policy in 2021 focussed on the UN negotiations at COP26. The resulting Glasgow Climate Pact (Box 1.6) and associated sector-level pledges strengthened global commitment to climate action, but major gaps remain, especially in near-term ambition and delivery.

In this section we summarise the key outcomes from COP26 and then set out the potential emissions pathways and temperature outcomes that they could lead to.

(a) Key outcomes of COP26

The UK COP Presidency helped to deliver meaningful overall progress in international climate negotiations. This section summarises the findings of the December 2021 CCC report 'COP26: Key outcomes and next steps for the UK'.

The Glasgow Climate Pact highlights the risks of exceeding 1.5°C warming and sets out key actions for countries on NDCs, climate finance and adaptation.

- **Glasgow Climate Pact.** The Glasgow Climate Pact agreed at COP26 represents important progress in the UN climate negotiations. Recognising the severity of impacts above 1.5°C warming, it resolves to pursue this target and sets out that this will require a 45% reduction of CO₂ emissions from 2010 levels by 2030 (around a halving of emissions from today's levels)¹³ along with deep reductions in non-CO₂ GHGs, followed by reaching Net Zero CO₂ by mid-century. The Pact sets out the following actions for countries to take:
 - During 2022, revisiting 2030 Nationally Determined Contribution (NDC) emissions targets to ensure they align with the Paris temperature goal.
 - Phasing down unabated coal power and phasing out inefficient fossil fuel subsidies.
 - By 2025, doubling developed countries' collective provision of adaptation finance (on 2019 levels).
 - Establishing the Glasgow-Sharm el-Sheikh work programme to better measure and implement the Global Goal on Adaptation and the Glasgow Dialogue to discuss arrangements for the funding of activities to avert, minimise and address Loss and Damage (harms caused by climate change).
- **Long-term ambition to reduce emissions has aligned around Net Zero.** A key aim of the UK Presidency was to encourage more countries to set Net Zero targets. Following COP26 approaching 90% of global emissions are now covered by a Net Zero target commitment (Figure 1.9).
 - Action is now needed to make these targets meaningful and robust. This can involve, where applicable, clarifying their coverage (CO₂ or all GHGs), placing them in legislation, and setting out clear pathways to reach them, as has been done in the UK.
 - International commitments should be accompanied by updated formal submission of Net Zero plans and policies to the UN as Long-Term Strategies.

Meeting the Paris temperature goal will require strengthening and implementation of 2030 emissions reduction targets.

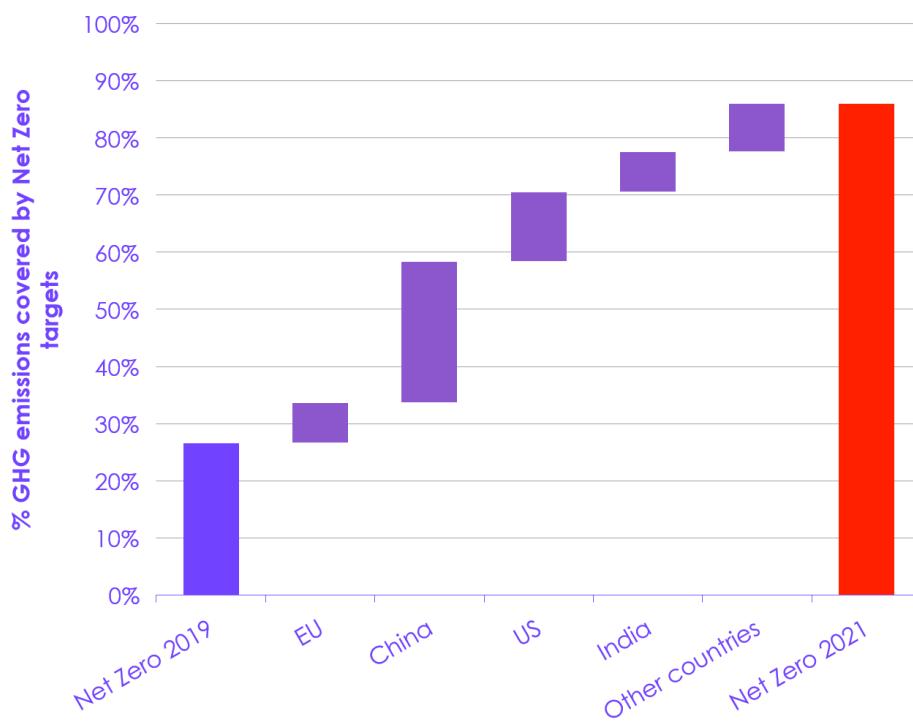
- **Near-term ambition remains well short of delivering the Paris temperature goal.** Many countries put forward 2030 Nationally Determined Contribution (NDC) emissions reduction targets that fall short of alignment to the Paris temperature goal. (The rate of emissions reduction to meet the UK target is consistent with Paris-aligned global pathways – see Section 5 below).
 - For the G20, assessment by Climate Action Tracker finds that 11 countries, amounting to around 50% of present global CO₂ emissions* have 2030 domestic targets that are insufficient to meet the Paris temperature goal. As requested by the Glasgow Climate Pact, these targets should be revisited and the headline emissions reduction ambition strengthened ahead of COP27.¹⁴
 - For G20 countries with NDCs rated as ‘almost sufficient’ (aligned to below 2°C, but not to 1.5°C) – the EU, US, Japan, South Africa and Canada[†] – the status of implementation policies is mixed. Revised and strengthened NDCs submitted ahead of COP27 should prioritise clear plans for delivery and explore further increases in 2030 ambition in line with the Glasgow Climate Pact.
- **The rules for implementing the Paris Agreement were finalised.** COP26 concluded negotiations on Article 4 (timeframes for future NDC submissions), Article 6 (rules for international trading of emissions reductions and removals), and Article 13 (country reporting of emissions, mitigation and adaptation actions, and finance contributions).
- **The 2020 \$100 billion goal for climate finance is yet to be delivered.** Developed countries did not meet their commitment to mobilise \$100 billion of climate finance a year by 2020. Delivery of agreed finance commitments is needed both to support mitigation and adaptation in developing countries and for maintaining trust and commitment to all goals of the Paris Agreement. Developed countries must meet this commitment by 2023 at the latest.
- **The need for increased focus on adaptation was recognised.** Some additional funding was pledged to the Adaptation Fund and Least Developed Countries Fund but more needs to be done. Progress on the Global Goal on Adaptation work programme and on delivering the developed countries’ committed doubling of adaption finance (see Box 1.6 on the Glasgow Climate Pact) will be of high importance as we look to COP27, where these topics will be a major focus.

Further progress is needed on climate finance and adaptation, particularly around the delivery of pledged actions from developed countries

* Countries' CO₂ emissions as a percentage of global total CO₂ emissions are calculated using data from Ritchie et al. (2020) CO₂ and Greenhouse Gas Emissions, published online at OurWorldInData.org.

[†] Countries with NDCs with Climate Action Tracker ratings of ‘almost sufficient’ (the EU, US, Japan, South Africa and Canada) and ‘1.5°C Paris Agreement compatible’ (the UK) represent around 30% of global CO₂ emissions.

Figure 1.9 Net Zero commitments announced in 2020 and 2021



Source: World Resources Institute, Net Zero Tracker (Energy and Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero).

Notes: This chart has assumed that countries' Net Zero Target commitments cover all GHG emissions. For a number of countries, current scope only covers CO₂ and for others, the scope has not been defined. Therefore, this chart represents the maximum amount of GHG emissions that could be covered by current Net Zero targets.

(b) Global emissions reduction ambitions

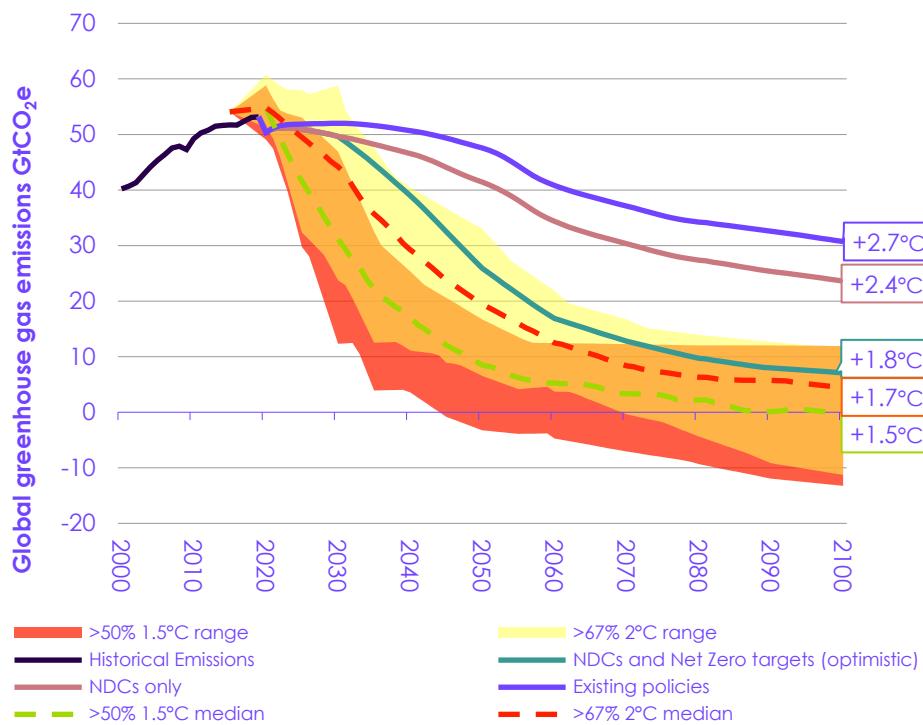
COP26 improved the outlook for global emissions pathways but a major ambition gap remains, especially in the near term to 2030.

Full implementation of the NDCs and Net Zero targets brought to COP26 can move global emissions pathways some of the way towards meeting the Paris Agreement temperature goal. However, large ambition gaps remain in the near term to 2030, and the full range of possible warming must be considered in assessing how well global ambitions address climate change risks (Figure 1.10).

- **Full implementation of the NDCs and Net Zero commitments could limit end-of-century warming to just below 2°C.** A recent study by Meinshausen finds that full implementation of COP26 commitments could limit peak warming to 1.9–2.0°C with a 50% probability (5%–95% range of 1.4–2.8°C).¹⁵ This corroborates the findings of analyses by the United Nations Environment Programme (UNEP)¹⁶, Climate Action Tracker (CAT)¹⁷ and the IEA¹⁸ immediately after COP26.
- **Major progress must be made on near-term emissions reduction.** All estimates of post-COP26 global pathways show large gaps in global ambition to 2030. This lack of ambition calls into question the credibility of Net Zero goals and risks warming of well above 2°C.
- **The COP26 sector pledges on forests, methane, fossil fuels and transport could help close some of the emissions reduction gap to 2030.** The Energy Transitions Commission (ETC) and CAT have assessed the maximum potential of sectoral pledges suggesting that, in combination with NDCs, they could reduce 2030 emissions by around 20-25% from the 'current policies' trajectory. This is around half of the reduction estimated to be needed to limit warming to 1.5°C (Figure B1.6).
 - The UK should take a leading role in ensuring that these pledges result in meaningful policy action through supporting creation of governance and delivery mechanisms and, where applicable, securing further signatories.

Analysis shows continuing with existing policies is likely to result in around 2.7°C of warming. Even full implementation of COP26 NDCs and Net Zero targets is unlikely to limit warming to 1.5°C.

**Figure 1.10 Post-COP26 global emissions pathways
2000-2100**



Source: IPCC, Climate Action Tracker, CCC analysis.

Notes: The shaded ranges represent the upper and lower bounds of the scenarios that limit warming to a) 1.5°C with a >50% probability and b) 2°C with a >67% probability from the scenario database used by the IPCC Sixth Assessment Report. The dashed lines represent the medians of these ranges. Ranges for median end of century warming are +2°C to +3.6°C for the existing policies scenario, +1.9°C to +3°C for the NDCs only scenario ('2030 Targets only') and +1.5°C to +2.4°C for the NDCs and Net Zero targets (optimistic) scenario ('Optimistic scenario – Net Zero pledges'). Aggregation of greenhouse gas emissions is done using the global warming potential metric at time horizon of 100 years. Values from the IPCC 5th Assessment report are used, with a methane correction factor applied to Climate Action Tracker values which have been calculated using AR4 GWP values with a 100-year time horizon.

The sectoral pledges made at COP26 have potential to contribute to near-term emissions reductions if they are followed up with meaningful policy action.

Box 1.6

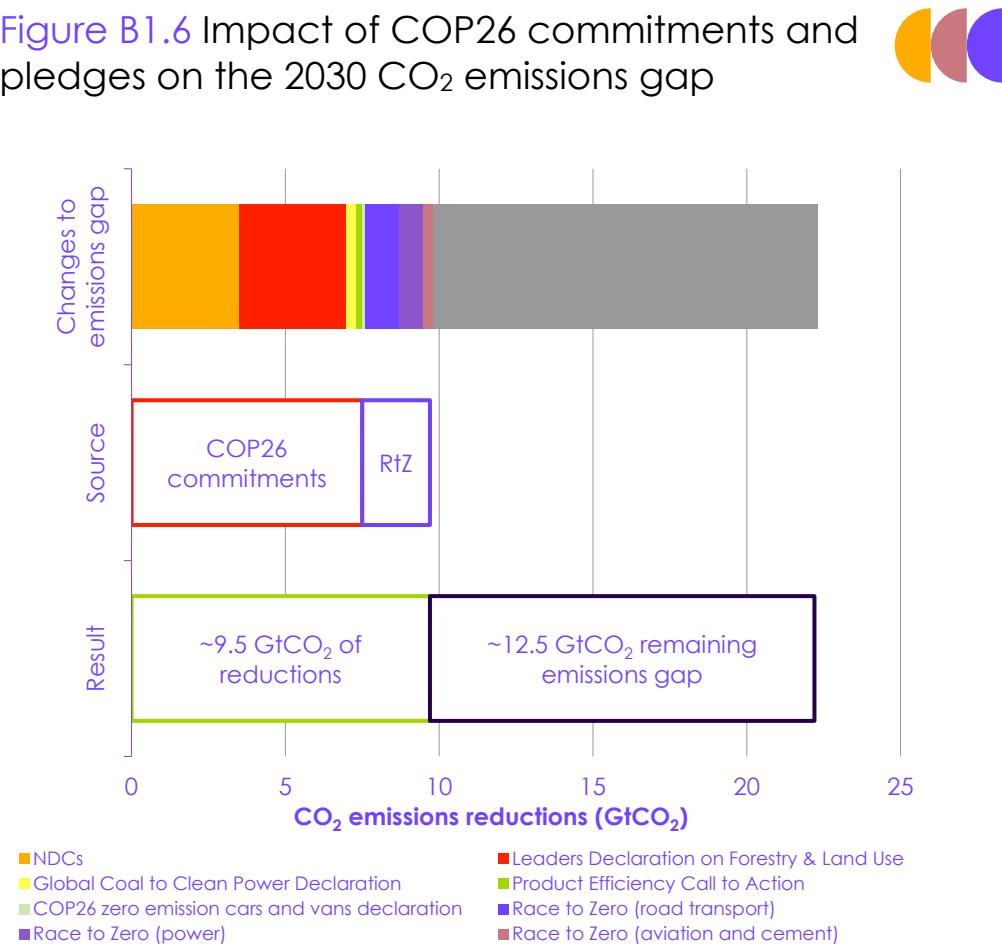
COP26 sectoral pledges and declarations

The sectoral pledges and declarations made at COP26 sit outside the formal UN system of NDCs, so could – if carried through – result in additional emissions reductions to 2030 and beyond.

The Energy Transitions Commission (ETC) estimated the NDCs, forest, coal, transport and power sector pledges together to bring up to 9.5 GtCO₂ in emissions reductions, reducing the 2030 CO₂ emissions gap to 1.5°C by about 40% (Figure B1.6).

If all signatories to the Methane Pledge achieved its 30% reduction this could lower methane emissions to ~48 MtCH₄ below the 2030 baseline estimate (48 MtCH₄ is ~1.3GtCO_{2e}). This is around 40% of the 130 MtCH₄ reduction ETC estimate to be in line with limiting warming to 1.5°C. Altogether, full delivery of COP26 NDCs and sectoral pledges could amount to around a 10.8 GtCO_{2e} reduction, just under half that needed by 2030 to be on a 1.5°C trajectory.

Figure B1.6 Impact of COP26 commitments and pledges on the 2030 CO₂ emissions gap



Source: Energy Transitions Commission (2021) *Assessing the commitments from COP26*.

Notes: The ETC estimates of the CO₂ emissions reductions from NDCs in 2030 are calculated by taking the midpoint of the Climate Action Tracker estimates of the impacts of conditional and unconditional NDCs. ETC estimates of CO₂ reductions resulting from pledges and declarations have been adjusted to take account of reductions covered by NDCs. The emissions gap represented in this chart assumes that CO₂ emissions will need to fall to around 21 GtCO₂ by 2030.

Source: Energy Transitions Commission (2021) *Assessing the commitments from COP26*.
Notes: Methane to CO_{2e} is calculated on a 100-year GWP-basis.

5. The UK's international role in 2022 and beyond

The ambition of the UK's NDC can provide leadership on the global stage. The UK should now focus on delivery, to demonstrate putting ambition into practice.

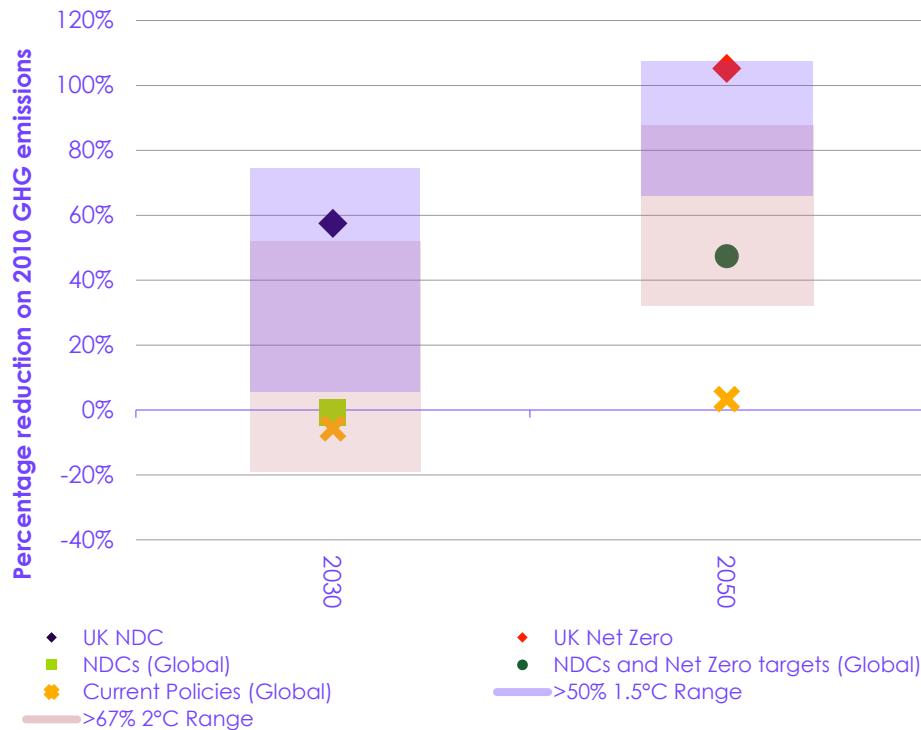
This section considers the international role of the UK following COP26. This includes the UK's 2030 emissions target, the actions needed from the UK resulting from the Glasgow Climate Pact and COP26 Pledges, and the UK's international climate role through 2022 as outgoing president of the UN COP process. It also sets out the Committee view on the forthcoming UK Strategic Framework 2030 on International Climate and Nature Action.

(a) The UK's Nationally Determined Contribution (NDC)

- **The UK NDC is ambitious and consistent with the Paris temperature goal** (Figure 1.11). The at least 68% emissions reduction on 1990 levels was set in line with the Committee's independent advice. This was set out in our 2020 Sixth Carbon Budget report, which took a holistic approach, considering all aspects of the UK's contribution to tackling climate change, including assessing a 'fair and ambitious' contribution from the UK to the Paris Agreement.¹⁹
 - The UK NDC involves around a 55% reduction in CO₂ from 2010 to 2030, excluding international aviation in line with UN convention. This is a greater reduction in CO₂ emissions than global scenarios consistent with 1.5°C (-45% from 2010 to 2030). It also involves earlier, faster deployment of low-carbon solutions than those scenarios. Figure 1.11 shows the UK targets in the global context in terms of all GHGs.
 - In Climate Action Tracker's assessment of domestic targets for 40 of the highest-emitting countries and the EU, the UK is the only one with a domestic 2030 target considered to be compatible with 1.5°C.²⁰
- **The Committee's view is that the UK should focus on delivery of the NDC.** Demonstrating that ambitious domestic emissions reductions can be delivered is key to influencing and encouraging others. Delivery will also help global efforts through driving low-carbon technology development and cost reduction.
- **The UK's NDC should be updated to clarify how it will be delivered.** We recommend that the NDC's technical annex - the Information to facilitate Clarity, Transparency and Understanding (ICTU) – is updated to detail its delivery through the Net Zero Strategy and other plans (e.g. the Energy Security Strategy). It should set out expected sector contributions including the amount of removals. It should also explain the UK's approach to the Just Transition; public engagement and participation; governance, accountability and reporting; and how adaptation is being integrated into the delivery of the NDC. We note that legislating the NDC into domestic climate law remains an option in the future.

The rate of emissions reduction implied by the UK NDC is consistent with the rates of reduction in 1.5°C and 2°C-compliant scenarios from the IPCC.

Figure 1.11 UK commitments in a global context



Source: Climate Action Tracker, IPCC Sixth Assessment Report Scenario Database, CCC analysis.

Notes: Aggregation of greenhouse gas emissions is done using the global warming potential metric at time horizon of 100 years. Values from the IPCC 5th Assessment report are used, with a methane correction factor applied to Climate Action Tracker values which have been calculated using AR4 GWP values with a 100-year time horizon. The shaded ranges are calculated from the global emissions scenario categories used by the IPCC Sixth Assessment Report. The reductions implied by the UK NDC and UK Net Zero commitment consider UK emissions with the exclusion of international aviation and shipping. The percentage reduction implied by the UK NDC will depend on the baseline used; a 2010 baseline corresponds to a 58% reduction in GHG emissions (excluding IAS) by 2030 and a 2019 baseline corresponds to a 42% reduction by 2030.

(b) UK actions on COP26 Pledges and Glasgow Climate Pact

The Government should be proactive in following up on COP26 agreements and pledges with meaningful policy action.

- The UK Government must ambitiously and transparently lead by example across all Glasgow Climate Pact commitments and COP26 Pledges signed by the UK.** The Committee intends to monitor both the UK's domestic compliance and international role in supporting the COP Pledges and Glasgow Climate Pact commitments (Box 1.7).
- Ensure all UK international climate finance commitments are delivered** including the £11.6 billion from 2021/2022 to 2025/2026, the extra £1 billion in 2024-2025 announced at COP26 to support clean technology and green infrastructure, and the 30% allocation to climate financing for green growth from British International Investment (formerly CDC Group plc).²¹
- The Government should set out its approach to meeting COP26 commitments and pledges before COP27** (Box 1.7), explaining how domestic compliance and achievement will be ensured and how the UK will support these initiatives internationally.

- **The Government should set out how it intends to support the Global Methane Pledge** by committing to reducing domestic methane emissions by at least 30% by 2030 on 2020 levels, and by clarifying longer-term UK ambition for methane reduction (this was not separately identified within the UK Net Zero Strategy).
- **The Breakthrough Agenda across power, road transport, steel and hydrogen could be an effective delivery mechanism** across many Pledges. We welcome and strongly encourage the UK COP Presidency commitment to establish the Global Checkpoint Process to annually track and review progress through to 2030.
- **The Just Energy Transition Partnership with South Africa**, which promised a \$8.5 billion support package from the EU, France, US and UK to facilitate a timely and fair transition from coal power, sets an important example for transition partnerships with other countries. Before COP27, the partnership should set out implementation progress and learnings on how this model could be replicated in other sectors and countries.
- **International Carbon Markets** (Article 6 of the Paris Agreement) agreed at COP26 can play a key role in increasing global ambition. While the Committee's advice is that the UK should not use international credits to meet UK carbon budgets, the UK should support the operationalisation of Article 6 through capacity building, support in meeting reporting requirements and developing policy on linkage with voluntary carbon markets (see Chapter 14).

The CCC will begin to monitor progress against Glasgow Climate Pact commitments and COP26 sector pledges and commitments.

Box 1.7

COP26 Pledges and Glasgow Climate Pact commitments

The Committee will begin to monitor progress against the following Glasgow Climate Pact commitments and COP26 sector pledges and commitments.

- **Global Methane Pledge:** commits signatories to contribute to a global effort to reduce methane emissions by at least 30% from 2020 levels by 2030. Domestically, the Committee's scenarios to achieve the UK's NDC involve a 32% methane reduction from 2020 to 2030. The Government's Net Zero Strategy adopted similar ambitions across the economy but did not split out the trajectories for different gases – this trajectory must now be clarified in line with the Methane Pledge. The UK should continue to support the operationalisation of the Global Methane Pledge.
- **Global Coal to Clean Power:** The Pledge includes commitments to transitioning away from unabated coal power generation in the 2030s and ending international support for unabated coal-fired power generation. Recognising the UK's domestic success in reducing coal power generation, the UK should continue to support international efforts to reduce coal use, such as the Powering Past Coal Alliance. The South Africa Just Energy Transition Partnership is a key opportunity and a model for providing UK financial and technical support to enable other countries to transition away from coal.
- **Glasgow Climate Pact commitment to phasing out inefficient fossil fuel subsidies:** The UK should continue to work within the G7 and G20 to ensure that repeated commitments to phase out inefficient fossil fuel subsidies result in measurable progress in 2022.
 - We reiterate our recommendation from the Committee's COP26 report that HM Treasury initiate a review of the role of tax policy in delivering Net Zero, including addressing any preferential tax treatments that could be considered to be a fossil fuel subsidy (see notes below).²²

- The UK Government should also consider other international levers it could use to reduce fossil fuel funding, such as building on the Glasgow Finance Alliance for Net Zero and undertaking a reciprocal peer review of fossil fuel support through the OECD process to improve transparency and accountability.
- **Glasgow Leaders' Declaration on Forests and Land Use:** The UK should continue to support international efforts to reduce deforestation. Some progress has been made on tackling illegal deforestation in UK supply chains and implementing agricultural reform through the Agriculture Act. Defra should continue to support the Taskforce on Nature-related Financial Disclosures. BEIS and FCDO should use the Forest, Agriculture and Commodity Trade (FACT) Dialogue to raise global standards on deforestation policy and ensure that producer countries have the right tools for sustainable production and trade. Domestically, the UK should set out how it intends to achieve the long-term woodland cover ambitions set out in the Net Zero Strategy and Environment Act consultation on environmental targets (see Chapter 8), improve its collection of data on international land use emissions that arise from UK consumption, particularly from deforestation, and develop new policy to remove unsustainable legal deforestation from UK supply chains (see Chapter 14).
- **Declaration on accelerating transition to 100% zero emission cars and vans sales by 2035 in leading markets:** UK domestic policy is aligned to the Declaration. The Road Transport Breakthrough has a wider signatories list, demonstrating potential for the UK to engage bilaterally and internationally to advocate for all major car markets and manufacturers to commit to ending the sales of light duty petrol and diesel vehicles.
- **Aviation and Shipping:** The UK is a signatory to the COP26 International Aviation Climate Ambition Coalition, and COP26 Clydebank Declaration for Green Shipping Corridors. The UK must lead by example through delivering on its inclusion of these sectors in its Net Zero commitments (see Chapters 9 and 10) and encouraging others to bring aviation and shipping within their targets. The UK must continue to work to advance meaningful progress on the climate ambitions of the International Civil Aviation Organisation (ICAO) and International Maritime Organisation (IMO). In particular, the UK should use the 41st ICAO General Assembly to try and strengthen CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation).

Source: CCC (2021) COP26 – Key Outcomes and Next Steps for the UK.

Notes: The CCC does not consider that any fossil fuel subsidies should be classed as 'efficient' in the UK, given that other mechanisms are available to support vulnerable consumers with their fuel bills.

(c) Implications for UK adaptation action

Support for international adaptation action must be complemented with an ambitious, cross-cutting domestic adaptation programme.

For the UK to effectively support international efforts on climate change adaptation an ambitious, cross-cutting and well-implemented domestic adaptation programme is essential. This can help serve as a template for what a credible response to the climate risk challenge can look like beyond the UK.

In addition to demonstrating good practice through its domestic adaptation efforts, the UK should continue to support adaptation internationally through and beyond the UK's COP Presidency.

- This includes maintaining a broadly 50:50 split between mitigation and adaptation in UK International Climate Finance, supporting constructive dialogue on loss and damage, and collaborating internationally to support further understanding and action on adaptation, such as through the Adaptation Research Alliance launched at COP26.
 - As climate finance actions are not fully separable from broader development support, Official Development Assistance should be restored to 0.7% of Gross National Income once the conditions originally set out by HM Treasury are met.

- The UK should also set out a frequency with which it intends to update its Adaptation Communication to help these genuinely drive enhanced ambition on adaptation, similar to the NDC ambition cycle. The UK should act as a champion for this.

(d) The UK's international role after COP26

The UK should maintain its diplomatic effort on climate change and continue to prioritise strong climate leadership.

COP26 secured an increase in global mitigation ambition and demonstrated countries' ongoing commitment to the multilateral climate process. Over the coming year, all countries will need to focus on translating their enhanced commitments into policy action and addressing remaining gaps across all three goals of the Paris Agreement on the road to COP27.

As outgoing COP President, the UK should maintain its diplomatic effort on climate change, focusing on issues including 2030 mitigation ambition, climate finance and the phaseout of fossil fuel subsidies. The UK should also seek to build on the international collaborations achieved over the past year. Partnerships such as the South Africa Just Energy Transition and the UK-India Climate Finance Leadership Initiative are an important step in unlocking the benefits of energy transition around the world and should be implemented at pace and replicated elsewhere.

Above all, it is crucial that the UK consistently demonstrates strong, proactive climate leadership both at home and through wider international actions. This leadership must extend to areas such as trade policies and consumption emissions and Chapter 14 sets out the Committee's view on these areas.

The Strategic Framework 2030 should set out a cohesive Government plan on advancing international action on mitigation, adaptation and nature that spans departments and involves the UK leading by example.

In March 2022 the Government issued a Call for Views on the UK 2030 Strategic Framework intended to guide the UK's longer-term role in tackling climate change and biodiversity loss around the world. The Committee's views are set out in Box 1.8.

The Strategic Framework 2030 should set out a cohesive Government plan on advancing international action on mitigation, adaptation and nature that spans departments and involves the UK leading by example.

Box 1.8

UK Strategic Framework 2030

The UK Strategic Framework 2030 on International Climate and Nature Action will set out the Government's vision for the UK's long-term role in tackling climate change and biodiversity loss around the world. It seeks to take an integrated approach to climate change mitigation, adaptation and resilience, and the protection, conservation and restoration of nature.

Following COP26, climate must continue to be a top international priority for the UK to ensure that the legacy of the UK Presidency is a success. International collaboration on climate can also bring benefits for domestic action, with global advances offering opportunities to further reduce costs and grow markets for key low-carbon technologies.

The Committee welcomes the Strategic Framework as a means of refining and strengthening the UK's approach to supporting efforts to drive ambition, reduce emissions and adapt to climate change around the world. The Committee suggests that the framework sets out:

- How the UK's relative experience in implementing Net Zero and adaptation approaches can be shared with partners around the world. This should look at strengthening existing programmes such as UKPACT, 2050 calculator and the NDC partnership, and establishing new offers to effectively respond to the capacity needs of international partners, particularly in middle and low-income countries.

- Appropriate resourcing of the UK's diplomatic network and funding of International Climate Finance to reflect the UK's ongoing ambition to be a global leader on climate and climate's position as HMG's top international priority as set out in the 2021 Integrated Review.²³ The framework should also set out plans to maintain and develop the wider international energy and climate capability built up across HMG in the run up to, and at, COP26.
- How the UK will use its diplomatic, financial, economic, and other strategic levers to press for genuine action and high ambition from the G7 and G20 on emissions reduction, adaptation and finance.
- How mitigation and adaptation will be fully integrated into UK Official Development Assistance (ODA) programmes, ensuring FCDO is supporting climate-resilient development. The UK should support sustainable development which recognises synergies between mitigation and adaptation interventions and reduces trade-offs.
- The UK should support locally-led adaptation, developing partnerships with local communities and Indigenous Peoples for sustainable land management, increasing biodiversity and minimising maladaptation.

The Committee will continue to support the UK's international climate effort through the CCC's international programme. This involves sharing the experience and insights from our work in the UK with other countries and collaborating with established and new climate councils through the International Climate Councils Network (Box 1.9).

Source: Defra (2022) *Call for Views – 2030 Strategic Framework on International Climate and Nature Action*.

The International Climate Councils Network (ICCN) is a group of 20+ climate councils from across six continents. Its mission is to foster collaboration between councils and improve climate governance.

Box 1.9

International Climate Councils Network

At COP26, the Committee, in partnership with 20 other Climate Councils from across six continents, formally launched the International Climate Councils Network (ICCN). As new Climate Councils are established the ICCN is growing, numbering 23 councils in May 2022.

The ICCN's mission is to foster collaboration between existing Climate Councils and act as a focal point for other governments interested in strengthening their national climate governance through the introduction of expert and independent advisors. The ICCN is an open and collaborative initiative that takes an inclusive approach to participation. It is jointly owned, and coordination is rotated among the participant councils. The 2022 steering group consists of the Canada Climate Institute and Canada Net Zero Advisory Board, France High Council on Climate, and Guatemala Climate Change Science System. As part of its launch, the ICCN issued an open letter to heads of Government of the Parties to the UNFCCC signed by the chairs of 19 Councils. This noted that the 2020s must be the decade of implementation and highlighted the value of Climate Councils to support Government in this task. The letter set out the following five principles for enabling Councils to undertake their role effectively:

- A robust grounding in the latest climate science, as exemplified by the assessments of the Intergovernmental Panel on Climate Change (IPCC), supported by strong expertise across relevant economic, physical, ecological and social sciences.
- A mandate to provide independent, evidence-led advice to and assessment of action by Government and stakeholders on climate mitigation and/or adaptation, with sufficient resources to deliver on that mandate.
- A remit to produce advice on the socioeconomic aspects of the climate transition to ensure that it is procedurally and substantively fair.
- A consultative and impartial approach to engaging stakeholders to help develop consensus and steer policy action, particularly in critical and/or challenging areas.
- A sharp focus on strengthening and aligning adaptation, mitigation and just transition efforts, and improving their integration – all three are essential to effective climate action.

Source: International Climate Councils Network (2021) *The role of advisory climate councils in supporting world leaders to deliver on the Paris Agreement*.

Endnotes

- ¹ Intergovernmental Panel on Climate Change (2022) *Climate Change 2022: Impacts, Adaptation and Vulnerability*, <https://www.ipcc.ch/report/ar6/wg2/>.
- ² Intergovernmental Panel on Climate Change (2022) *Climate Change 2022: Mitigation of Climate Change*, <https://www.ipcc.ch/working-group/wg3/>.
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- ⁸ Jackson, R. B. et al. (2022) *Global Fossil Fuels Rebound near pre-Covid-19 Levels*, *Environmental Research Letters*, 17 031001.
- ⁹ International Energy Agency (2022) *Global Energy Review: CO₂ Emissions in 2021*, <https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2>.
- ¹⁰ Le Quéré et al. (2019) *Drivers of declining CO₂ emissions in 18 developed economies*, *Nature Climate Change*, 9, pages 213–217.
- ¹¹ Organisation for Economic Co-operation and Development (2021) *Climate Finance Provided and Mobilised by Developed Countries: Aggregate Trends Updated with 2019 Data*, <https://www.oecd.org/env/climate-finance-provided-and-mobilised-by-developed-countries-aggregate-trends-updated-with-2019-data-03590fb7-en.htm>.
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- ¹³ Climate Change Committee (2021) *COP26 - Key Outcomes and Next Steps for the UK*, www.theccc.org.uk/publication/cop26-key-outcomes-and-next-steps-for-the-uk/.
- ¹⁴ Climate Action Tracker (2022) *Country Summaries*, <https://climateactiontracker.org/countries/>.
- ¹⁵ Meinshausen et al (2022) *Realization of Paris Agreement pledges may limit warming just below 2°C*, *Nature*, 604, pages 304–309.
- ¹⁶ United Nations Environment Programme (2021) *Addendum to the Emissions Gap Report 2021*, <https://wedocs.unep.org/bitstream/handle/20.500.11822/37350/AddEGR21.pdf>.
- ¹⁷ Climate Action Tracker (2021) *Glasgow's Credibility Gap*, <https://climateactiontracker.org/publications/glasgows-2030-credibility-gap-net-zeros-lip-service-to-climate-action/>.
- ¹⁸ International Energy Agency (2021) *Technical note on the emissions and temperature implications of COP26 pledges*, <https://iea.blob.core.windows.net/assets/aa17bd09-2ad0-4d0a-b5aaee418900c4af/Theimpactsnewemissionspledgesonlongtermtemperatures.pdf>.

¹⁹ Climate Change Committee (2020) *The Sixth Carbon Budget: the UK's Path to Net Zero*, www.theccc.org.uk/publication/sixth-carbon-budget/.

²⁰ Climate Action Tracker (2021) UK Country Summary
<https://climateactiontracker.org/countries/uk/>.

²¹ UK COP Presidency (2021) *COP26 Presidency Compilation of 2021-2025 Climate Finance Commitments* <https://ukcop26.org/wp-content/uploads/2021/11/Table-of-climate-finance-commitments-November-2021.pdf>.

²² Climate Change Committee (2021) *COP26 - Key Outcomes and Next Steps for the UK* www.theccc.org.uk/publication/cop26-key-outcomes-and-next-steps-for-the-uk/.

²³ Foreign, Commonwealth & Development Office (2021) *Global Britain in a Competitive Age: the Integrated Review of Security, Defence, Development and Foreign Policy*, <https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy>.



Chapter 2: Overall progress

Policy and emissions

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Introduction and key messages

The UK Government's new Net Zero Strategy,¹ together with its many accompanying publications, lays out a broad set of plans and policies required to reduce the UK's territorial emissions, including international aviation and shipping.

This chapter summarises the ambition and approach taken in the Net Zero Strategy and presents progress in the UK's reduction of emissions. We assess the Government's policies and plans, identify major risks and summarise our recommendations to departments for the coming year.

Our assessment in this chapter, and throughout this report, includes a new set of indicators developed as part of a broader refresh of how the Committee monitors and assesses progress. With the publication of the Net Zero Strategy, we can start to assess progress against the Government's own plans. Details on how we monitor progress are outlined in the accompanying Monitoring Framework and are summarised in Box 2.1.

Our key messages are:

- **Emissions.** UK greenhouse gas emissions were 447 MtCO₂e in 2021, including the UK's share of international aviation and shipping emissions. This is 47% below 1990, a decrease of 10% on 2019 emissions but an increase of 4% on 2020 emissions, which were low due to the effects of the COVID-19 pandemic. UK consumption emissions, which include emissions embedded in imports, fell by 29% from 1990 to 2018.
- **The Net Zero Strategy.** The UK Government has taken an important step with the publication of the Net Zero Strategy, detailing plans of a pathway that, if achieved, would meet the Fourth, Fifth and Sixth Carbon Budgets and the 2030 Nationally Determined Contribution (NDC). It has made several commitments, including – but not limited to – the following targets and ambitions that are pivotal to achieving the majority of the emissions reduction:
 - **Electricity supply.** Fully low-carbon electricity supply by 2035, underpinned by 50 GW of offshore wind capacity* by 2030.
 - **Surface transport.** End of sales of conventional fossil-fuelled cars and vans by 2030.
 - **Buildings.** At least 600,000 heat pump installations per year by 2028 and as many homes as possible reaching at least a 'C' efficiency rating by 2035.
 - **Manufacturing and construction.** Industrial emissions to be reduced 63-76% on 2019 levels by 2035.
 - **Greenhouse gas removals.** 5 MtCO₂ per year of engineered greenhouse gas removals by 2030 and 30,000 hectares per year of new tree planting by 2025.

* The Energy Security Strategy increased the offshore wind target to 50 GW from the 40 GW target in the Net Zero Strategy.

- **The Government's narrow approach.** The Government has made a clear choice to rely heavily on technology, with much less focus on efficiency improvements and demand management across the economy. This is a relatively narrow approach that could lead the UK down a more expensive path to Net Zero, with a higher risk of failure and energy insecurity. It also misses the opportunity to maximise on co-benefits to the transition via improvements to health through more comfortable homes, reduced air pollution, healthier diets and more active lifestyles.
- **Tracking tangible progress.** With an emissions path set for the UK and the Net Zero Strategy published, greater emphasis and focus must be placed on delivery. This is needed for the UK's climate ambitions to be credible. Recent uptake of electric cars is very positive – as with renewable electricity, the combination of cost reductions over the last decade and the policy framework now in place provide confidence that the necessary progress will be made in deployment. However, outside these bright spots, we are not seeing the necessary progress across a wide range of areas.
- **The Fourth Carbon Budget.** The majority of the required emissions reduction for meeting the Fourth Carbon Budget (2023-2027) has sufficient plans, predominantly in the electricity supply and surface transport sectors, however, some risks remain and meeting the target will depend on near-term macroeconomic trends. It should be noted that meeting the Fourth Carbon Budget is not sufficient to be on track for the later targets.
- **The 2030 NDC, the Sixth Carbon Budget and Net Zero.** There are significant delivery risks to meeting the 2030 NDC – which supersedes the Fifth Carbon Budget as the appropriate level of reduction on the way to Net Zero – and the Sixth Carbon Budget (2033-2037), as well as the long-term goal of Net Zero by 2050. There are risks in all sectors, although surface transport and electricity supply have the most credible plans. Buildings, agriculture and land use pose the largest risk.
- **Mitigating risk.** Not all policies will deliver as planned. Some may be more successful than expected, while others will fall behind. The Net Zero Strategy sets a pathway to deliver the necessary emissions reductions, but takes an approach that does not include significant ambition to reduce consumer demand for high-carbon activities (e.g. through healthier diets, or curbs to growth in aviation demand). Given the range of delivery risks highlighted in this report and the lack of progress seen in many areas to date, the Net Zero Strategy is not fully credible until the Government develops and begins to implement contingency plans. These should broaden the Government's approach, in particular by including demand-side policies. It would be particularly risky to compensate shortfalls in delivery with extra engineered CO₂ removals, given the already high reliance on these in the Strategy.

This chapter is followed by 11 sectoral chapters, giving more detail of our assessment within each sector. The final chapter of the report then discusses progress in enablers of the transition including governance, public engagement, fair funding and affordability, workers and skills and business and investment.

We assess progress according to our own sector definitions, which are aligned with the policy levers for emissions reduction. These are broadly similar to those in the Government's Net Zero Strategy, but with a few notable differences outlined in our accompanying Monitoring Framework.

The rest of this chapter is laid out as follows:

1. Ambition and approach in the UK's Net Zero Strategy
2. The proposed UK ETS cap
3. Progress in reducing UK emissions
4. Indicators of progress
5. Assessment of policies and plans
6. Progress against last year's recommendations
7. Recommendations and risks

Box 2.1

How we monitor progress

This year sees a change in approach to our progress monitoring. With the publication of the Net Zero Strategy, we can start to assess the Government's progress against its own plans. We are shifting our focus and developing a comprehensive set of indicators to track real-world progress across the economy, to ensure enablers are put in place and blockages are removed. A full description of how we monitor progress from 2022 onwards is given in our accompanying Monitoring Framework.

Each year we report on annual progress in each sector and in the cross-cutting enablers of the decarbonisation transition, including:

- **Emissions.** We monitor progress in territorial and consumption emissions and compare to the Government's pathway for the former.
- **Indicators of progress.** By tracking sectoral and cross-cutting enabling indicators against required pathways or benchmarks, we assess the delivery of the Government's many policies, plans and commitments. Some of these are relevant to enable the required emissions reduction in the future and others are needed to see the required emissions reductions today. In cases where the Government has not provided sufficient detail, we track against our own Balanced Pathway.
- **Progress in policy development.** Policy progress in the past year is summarised, with remaining gaps highlighted.
- **Assessment of policies and plans.** Emissions savings from the Government's various measures are estimated, currently up to the Sixth Carbon Budget. The policies and plans for each set of measures are then assessed to determine if they are credible and on track. These are presented as sectoral and cross-economy charts that indicate the proportion of required abatement that either has credible plans; has some risks; has significant risks; or has insufficient plans. Also presented are policy scorecard tables providing a more detailed assessment at a sub-sector level.
- **Recommendations to each department.** These are included as a separate Annex and are available on our website in sortable and filterable tables with a summary provided in the report. These recommendations are scored in the following year's Progress Report. A summary of the priority recommendations is given here.
- **Identifying risks.** We identify major risks to achieving emissions reduction targets together with mitigating actions. In some cases, the risks result from the inherent reliance on new technologies and new ways of doing things. In others, there may be fewer inherent risks, but the policy framework does not yet provide confidence that full delivery will ensue.

1. Ambition and approach in the UK's Net Zero Strategy

The Government's Net Zero Strategy has broadly appropriate ambition in emissions reduction and adoption of key technologies.

The Government has made a relatively high-risk choice to rely heavily on technology, with less focus on efficiency improvements and demand management.

The Government's Net Zero Strategy presents a wide-ranging set of plans and policies, detailing how each sector in the economy will contribute to the path to Net Zero, including the UK's share of international aviation and shipping. It has broadly appropriate ambition in emissions reduction in each sector, and in the adoption of key technologies.

While its proposed pathway is similar to the CCC's, the Government has made a relatively high-risk choice to rely heavily on technology to reach its targets, with much less focus on efficiency improvements and demand management across the economy. This is a narrow approach that could lead the UK down a more expensive path to Net Zero, with a higher risk of failure and energy insecurity. It also misses the opportunity to maximise on co-benefits to the transition via improvements to health through more comfortable homes, reduced air pollution, healthier diets and more active lifestyles.

- The Government's emissions pathway* is presented as a range reflecting how uncertainties in future macroeconomic trends affect future emissions, from which a central pathway can be determined (Box 2.2).
 - The Government's central pathway would, if delivered successfully, meet the Fourth, Fifth and Sixth Carbon Budgets and the 2030 NDC (Figure 2.1).
 - However, if future macroeconomic trends lead to emissions towards the upper range of the pathway, the 2030 NDC and the Sixth Carbon Budget would not be met, even assuming full delivery of the policies (Figure 2.1).
- The Government's pathway for emissions is similar to the CCC's Balanced Pathway in the 2030s (Figure 2.2), with lower forecasted emissions in the 2020s.
 - In 2020 this is due to a more comprehensive modelling by the Government of the effects of the COVID-19 pandemic across the economy.
 - In the mid-2020s, this is primarily due to Government assuming a much faster phase-down of unabated gas generation in the electricity supply sector. There are also sizeable differences in buildings and land use, in both cases due to different assumptions regarding expected emissions before policy savings are considered (Box 2.2).
- There are differences between the Government and the CCC in ambition between sectors in 2035 (Figure 2.3).
 - Government's expected emissions are higher in the fuel supply sector, due to an unambitious North Sea Transition Deal² and, to a lesser extent, in the aviation sector, due to a lack of demand management.

* The Government's pathway is taken from the Net Zero Strategy, with aviation updated to use the latest pathway from the Jet Zero Strategy consultation.

- The Government's expected emissions continue to be lower in the buildings sector, primarily due to the aforementioned assumptions when determining the expected emissions before policy savings (Box 2.2). However, this sector has significant delivery risks (see Chapter 4 on Buildings).
- The Government has made a number of commitments, including, but not limited to, a set of “targets and ambitions” that are pivotal to achieving the majority of emissions reduction by the Sixth Carbon Budget (Table 2.1).
- The Government has made a clear choice to focus primarily on technological solutions with much less emphasis on demand-side action with:
 - No stated ambition for reducing consumption of meat and dairy.
 - No stated ambition for aviation demand management.
 - Limited detail on targets for shifting travel from cars to public transport, cycling and walking.
 - A bigger focus on carbon capture and storage (CCS) and on hydrogen in manufacturing and construction than on resource- and energy-efficiency.
- This choice to focus on technology is also apparent in the Government's 2050 Net Zero scenarios, which have a strong reliance on engineered greenhouse removals and aviation technology (Box 2.3). This reliance on removals is particularly risky without a strategy to free up UK land for biomass, to be used with CCS. In the CCC's pathways this is done via shifting to diets with less meat and dairy, but the Government's approach relies on optimistic levels of innovation and productivity improvements.

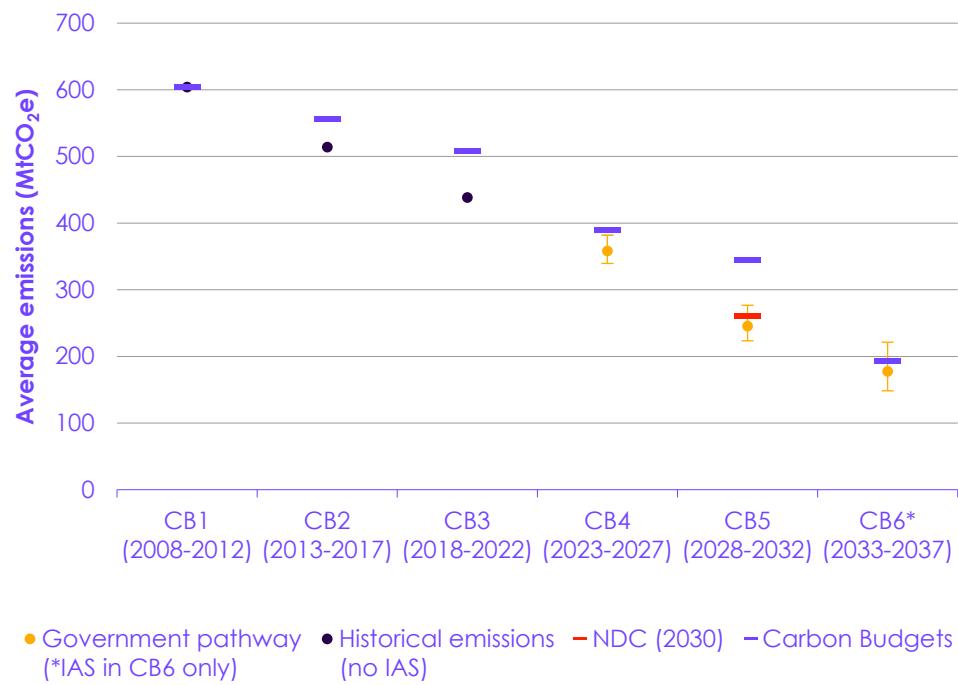
The UK Government should pursue demand-side options as part of good risk management and given the significant co-benefits.

We recommend that the Government develops policy options and begins to take steps towards supporting low-carbon consumer choices to help mitigate risks in meeting the carbon budgets. In particular, there are opportunities on travel demand and diet change (see Chapters 3, 8 and 9 on surface transport, agriculture and land use, and aviation respectively).

While the majority of the UK's emissions come from England, there are important contributions from Scotland, Wales and Northern Ireland, which each have their own emissions reduction targets and plans, and where many of the key policy levers are devolved. Scotland and Wales have more emphasis on demand-side action than the UK, with Wales being the only of the UK nations with a policy proposal to address a shift to low-carbon diets (Box 2.4).

If delivered, the Government's central pathway would meet all Carbon Budgets and the 2030 NDC. However, there are risks to meeting both the NDC and the Sixth Carbon Budget, even assuming full delivery of policies, due to uncertainties in future emissions originating from uncertainties in macroeconomic trends.

Figure 2.1 Government pathway and historical emissions compared to legislated targets



- Government pathway
- Historical emissions
- NDC (2030)
- Carbon Budgets
- (*IAS in CB6 only)
- (no IAS)

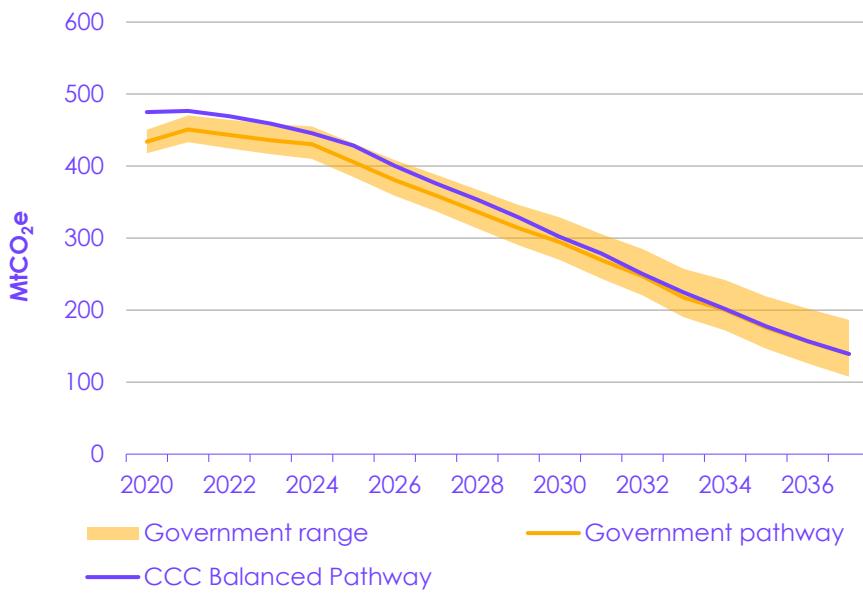
Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2022) *Final UK greenhouse gas emissions national statistics: 1990 to 2020*; BEIS (2022) *Provisional UK greenhouse gas emissions national statistics 2021*; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. The CB3 historical value is the average emissions in years 2018-2021. When 2022 emissions data is available, the average emissions over the CB3 period may rise due to continued rebound from the pandemic but CB3 will still be comfortably met.

* The UK's share of emission from international aviation and shipping (IAS) is included in CB6 only and removed from the emissions and pathway in all other periods to enable direct comparison with the targets.

The Government's expected emissions are similar to the CCC's in the 2030s and lower in the 2020s, predominantly due to different assumptions in the generation mix for electricity supply.

Figure 2.2 Comparing the Government and CCC pathways

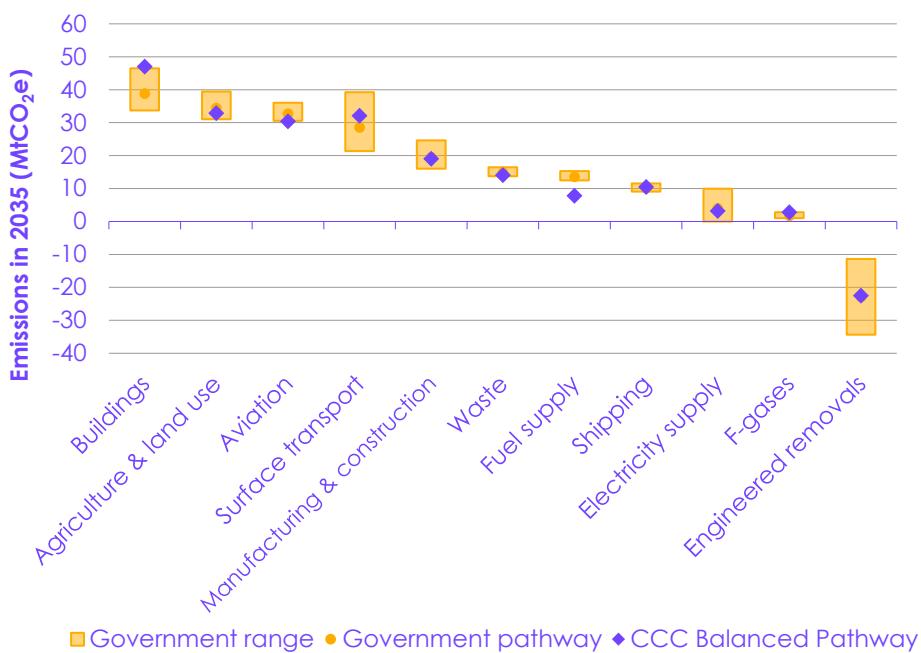


Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; CCC analysis.

Notes: The aviation pathway has been updated with respect to the Net Zero Strategy to the latest from the Jet Zero Strategy and the UK share of emissions from international aviation and shipping (IAS) is included in both pathways. Global warming potentials from IPCC AR5 without feedback are used. The CCC pathway has higher emissions in 2020 as it only modelled pandemic effects for IAS in 2020.

In 2035 the Government expects higher emissions than the CCC in fuel supply, due to a weak North Sea transition deal. This is largely balanced by lower expected emissions in buildings, which has significant delivery risks.

Figure 2.3 Government and CCC pathway comparison in 2035



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; CCC analysis.

Notes: The aviation pathway has been updated with respect to the Net Zero Strategy to the latest from the Jet Zero Strategy and international aviation and shipping (IAS) is included in both pathways. Global warming potentials from IPCC AR5 without feedback are used.

Table 2.1

Key Government commitments compared to the CCC

Sector	Key Government commitment	CCC Balanced Net Zero Pathway
Surface transport	End of sales of fossil-fuelled cars and vans by 2030	2032
Electricity supply	Fully low-carbon electricity supply by 2035	The same
	The above is underpinned by 50 GW offshore wind capacity* by 2030	40 GW
Buildings	At least 600,000 heat pump installations / year installed by 2028	900,000
	As many homes as possible reaching at least a 'C' efficiency rating by 2035	Not specified ⁺
Manufacturing and construction	Industrial emissions to be reduced by 63-76% on 2019 levels by 2035	Similar (71%)
Agriculture and land use	30,000 hectares / year of new woodland creation by 2025	The same
Engineered removals	5 MtCO ₂ /year of engineered greenhouse gas removals by 2030	The same

Notes: Most of these commitments are taken from the table on p. 254 in the Net Zero Strategy. *The 50 GW target for offshore wind was increased in the Energy Security Strategy, from the 40 GW target in the Net Zero Strategy. ⁺See Table 2.1 in the CCC's Independent Assessment of the UK's Heat and Buildings Strategy³ for a comparison of the energy efficiency targets between the Government and the CCC.

Box 2.2

Baseline emissions and uncertainty ranges in the pathway

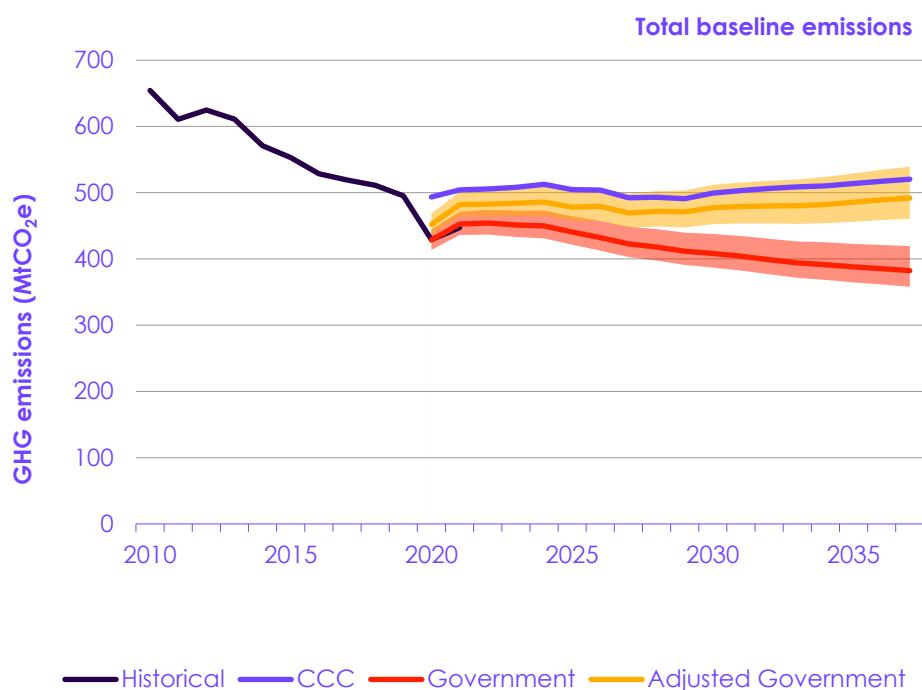
The emissions pathway in the Government's Net Zero Strategy was constructed with respect to a projected baseline, intended to represent the path for emissions that would occur without the new policies and plans announced in the Strategy. The pathway is then determined by subtracting the emissions reductions expected from new policies and plans from this baseline. For some sectors there is a small inconsistency between the published baseline and that used when determining the pathway, with the two being based on different assumptions. We refer to this as the Government's 'baseline inconsistency'.

For the analysis in this report, we have adjusted the baseline to remove the impact of some existing policies so that they can be brought into our policy assessment, enabling them to be assessed together with those included in the Net Zero Strategy, and to account for the Government's baseline inconsistency.

- **The Government's baseline.** The baseline is based on the 2019 energy and emissions projections (EEP) reference scenario⁴ with some corrections, most notably accounting for the impact of the COVID-19 pandemic on GDP growth and transport use. It includes some existing pre-Net Zero Strategy policies that lead to baseline emissions declining over time. The largest reductions come from policies on car fuel-efficiency and shifting to renewable power generation.
- **Our adjustments to the baseline.** We have made the following adjustments to the published baseline that enable us to assess the majority of policies leading to the required abatement. The impact of these adjustments can be seen in Figure B2.1.
 - **Surface transport.** We have removed the impact of pre-Net Zero Strategy car fuel-efficiency and other policies and adjusted to account for the Government's baseline inconsistency.
 - **Electricity supply.** We have used the baseline from our Sixth Carbon Budget analysis. This is because the Government's baseline included the impact of policies on renewable energy deployment and these were not sufficiently quantified to enable us to remove the impact.
 - **Waste.** The baseline includes an adjustment to wastewater emissions to account for an update to the UK greenhouse gas inventory methodology in 2021 in which estimates of emissions were revised down.
 - **F-gases.** We have removed the impact of the F-gas Regulation from the Government's baseline, and then rescaled the baseline so that it equals the recorded emissions in 2020.
- **Uncertainty in the baseline.** The Net Zero Strategy baseline is presented with a 95% confidence interval range,* generated by propagating uncertainties from macroeconomic trends (such as GDP, population size and fuel prices) as well as structural uncertainty in the EEP. The uncertainty is determined for the total economy-wide baseline. The percentage uncertainty determined this way is then assumed to apply to the baseline in each of the individual sectors (excluding engineered removals). The assumption that the percentage uncertainty is the same for all sectors is unlikely to be valid as dependencies on macroeconomic trends are likely to differ between sectors.
- **Uncertainty in the pathway.** The uncertainties in the pathways, in all sectors apart from engineered removals, originate from the baseline uncertainties. The absolute uncertainty (in MtCO₂e) on the emissions pathway is assumed to be the same as that on the baseline, implying that abatement from policies in the Net Zero Strategy is unaffected by changes to the baseline and has no uncertainty attached to it. In reality, many types of policy would result in abatement that scales with the baseline, resulting in a smaller change to the pathway for emissions.
- **Comparing the Government and CCC baselines.** The adjusted Government's baseline is lower than the one used in our Sixth Carbon Budget analysis and is in better agreement with reported emissions in 2020 and 2021 (Figure B2.1).

- **Pandemic effects.** In 2020 this is largely because we did not model the impact of the COVID-19 pandemic across the economy, doing so only in the aviation and shipping sectors.
- **Buildings.** The CCC baseline starting point included a temperature adjustment to historical emissions based on an averaged 1981-2010 temperature rather than more recent trends, which leads to an overestimate of projected emissions.
- **Land use.** The Government's baseline included an updated value of peatland emissions from the 1990-2019 greenhouse gas inventory, published in 2021.
- **Waste.** The CCC waste baseline was based on the 1990-2019 and the Government's on the 1990-2018 greenhouse gas inventories.
- **Fuel supply.** The Government's baseline was based on an updated projection of oil and gas production from the OGA.

Figure B2.1 Comparing Government and CCC baselines



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. IAS is included.

Notes: *A 95% confidence interval range means it is estimated that there is a 95% probability that the true value is within the quoted range.

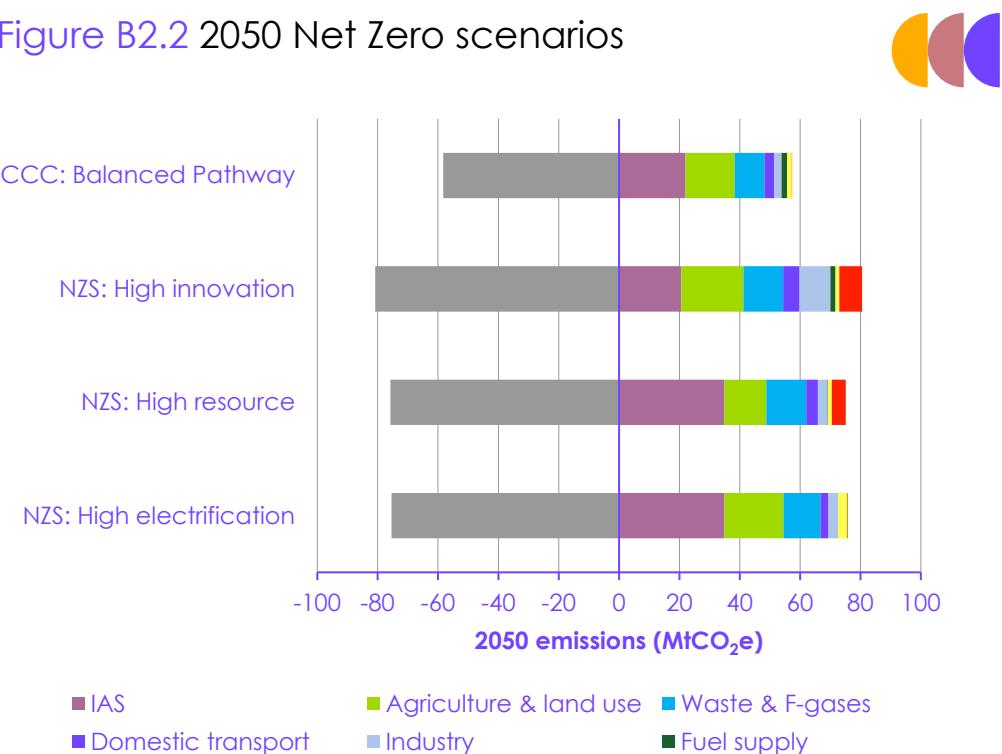
Box 2.3

The Government's Net Zero scenarios in 2050

The Government's Net Zero Strategy presents three illustrative 2050 Net Zero scenarios (Figure B2.2). The Government's pathway only goes to 2037 and does not connect up to these scenarios in 2050.

- The three scenarios have varying dependence on how technologies develop over the next two decades:
 - **High electrification scenario** – widespread adoption of electrification.
 - **High resource scenario** – a significant contribution to meeting heat demand in buildings with hydrogen, with a heavy dependence on fossil gas and carbon capture and storage (CCS).
 - **High innovation scenario** – balance of electricity and hydrogen sits in between the other two scenarios. Successful innovation in aviation and Direct Air CCS (DACCs) result in a reduction in emissions.
- Compared to the CCC's Balanced Pathway, all three of the Government's Net Zero Strategy scenarios have a higher reliance on engineered removals and aviation technology, making them relatively high-risk (Figure B2.2).
- In the CCC's pathway, UK deployment of engineered removals is enabled by shifting to diets with less meat and dairy, in order to free up land for afforestation and biomass to be used with CCS (i.e. BECCS). The Government's Net Zero Strategy scenarios are likely to rely much more on imported biomass, which could leave less sustainable biomass resource available for decarbonisation elsewhere in the world and/or place more pressure on land use globally. This reliance on imported biomass will not be possible unless there is a strong international mechanism on sustainability in place.

Figure B2.2 2050 Net Zero scenarios



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*.

Notes: Global warming potentials from IPCC AR5 with feedback are used. Sectors are as defined in the Government's Net Zero Strategy.

Source: BEIS (2021) *Net Zero Strategy: Build Back Greener*.

Box 2.4

Emissions reduction ambition in Scotland, Wales and Northern Ireland

While the majority of the UK's emissions occur in England, there are important contributions from Scotland, Wales and Northern Ireland, which each have their own emissions reductions targets (Table B2.1).

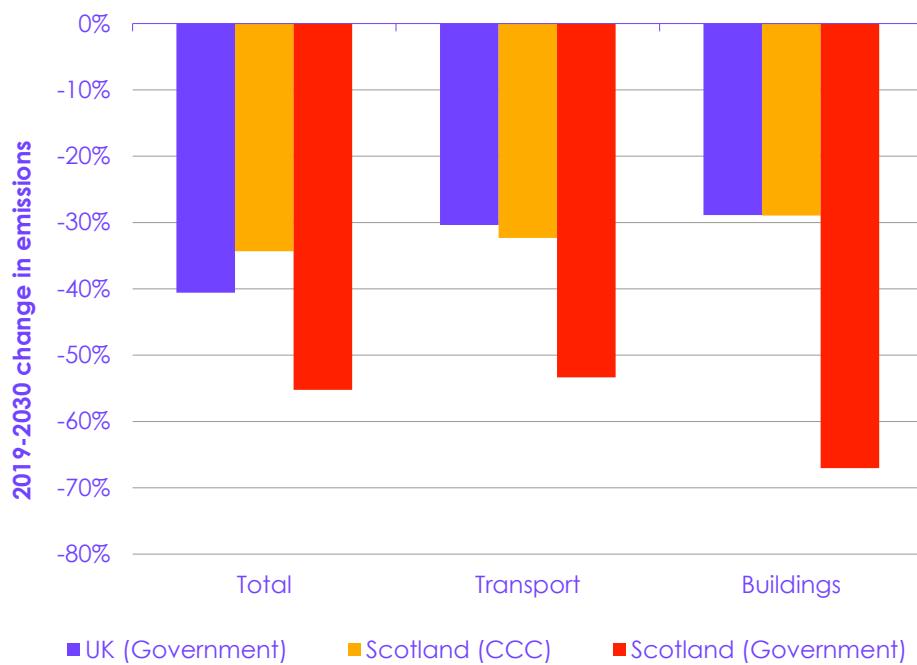
- **Scotland.** The 2045 Net Zero target in Scotland is in line with the CCC's advice. However, Scotland's 2030 target is considerably more ambitious than we advised and has major delivery risks.⁵ In December 2020, the Scottish Government published an update to its Climate Change Plan,⁶ presenting a pathway to 2032 meeting the legislated targets.
 - The Plan aims to achieve the 2030 target by including engineered removals and going further than the CCC's Balanced Pathway in almost all sectors, particularly in buildings and transport, which also see much more rapid decarbonisation than in the UK as a whole (Figure B2.3).
 - There is a stronger focus on a modal shift in surface transport and on energy efficiency in buildings than in the UK as a whole.
- **Wales.** The targets in Wales are in line with the CCC's advice. In October 2021, Wales published its Second Welsh Carbon Budget (2021-2025),⁷ outlining plans for policy delivery to cut Welsh emissions and setting the foundations for the Third Carbon Budget (2026-2030) and 2030 interim target. There is a stronger focus on demand-side measures than in the UK's Net Zero Strategy, including plans for modal shift in transport and a policy proposal to encourage a shift towards lower-emission diets.
- **Northern Ireland.** In June 2022, Northern Ireland received Royal Assent for its first Climate Change Act, setting a 2050 Net Zero target.* The Act includes a 2030 target in line with the CCC's advice (Table B2.1). The Act also establishes an obligation for the Northern Irish Executive to set a 2040 target and annual emissions targets to 2050, as well as sequential five-year carbon budgets. Northern Ireland's 2050 Net Zero target is significantly more ambitious than the CCC pathway, which sees an 82% reduction on 1990 emissions by 2050, with residual emissions largely in the agriculture and land use sector.

Table B2.1

Emissions targets in Scotland, Wales & Northern Ireland compared to the UK

	UK	Scotland	Wales	Northern Ireland
% of 2019 UK emissions	100%	9%	8%	5%
Net Zero target	2050	2045	2050	2050
2030 target (% change from 1990)	-68% (NDC excludes IAS)	-75%	-63%	-48%
2030 in CCC's pathway (% change from 1990)	-64%	-64%	-62%	-50%
2030 target (% change from 2019)	-46% (NDC excludes IAS)	-55%	-46%	-35%
2030 in CCC's pathway (% change from 2019)	-38%	-34%	-44%	-38%
Notes: Global warming potentials from IPCC AR5 without feedback are used. International aviation and shipping (IAS).				

Figure B2.3 Planned change in UK and Scottish emissions, 2019-2030



Source: NAEI (2022) Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2020; CCC (2020) The Sixth Carbon Budget; BEIS (2021) Net Zero Strategy: Build Back Greener; Scottish Government (2020) Securing a Green Recovery on a Path to Net Zero: climate change plan 2018-2032 – update; CCC analysis.

Note: Global warming potentials from IPCC AR5 without feedback are used.

Note: *The CCC wrote a letter to the Northern Ireland Government on this legislation in March. This letter can be found on our website: <https://www.theccc.org.uk/publication/letter-northern-irelands-climate-change-bill/>.

2. The proposed UK ETS cap

The Government's proposed UK ETS cap is tighter than that recommended by the Committee, which is appropriate given the Government's pathway.

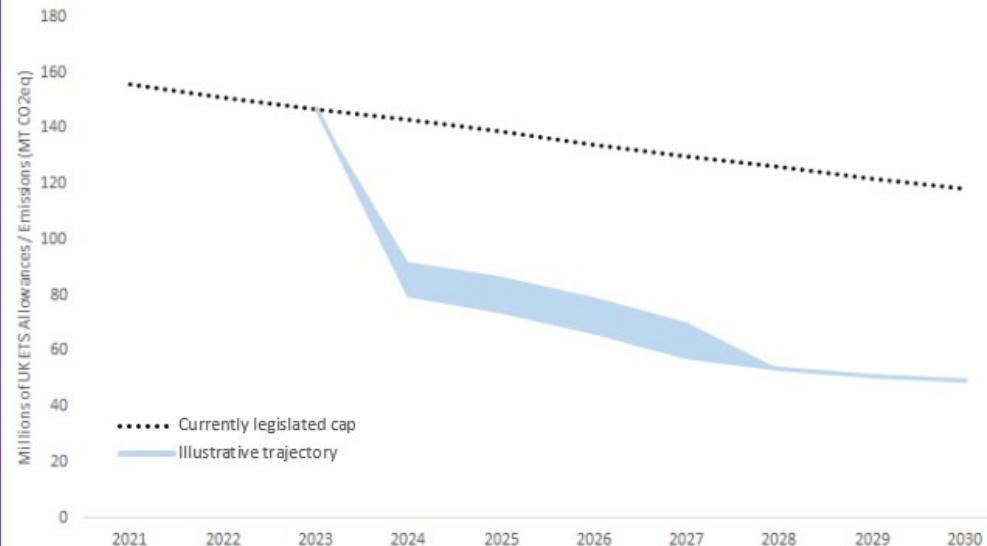
In March 2022, the Government published a consultation, **Developing the UK Emissions Trading Scheme (UK ETS)**, which set out the proposed path for the UK ETS cap out to 2030. The consultation also contains questions or calls for evidence in a range of specific sectors (Box 2.5)

The existing UK ETS cap is not consistent with the path to Net Zero. In proposing the new cap, for implementation in 2024 (Figure 2.4), the intention is to bring it into line with the path for allowed emissions over the period to 2030 in the delivery pathway of the Net Zero Strategy. Due to a different balance of sectoral emissions in the Government's pathway compared to that in our Balanced Pathway (e.g. the Government pathway has lower projected emissions from electricity generation), the proposed UK ETS cap is tighter than that recommended by the Committee.⁸ This is appropriate, given the pathway set out in the Net Zero Strategy.

However, prior to implementation of the new cap, which is much tighter than that currently in place, a considerable excess of allowances is accruing. This excess was 48 MtCO₂e in 2021, given actual emissions were 108 MtCO₂e,⁹ and the emissions cap was 156 MtCO₂e (Figure 2.4). These allowances are likely to be released by participants and Government to help towards meeting the future, more stringent cap, which means that the downward path for emissions will not be as low as it appears.

The new, much more stringent, UK ETS cap is aligned to the Net Zero Strategy, but early oversupply will effectively allow a shallower path for emissions in the 2020s.

Figure 2.4 UK Emissions Trading Scheme cap: current and proposed



Source: BEIS, Welsh Government, Scottish Government, DAERA (2022), *Developing the UK Emissions Trading Scheme (UK ETS)*, Figure 1.2.

Notes: Dotted line: currently legislated cap, which is not consistent with delivering Net Zero, will remain in place until end 2023. Blue: illustrative trajectory, represented as a range.

Box 2.5

Sectoral calls for evidence in the UK ETS consultation

- **Aviation.** The consultation summarises a 2021 call for evidence on the free allocation policy for aviation and the economic impacts of carbon pricing on the aviation sector. It consults on how sustainable aviation fuels (SAF) are treated under the UK ETS, the potential to include non-CO₂ effects under the scheme in the long-term, and expanding the flights covered to include UK-Switzerland routes. It also reiterates that the Department for Transport is continuing to consider how the UK ETS should interact with the Carbon Offsetting and Reduction Scheme for Aviation (CORSIA). See Chapter 9 for more detail.
- **Waste.** The document sets out proposals to include fossil CO₂ emissions from incineration and Energy from Waste (EfW) plants within the scope of the ETS – which would meet a Committee recommendation from 2021. Such a move could strengthen incentives to reduce fossil inputs to incineration/EfW and support future investment into CCS. However, there needs to be careful consideration of the specific challenges around applying a carbon price to emissions within the waste sector – such as where the costs will fall and ensuring consistency with the waste hierarchy. See Chapter 11 for more context.
- **Free allocation.** The Government consulted on plans to extend the current approach to the allocation of free allowances until the end of 2025 and indicated it may implement a revised approach from 2026. See Chapter 14 (carbon leakage section) for further detail.

Source: BEIS, Welsh Government, The Scottish Government, Department of Agriculture, Environment and Rural Affairs (Northern Ireland) (2022) *Developing the UK Emissions Trading Scheme (UK ETS)*.

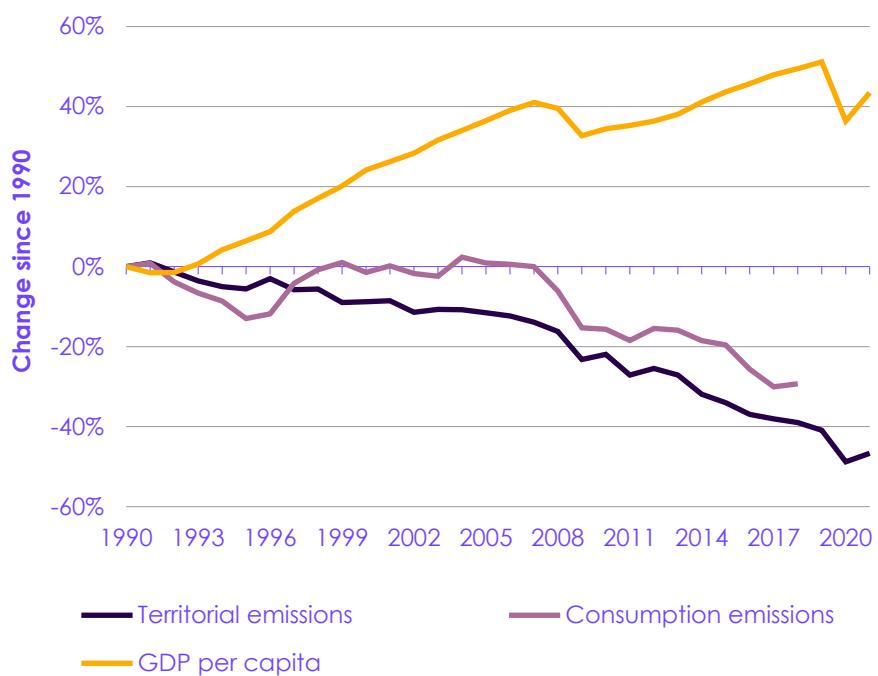
3. Progress in reducing UK emissions

In this section we discuss progress in reducing the UK's greenhouse gas emissions. We cover both territorial emissions (those occurring within the boundaries of the UK plus the UK's share of international aviation and shipping) and consumption emissions (those associated with the production, transportation, use and disposal of products and services by UK households, no matter where in the world the emissions occur). Under UK Carbon Budgets and the Paris Agreement, the UK's greenhouse gas emissions reduction targets are based on territorial emissions.*

The UK's greenhouse gas emissions are falling on both a territorial and consumption basis whilst GDP grows (Figure 2.5). The dip in 2020 in both GDP and emissions is due to the COVID-19 pandemic, which has partially rebounded for both in 2021.

UK territorial emissions have been falling steadily with emissions in 2021, 47% below 1990 levels, primarily due to the phase-out of coal. UK consumption emissions have been falling the last 10 years, with emissions in 2018 29% below 1990 levels.

Figure 2.5 The UK's historical emissions and GDP



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; Defra (2021) UK's Carbon Footprint 1997-2018; ONS (2022) GDP & population data; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. International aviation and shipping (IAS) is included.

* International aviation and shipping (IAS) are only included from the Sixth Carbon Budget and are dealt with separately in UN accounting.

Recent progress reducing UK territorial emissions

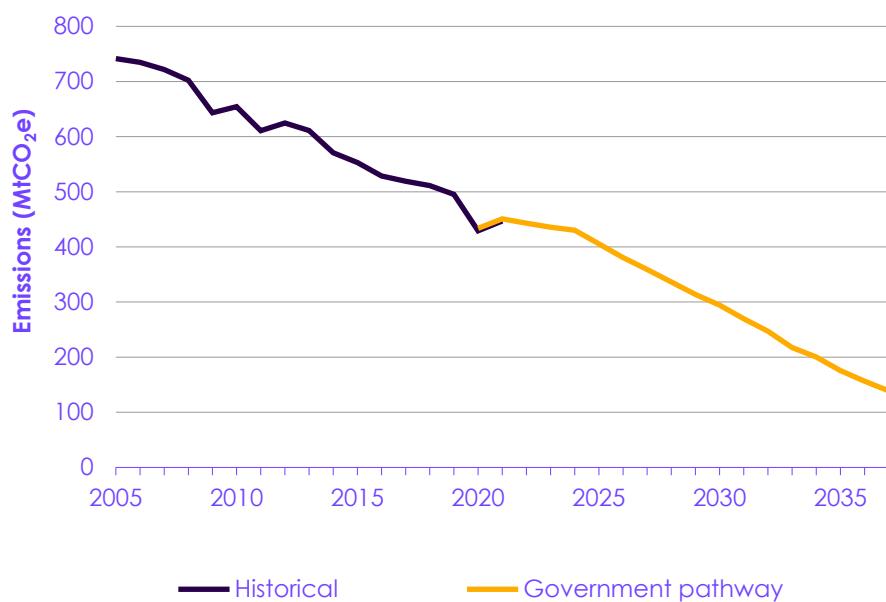
Emissions in 2020. Emissions were 429 MtCO₂e in 2020, a decrease of 13% since 2019, compared to an average fall of 2% per year in the previous ten years (Figure 2.6), due to the pandemic affecting travel and demand. There was an increase in (temperature-adjusted*) buildings emissions due to increased home-working (Figures 2.7 and 2.8).

Emissions in 2021. A provisional estimate of 2021 emissions (Box 2.6) is 447 MtCO₂e, 4% above 2020 levels, but remaining 10% below 2019 levels (Figure 2.6). There has been only a partial rebound in emissions, with aviation emissions remaining particularly low (Figures 2.6 and 2.7). It is unclear what the long-term impact of the pandemic will be.

Government pathways compared to reported emissions. Total emissions in 2020 and 2021 are close to the Government's pathway (Figure 2.6). Sectoral emissions are generally also close (Figure 2.7) except for electricity,[†] where emissions in 2021 were 15 MtCO₂e higher than the Government's pathway. This was due to exceptionally low wind levels, higher than expected nuclear outages, and the modelled rate of gas phase down being faster than reality. It is not clear how much this discrepancy will persist into the 2020s.

UK territorial emissions increased by 4% in 2021 after the COVID-19 pandemic but are still 10% lower than 2019 values. The Government's pathway agrees well with total emissions.

Figure 2.6 UK historical emissions compared to the Government's pathway



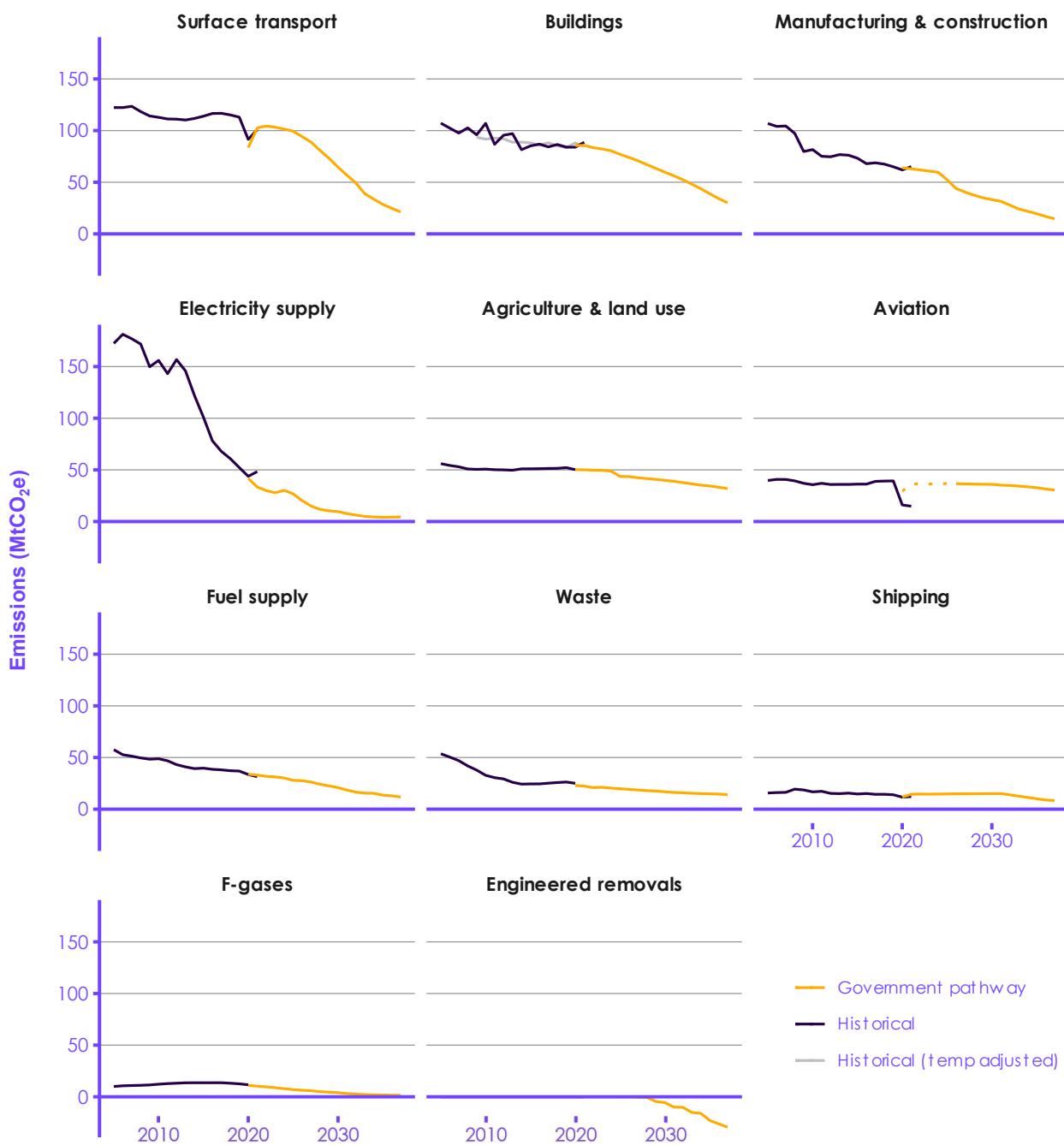
Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; BEIS (2021) Net Zero Strategy: Build Back Greener; DfT (2022) Jet zero: further technical consultation; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. International aviation and shipping (IAS) is included.

* Temperature-adjustment removes the year-to-year effects of differing winter weather conditions on emissions. We updated our approach to temperature-adjustment of emissions this year – see Box 4.1 in Chapter 4 for details.

† Emissions in aviation are lower than the Government's estimate in 2021. Due to the uncertainty of the pandemic, Government did not provide an aviation pathway in the early 2020s. The estimate is only used to obtain the total.

Figure 2.7 UK historical emissions compared to the Government's pathway by sector

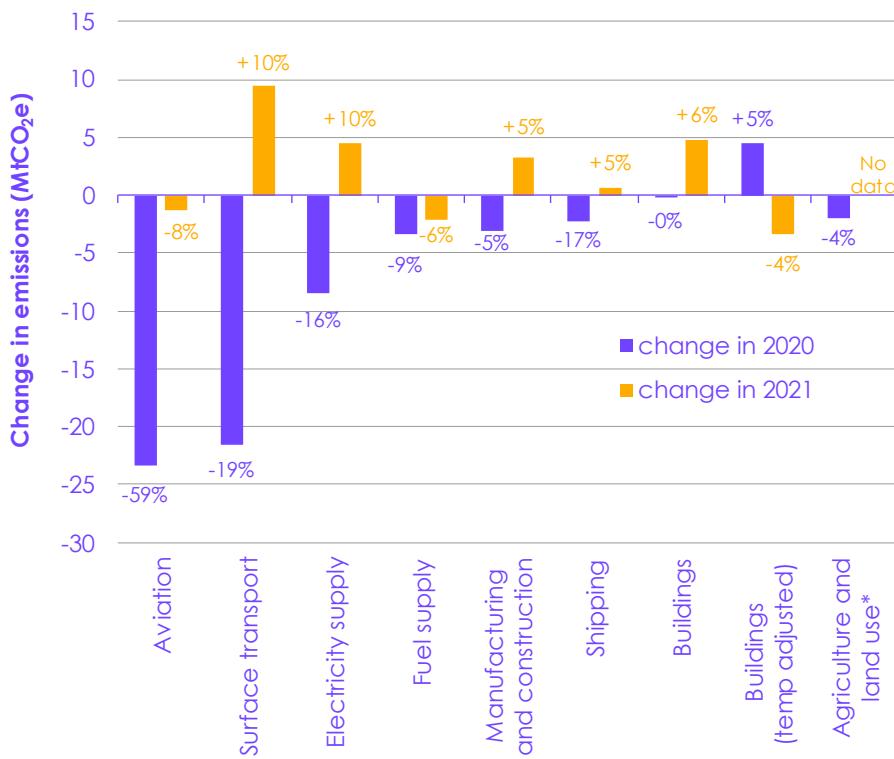


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; BEIS (2021) Net Zero Strategy: Build Back Greener; DfT (2022) Jet zero: further technical consultation; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. The aviation pathway published by the Government starts in 2025 but the earlier years were estimated by Government in order to get a total emissions pathway. We show this estimation as a dashed line.

Emissions in 2020 reduced compared to 2019 largely due to a significant reduction in the transport sectors alongside smaller reductions elsewhere. There has been a partial rebound in 2021, with emissions from the transport sectors still remaining lower than in 2019.

Figure 2.8 Change in UK emissions 2019-2021



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. *Provisional 2021 estimates are not made for non-CO₂ greenhouse gases, so the change in 2021 agriculture and land use emissions is not shown.

Box 2.6

The provisional estimate of UK emissions in 2021

BEIS has published a provisional estimate of emissions for 2021 that covers most sources, based on various analytical approaches. To produce a more complete estimate of UK emissions, the CCC has added its own estimate for international aviation and shipping emissions, based on official statistics.

Estimates provided by BEIS:

- **CO₂ emissions in the major 'energy system' sectors.** These are based on fuel consumption data, and therefore account for the impacts of the pandemic (electricity supply, buildings, manufacturing and construction, fuel supply, surface transport and domestic aviation and shipping).
- **CO₂ emissions from other sectors.** CO₂ emissions that are not associated with the combustion of fossil fuels are held constant from their final estimates for 2019 (mostly in waste, agriculture and land use).
- **Non-CO₂ emissions.** These are assumed to fall in line with the latest BEIS emissions forecasts for 2020 to 2021. This simple approach does not capture any impact of the pandemic.

Estimates made by the CCC:

- **International aviation and shipping.** The CCC has produced a provisional independent estimate of the UK's share of international aviation and shipping emissions based on fuel sales data in 2021.¹⁰

These estimates for 2021 are all provisional and will vary to some extent from the final BEIS data for 2021, which will be published in 2023.

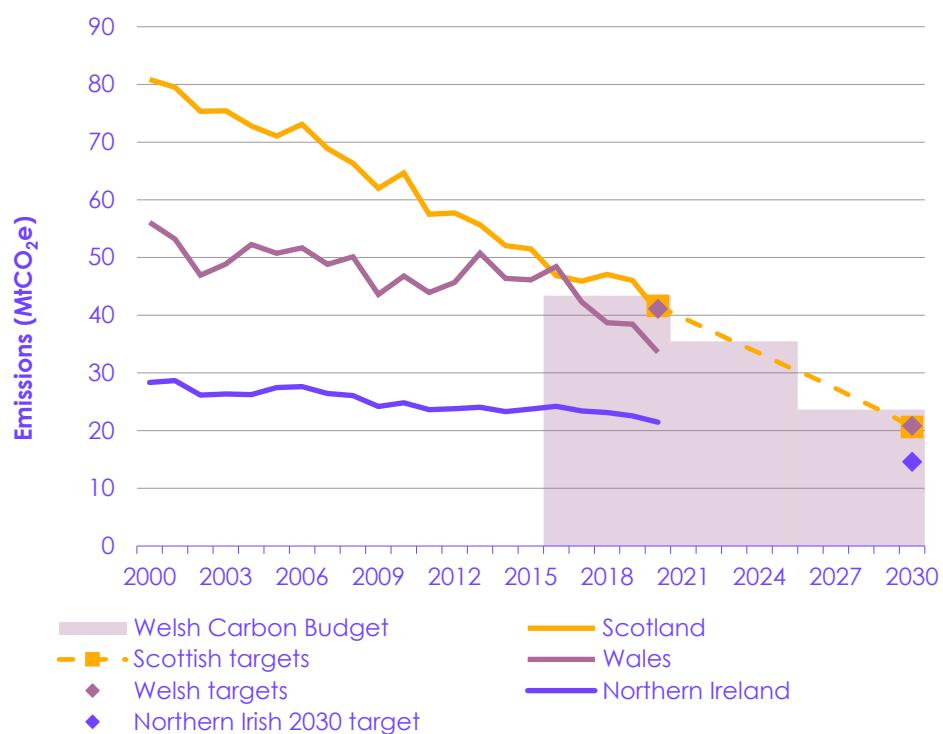
Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021.

Emissions in Scotland, Wales and Northern Ireland

Scotland, Wales and Northern Ireland (where the latest emissions data is less recent than for the UK) all saw a decrease in 2020 emissions compared to 2019, primarily coming from the surface transport sector. Significant progress in the sectors outside electricity supply will be needed for the devolved administrations to be on track to meet their targets (Figure 2.9). There was mixed progress up to 2019:

- Emissions in Scotland have fallen significantly between 2000 and 2020, by almost 50%.
- Progress has been much slower in Wales over this period, although it has seen a rapid reduction since 2015 and is likely to have met its First Carbon Budget (2016-2020) and 2020 target* (Figure 2.9). The reductions are primarily from the electricity supply sector.
- Progress has also been slow in Northern Ireland, largely due to agriculture being the dominant sector and emissions remaining fairly flat (Figure 2.10).

Figure 2.9 Emissions in Scotland, Wales and Northern Ireland compared to targets

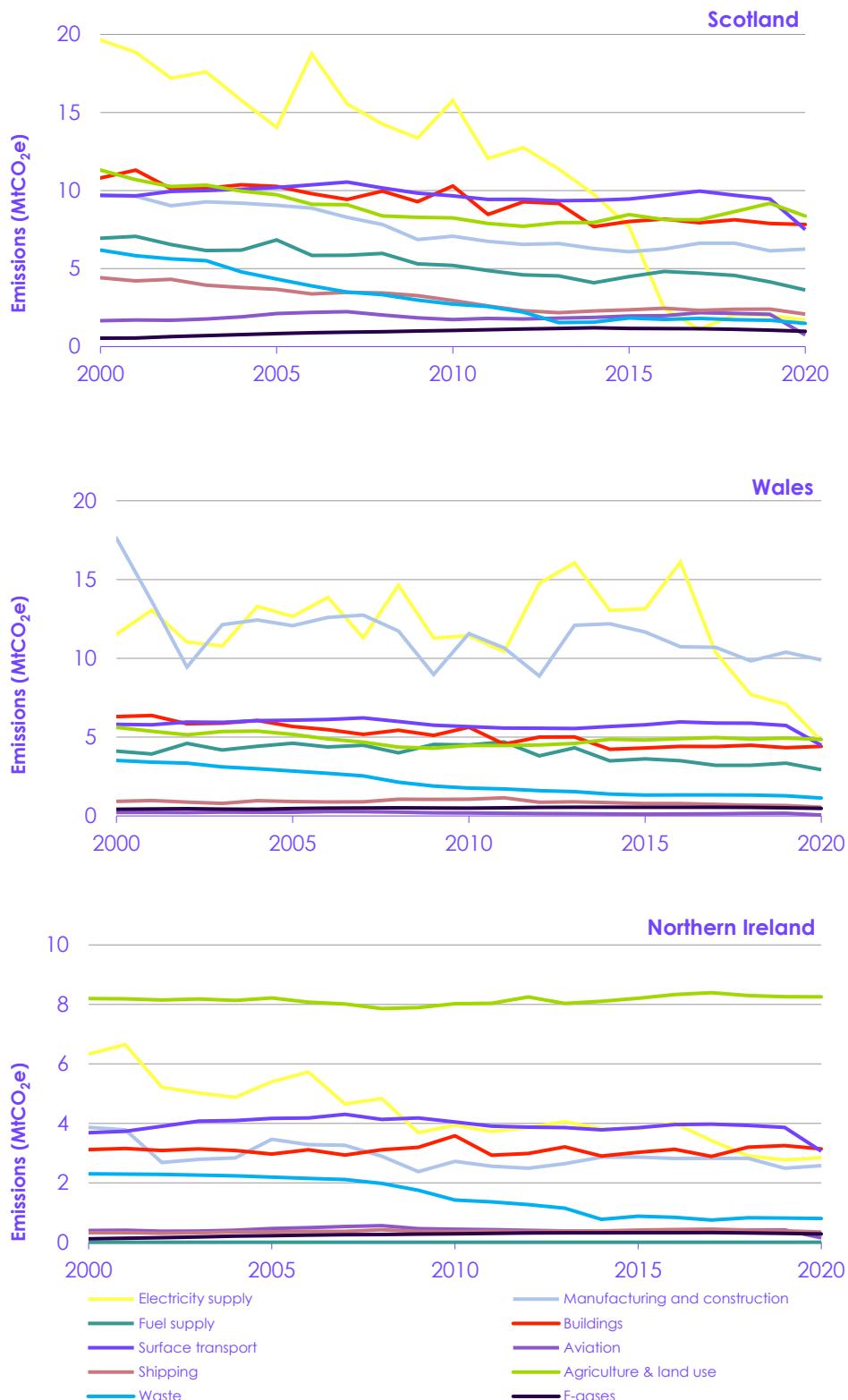


Source: NAEI (2022) Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2020; Scottish Government (2021) Securing a Green Recovery on a Path to Net Zero: climate change plan 2018-2032 – update; Northern Irish Assembly (2022) Climate Change (No.2) Bill; Welsh Parliament (2021) The Climate Change (Interim Emissions Targets) (Wales) (Amendment) Regulations 2021; CCC analysis.
Note: Global warming potentials from IPCC AR5 without feedback are used.

* The full Net Welsh Emissions Account, upon which Welsh legal targets are based, will be published in their legislative Statement of Progress in December.

Scotland, Wales and Northern Ireland all saw a decrease in 2020 emissions compared to 2019. Reductions prior to this were mostly in the electricity sector. Significant progress in all other sectors is needed.

Figure 2.10 Emissions in Scotland, Wales and Northern Ireland by sector



Emissions reductions in Scotland, Wales and Northern Ireland in 2020 were primarily in the transport sectors due to travel restrictions during the pandemic. Prior to this, emissions reductions were largely in the electricity supply sector.

Source: NAEI (2022) Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2020; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedbacks are used.

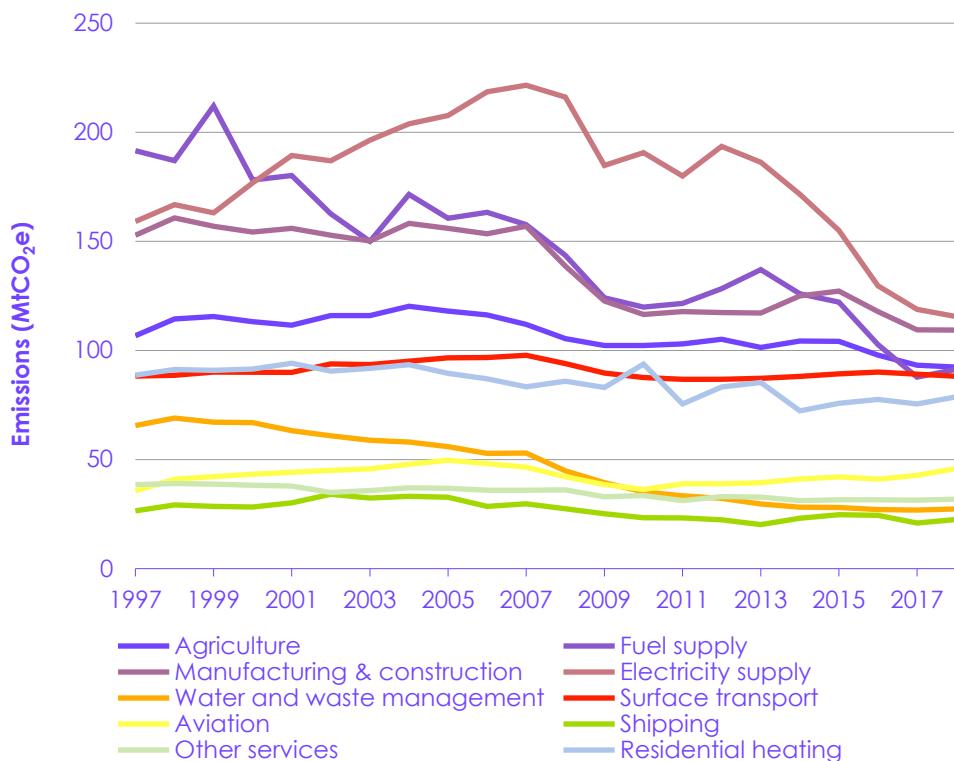
Progress reducing UK consumption emissions

Emissions in 2018. UK consumption emissions were estimated at 703 MtCO₂e in 2018 (11 tCO₂e per person),* 39% more than UK territorial emissions and an estimated 1% increase from 2017 due to small increases in emissions from fuel supply, aviation and residential heating.[†] This was against an average fall of 2% per year since 2010, mainly driven by the electricity and fuel supply sectors, following a substantial fall from 2007-2009 around the time of the financial crisis (Figures 2.5 and 2.11). Over the period 2010-2018, emissions associated with imports fell by 1% per year on average (see Chapter 14, Figure 14.14).

Future monitoring. We do not currently track UK consumption emissions against an indicator pathway but intend to set one out in the coming year, against which we will track future progress (see Chapter 14, section on Trade, Carbon Leakage and Reducing Consumption Emissions). As part of our future monitoring, we will consider the effects of trade policy, international leadership and energy and resource efficiency policy.

Reductions in UK consumption emissions in the last decade have been primarily in the electricity and fuel supply sectors.

Figure 2.11 Consumption emissions by source sector 1997-2018



Source: Defra (2021) UK's Carbon Footprint 1997-2018, CCC analysis.

Notes: Other services include food and drink, health, public administration and defence, real estate, education. F-gases are spread across sectors.

* The latest data available at time of writing. 2019 emissions data due for publication in late June. Consumption emissions statistics are published with a longer lag than territorial emissions. The UK consumption footprint data does not include emissions associated with land use, land use change and forestry.

† There are large uncertainties in reported consumption emissions so short-term trends should not be overinterpreted.

4. Indicators of progress

This year we have changed our approach to progress monitoring, with more focus on real-world indicators of progress.

Good progress can be seen in electric vehicle sales and deployment of renewable energy. However, we are not seeing the necessary progress in many other areas.

This year we have changed our approach to monitoring, with more focus on real-world indicators of progress. Our accompanying Monitoring Framework includes a comprehensive list of these indicators. Recent progress against key indicators is shown in the following chapters. Progress against the full set of indicators is shown in the supporting data to this report.

Measuring progress is a pre-requisite to successful delivery. In this report we refresh our monitoring framework, aiming to improve our ability to assess whether sufficient progress is being made in delivering the UK's path to Net Zero. Outside the bright spots of electric car sales and renewable electricity deployment, we have not seen the necessary tangible progress in a host of areas. In other areas, it is still too early to say whether progress is sufficient, while for others insufficient data are available (Table 2.2). More detail is given in the following sectoral chapters.

The Government has committed to an annual monitoring report, in which it will check progress against its key commitments (on p.254 of the Net Zero Strategy). It will summarise key areas of progress and comment on any contextual changes that may affect its pathway. The Government should use this to set out plans for how barriers or issues will be resolved, and shortfalls addressed.

Table 2.2

Summary of progress against key indicators

Surface transport	Electricity supply	Buildings	Manufacturing and construction	Agriculture and land use
BEV car sales	Offshore wind, installed	Energy demand	Sector territorial emissions	Agriculture CH ₄
EV cars sales	Onshore wind, installed	Energy efficiency retrofits	Sector consumption emissions	Agriculture N ₂ O
BEV van sales	Solar PV, installed	Non-res buildings energy intensity	Carbon intensity of energy	New woodland
EV van sales	Grid emissions intensity	Low-carbon heat supply	Material and product use	Woodland management
ICE car intensity	Unabated gas generation	Heat pump installations	Steel: energy efficiency	Peat restoration
ICE van intensity	Low-carbon flexible capacity	Heat pump costs	Paper: energy efficiency	Energy crops
Charge points	Nuclear	Electricity to gas price ratio	Low-carbon fuel use	Farmer action
Car km	Flexible demand	Heat networks	Industrial hydrogen project pipeline	Crop yields
Van km	Onshore networks	Retrofit coordinators	Industrial CCS project pipeline	Livestock numbers
HGV km	Offshore networks	Willingness to replace boiler	Average embodied carbon of buildings	Meat consumption

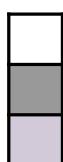
Key:



On track

Slightly off track

Significantly off track



Too early to say

Data not reported

No benchmark or target

Notes: An indicator is on track if it is going in the right direction at an appropriate rate. This is determined either by comparing to a quantified pathway/benchmark, using data from 2019, 2020 and 2021, where available.

EV = electric vehicle, BEV = battery-electric vehicle, ICE = internal combustion engine.

5. Assessment of policies and plans

There are significant risks to meeting the 2030 NDC, the Sixth Carbon Budget and the ultimate goal of Net Zero in 2050.

In this section we assess the Government's policies and plans, including delivery and implementation. Overall, good progress has been made since our 2021 Progress Report,¹¹ but there are still significant risks to meeting the UK's emissions reduction targets, particularly the 2030 NDC, the Sixth Carbon Budget and the ultimate goal of Net Zero in 2050. To mitigate these risks, Government should start to prepare currently lacking policy options for travel demand management, a shift to low-carbon diets and energy efficiency in non-fuel poor homes.

In order to assess if policies and plans are sufficient to achieve the Government's pathway up to the Sixth Carbon Budget, we have attempted to quantify the emissions reductions expected from the Government's various policies and proposals. This is based on details in the Net Zero Strategy and further clarifications we have received from the Government but we recommend that the Government publish a clear breakdown of the policy savings it has assumed in the Net Zero Strategy. The policies and plans associated with each measure are then assessed to determine if they are credible and on track, according to the criteria outlined in Table 2.3.

It is quite proper that plans for near-term emissions reduction are more certain than those for the longer term. Meeting the carbon budgets is an evolving task, requiring constant evaluation of policy effectiveness and real-world change. We do not, therefore, expect full and final plans to be in place for all emissions reductions to 2037. However, progress in the next few years is essential and must take due account of uncertainty.

If delivered in full, the Government's pathway would slightly outperform the Sixth Carbon Budget in part due to accounting changes since the budget was recommended. This is an appropriate aim, given possible future changes in emissions estimation methods and uncertainties on future macroeconomic trends affecting the pathway, as highlighted in the range presented in the Net Zero Strategy.

In this report, we assess the risks relating to delivery of the Government's pathway and the Sixth Carbon Budget, tracking progress against the Government's stated objectives, informed by the CCC's independent analysis of potential pathways. We find a mixed picture, with either significant risks or a policy gap for 38% of the required emissions reduction to meet the Sixth Carbon Budget (Figure 2.12):

- **Credible plans exist for 39% of the required emissions reduction**, with funding, enablers and timelines in place. This comes predominantly from the zero-emission vehicle mandate and renewable electricity supply.
- **There are some risks attached to 24% of the required emissions reduction**, where changes are needed to mitigate delivery risks. These include policies to address price disparity in car charging, zero-emission HGVs, flexible low-carbon electricity generation, decarbonising new homes, and policies for industrial CCS and hydrogen, especially for dispersed sites.

- **There are significant risks attached to 33% of the required emissions reduction**, where plans are either under development without a clear timeline for next steps or need further work to mitigate a significant delivery risk. These include, in particular, policies for a market-based mechanism for low-carbon heat in homes, industrial resource efficiency, peatland restoration, and for the necessary infrastructure, CO₂ storage sites and funding mechanisms for engineered removals.
- **Plans are either completely missing or currently clearly inadequate for 5% of the required emissions reduction.** This is a particular problem for low-carbon farming practices, the UK's strategy for biomass, energy efficiency in non-fuel-poor homes, and industrial electrification.

There are currently significant risks in the plans for meeting the UK's 2030 NDC under the Paris Agreement process (which has greater ambition than the Fifth Carbon Budget for 2028-32), and for the Sixth Carbon Budget (2033-37). Prospects for meeting the Fourth Carbon Budget (2023-27) are better although this will depend to some extent on near-term macroeconomic trends and the extent to which emissions rebound following the COVID-19 pandemic. At present, that is uncertain. It should also be noted that meeting the Fourth Carbon Budget is not sufficient to be on track for the later targets.

The view of the Committee is that the policy framework is not yet fully in place to drive the large programme of delivery required within this decade.

The view of the Committee is that the policy framework is not yet fully in place to drive the large programme of delivery required within this decade. There is time to complete this, but it is imperative that the Government does so in the next year, as implied by the Net Zero Strategy.

Within this overall picture, the surface transport and electricity supply and F-gas sectors are well placed to deliver the necessary emissions reductions, while in other sectors there are more substantial risks to delivering the Government's emissions pathway (Figure 2.13, Table 2.4). Delivery will be required across all sectors to meet the NDC and Sixth Carbon Budget, on the way to Net Zero.

Table 2.3

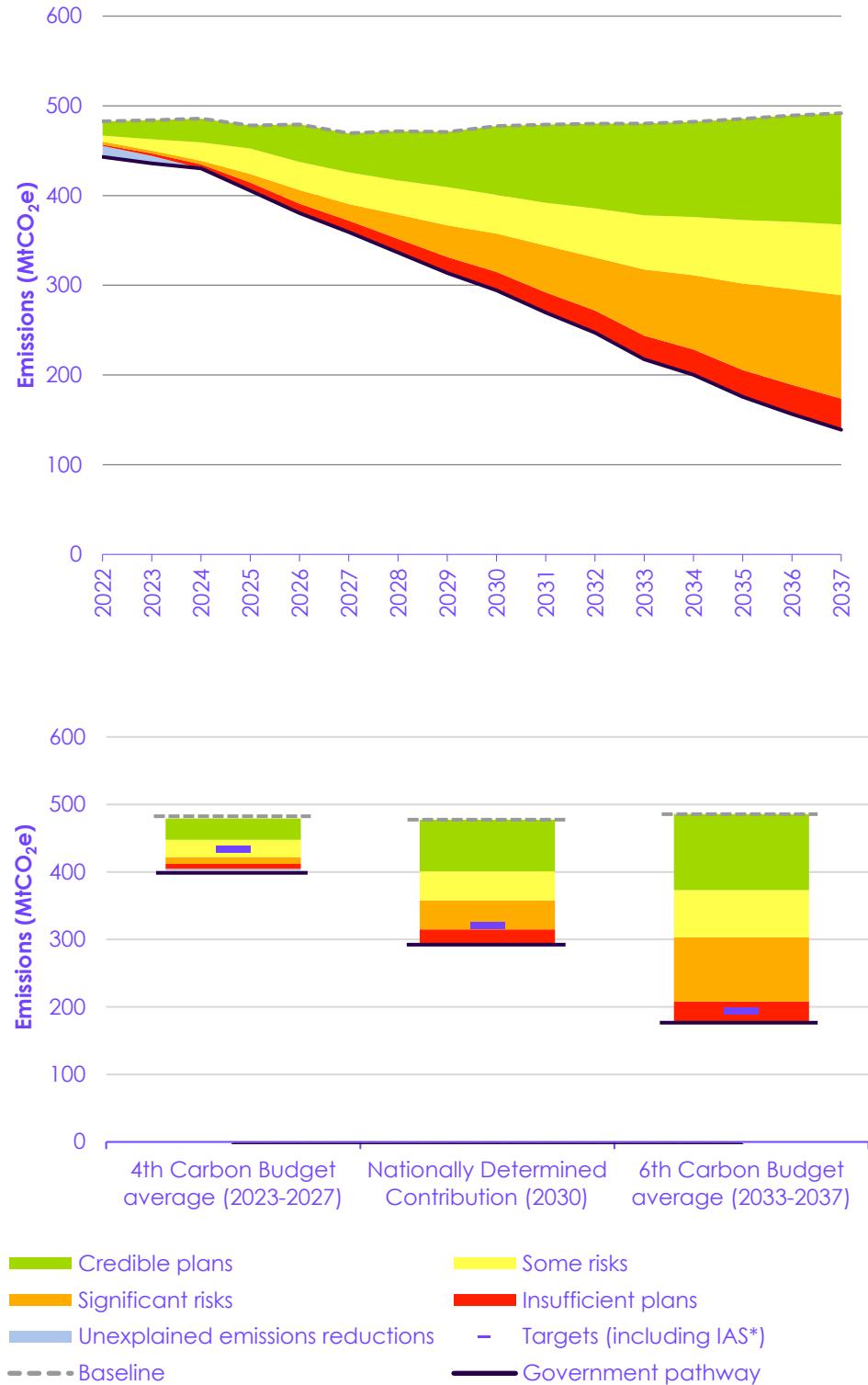
Scoring criteria for assessing policies and plans

	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future plans	Overall score
Credible plans	Proven delivery mechanism that covers all the important elements in the sector	The combination of public funding and plans to encourage private funding is credible	Plans consider enablers, such as governance, fair funding, public engagement, and workers & skills; potential barriers are overcome	Appropriate timelines are given for future decisions and policy development	Credible plans with funding, enablers and timelines in place
Some risks	Mostly based on proven delivery mechanism, but missing a small number of key elements	Combination of public funding and plans to encourage private funding are credible, but some risks remain	Plans consider some, but not all, of the enablers and/or some barriers remain	Timelines are proposed for some future decisions and policy development, but questions remain	Some adjustment to plans may be needed to mitigate uncertainties and delivery or funding risks
Significant risks	Some plans based on proven mechanism, but several key elements are missing	Some funding commitments but unclear where significant part of the funding will come from	Plans do not address significant key enablers and barriers	Plans provide only partial indication of the timeline for future decisions and policy development	Plans under development and/or further work needed to enact policies and overcome uncertainties and delivery or funding risks
Insufficient plans	No comprehensive plan or strategy; or plan/strategy missing most key elements	Unclear where the bulk of funding will come from; not yet considered incentives to address these	Plans give negligible consideration of the enablers and barriers	Plans do not indicate when gaps will be filled, or when future decisions will be made	Plans are either missing, clearly inadequate, or lack funding, and new proposals are needed

Notes: (1) The policy gap analysis is produced by analysing a mix of announced policies and measures, depending on the information the Government has chosen to make publicly available; (2) In some cases, scores may change later in the period to 2037, depending on how the policy landscape changes for the subsector/measure.

There are significant risks to meeting the 2030 NDC and the Sixth Carbon Budget, while meeting the Fourth Carbon Budget has some risks.

Figure 2.12 Assessment of policies and plans

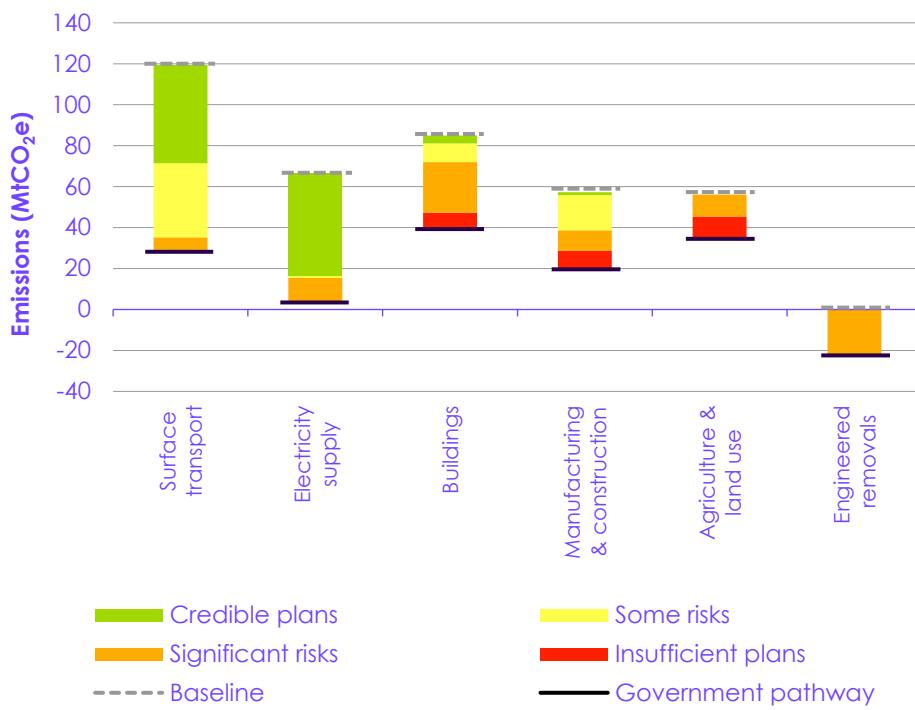


Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. *International aviation and shipping (IAS); for comparability, we added the Net Zero Strategy IAS pathway values to CB4 and the NDC. The baseline is an adjustment to the Government's Net Zero Strategy baseline, with the impact of some policies removed so that they can be assessed. The unexplained emissions reduction is emissions reduction that could not be attributed to a plan published by the Government.

Credible plans are mostly in the surface transport and electricity supply sectors
existing policies, with significant risks in all other sectors.

Figure 2.13 Assessment of policies and plans in 2035 for key sectors



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used. The Carbon Budgets and the NDC have been adjusted to include international aviation and shipping (IAS) to enable a direct comparison with the Government's pathway. The baseline is an adjustment to the Government's Net Zero Strategy baseline, with the impact of some policies removed so that they can be assessed. The unexplained emissions reduction is emissions reduction that was not attributed to a plan published by the Government.

Table 2.4

Summary policy scorecard for sectors up to the Sixth Carbon Budget

Sector	Change in emissions: 2019-2035	Delivery mechanism and responsibilities	Funding and other incentives	Enablers in place / barriers overcome	Timeline for future policies	Overall sector assessment
Surface transport	-84 MtCO ₂ e	G	Y	O	G	Y
Electricity supply	-48 MtCO ₂ e	G	G	Y	Y	G
Manufacturing & construction	-45 MtCO ₂ e	O	O	O	O	O
Buildings	-45 MtCO ₂ e	O	O	O	O	O
Fuel supply	-23 MtCO ₂ e	Y	Y	O	Y	Y
Engineered removals	-23 MtCO ₂ e	N/A	Y	O	O	O
Agriculture & land: sources	-18 MtCO ₂ e	R	O	R	O	R
Agriculture & land: sinks		O	O	O	O	O
Waste	-11 MtCO ₂ e	O	O	O	O	O
F-gases	-11 MtCO ₂ e	G	G	G	G	G
Aviation	-7 MtCO ₂ e	O	Y	Y	O	O
Aviation (in 2050)	-23 MtCO ₂ e (2019-2050)	R	O	R	O	R
Shipping	-4 MtCO ₂ e	O	Y	O	Y	O

 Credible plans

 Some risks

 Significant risks

 Insufficient plans

 Not applicable

Notes: The scores in this table are an average of the sub-sector scores, weighted by that sub-sectors contribution to required emissions reduction in 2035. Occasionally our judgement is used to moderate the average score.

6. Progress against last year's recommendations

In our 2021 Progress Report, we made 283 recommendations to the various departments that have been scored in this report. Recommendations with a timing for action within the last year are scored as either: achieved; partly achieved; underway; or not achieved. Those of an ongoing nature are scored as either: making sufficient progress; making some, but insufficient, progress; or making no progress.

Scores of each recommendation are available in the material accompanying this report and discussed in the following chapters. A summary by department is given in Figures 2.14 and 2.15.

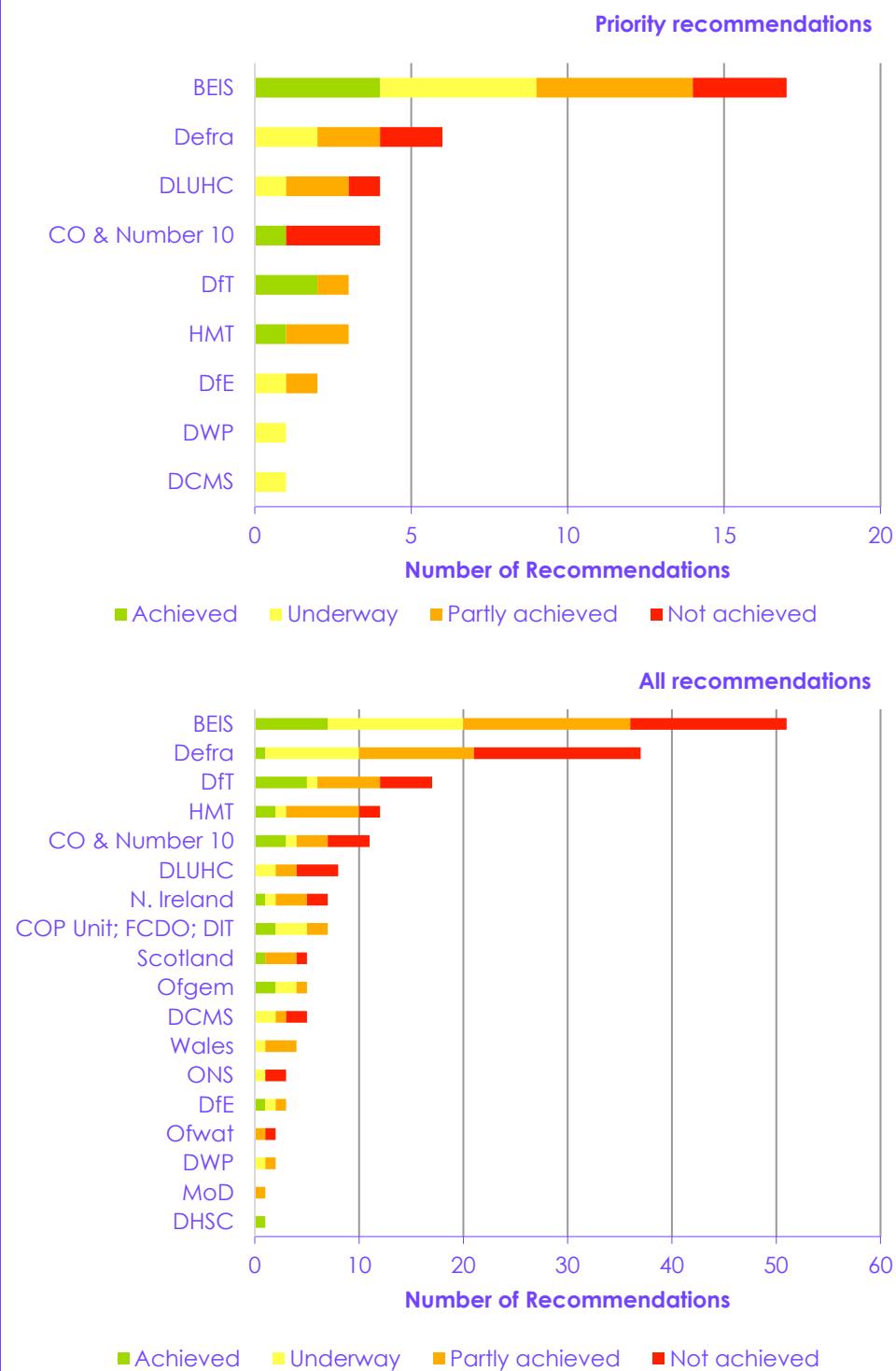
We continue to see indications of a multi-speed Government with DLUHC and Defra lagging behind.

We continue to see indications of a multi-speed Government:

- **The Department for Business, Energy and Industrial Strategy (BEIS).** The publication of the Net Zero Strategy is a big step forward, as is the commitment on low-carbon electricity supply by 2035, but a long-term strategy for the latter is missing. No apparent progress has been made on a public engagement strategy to support the transition to Net Zero.
- **The Department for Transport (DfT)** has made good progress in supporting electric vehicle sales. However, there has been only limited progress in encouraging a modal shift for transport and, most notably, no progress on addressing aviation demand and no action in response to our recommendation to assess airport capacity.
- **The Department for Levelling Up, Housing and Communities (DLUHC).*** No recommendations have been achieved in full. Local government is still not sufficiently supported and there has been insufficient progress in ensuring buildings standards are fit for purpose and properly enforced.
- **The Department for Environment, Food & Rural Affairs (Defra).** No priority recommendations have been achieved in full. In general progress on agriculture and land use remains slow and partial. We have limited information on plans to decarbonise the waste sector.

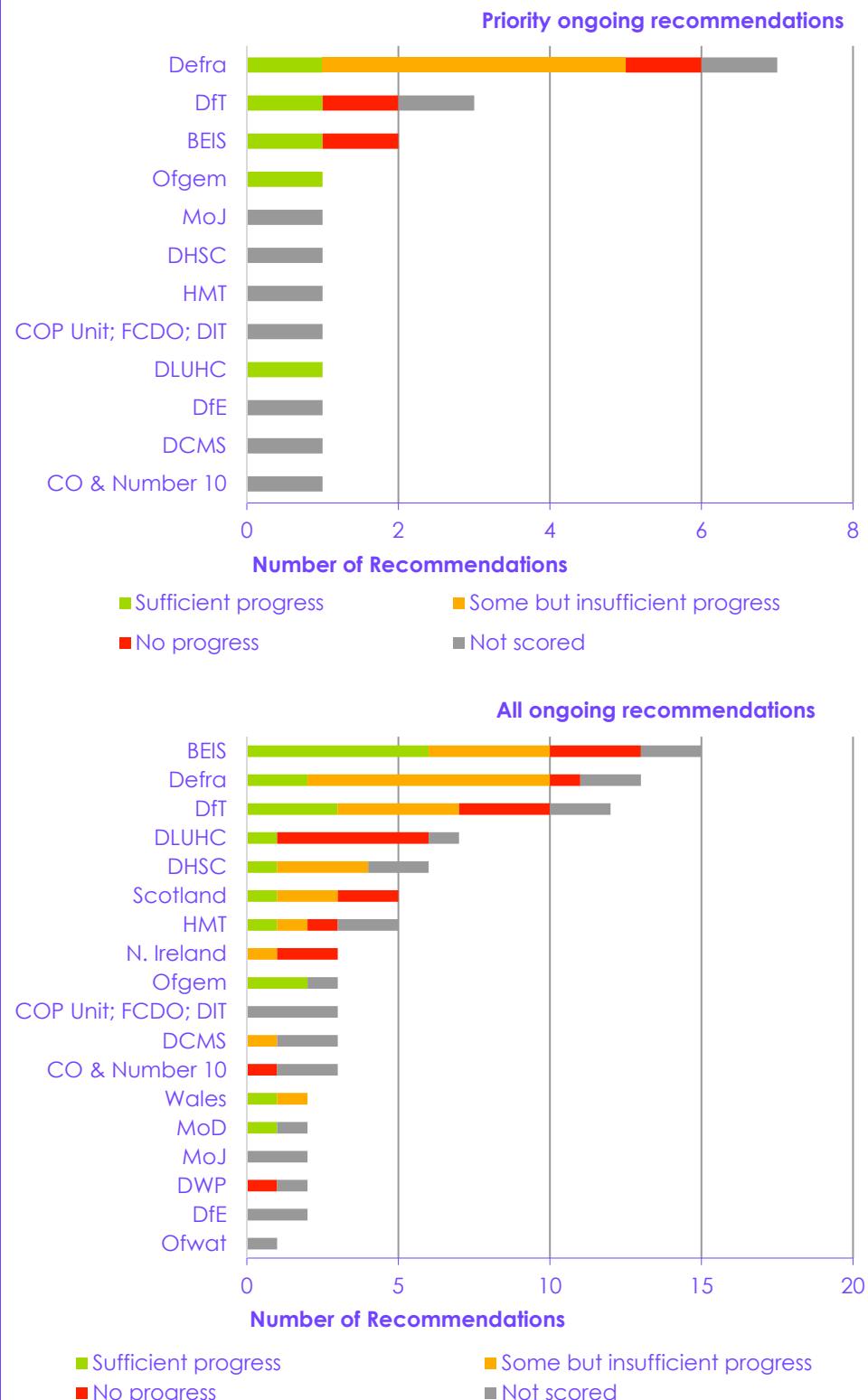
* The Department for Levelling Up, Housing and Communities was known as the department for Ministry of Housing, Communities & Local Government (MHCLG) at the time of the 2021 UK Progress report.

Figure 2.14 Scores of 2021 departmental recommendations expected to be achieved this year



Source: CCC analysis.

Figure 2.15 Scores of 2021 departmental ongoing recommendations



Source: CCC analysis.

Notes: In some cases the recommendations have not been scored. This is explained for each recommendation in the accompanying material to this report. For example, some are about the next National Adaptation Programme, which we cannot score until after this is published in 2023.

7. Recommendations and risks

The following sectoral and cross-cutting chapters of this report identify various actions required to complete the UK policy framework for, and to deliver, Net Zero. Our recommendations to each department are available as an Annex to this report and in sortable and filterable tables in our accompanying webpage. The Executive Summary provides a summary of the priority recommendations by department.

We also identify various risks to delivery across the sector and cross-cutting chapters. These are also summarised in the Executive Summary.

Endnotes

¹ BEIS (2021) *Net Zero Strategy: Build Back Greener*,

<https://www.gov.uk/government/publications/net-zero-strategy>.

² BEIS (2021) *North Sea Transition Deal*, <https://www.gov.uk/government/publications/north-sea-transition-deal>.

³ CCC (2022) *Independent Assessment: The UK's Heat and Buildings Strategy*,

<https://www.theccc.org.uk/publication/independent-assessment-the-uks-heat-and-buildings-strategy/>.

⁴ BEIS (2020) *Updated energy and emissions projections: 2019*,

<https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019>.

⁵ CCC (2021) *Progress reducing emissions in Scotland*,

<https://www.theccc.org.uk/publication/progress-reducing-emissions-in-scotland-2021-report-to-parliament/>.

⁶ Scottish Government (2020) *Securing a green recovery on a path to net zero: climate change plan 2018–2032 – update*, [https://www.gov.scot/publications/securing-green-recovery-path-netzero-update-climate-change-plan-20182032/documents/](https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/documents/).

⁷ Welsh Government (2021), *Net Zero Wales Carbon Budget 2 (2021-2025)*, <https://gov.wales/net-zero-wales-carbon-budget-2-2021-2025>.

⁸ CCC (2021) *Letter: UK Emissions Trading Scheme and CORSIA*,

<https://www.theccc.org.uk/publication/letter-uk-emissions-trading-scheme-and-corsia/>.

⁹ UK Emissions Trading Registry (2021) *Compliance Report*, <https://reports.view-emissions-trading-registry.service.gov.uk/ets-reports.html>.

¹⁰ BEIS (2022) *Energy Trends: UK oil and oil products March 2022*,

<https://www.gov.uk/government/statistics/oil-and-oil-products-section-3-energy-trends>.

¹¹ CCC (2021) *2021 Progress Report to Parliament*, <https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/>.



Chapter 3: Surface transport

101 MtCO₂e, 23% of UK emissions, in 2021

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Introduction and key messages

Surface transport is the largest source of UK emissions, with emissions relatively flat prior to the pandemic. The Government aims to change this by phasing out sales of conventional cars and vans by 2030, alongside supporting actions. Progress on electric vehicles has been particularly encouraging in the last year, with sales of electric cars ahead of the Committee's trajectory. Notable policy progress has been made on surface transport in the last year and should be further strengthened next year, especially to support active travel and public transport.

This chapter reviews progress in reducing emissions from the UK surface transport sector and outlines the next steps required to deliver these key outcomes and meet future carbon budgets.

Our key messages are:

- **Electric vehicle market.** The pivotal outcome for this sector is for electric vehicle uptake to grow rapidly through the 2020s so that sales of new petrol and diesel cars and vans end by 2030. The market is currently growing well.
 - Fully electric car sales grew substantially to 12% of the new car market in 2021, with around 191,000 being sold. This is ahead of the trajectory required (8%), although this is within a depressed overall new car market. Electric van sales are also beginning to scale up, growing by 87% over the past year, albeit from a low level.
 - There are now over 28,000 public charge points across the UK, with 7,600 of these having been added to the network in the past year. This rate of deployment will need to increase substantially to meet the Government's commitment to at least 300,000 by 2030. Provision also needs to become more consistent across the country.
- **Electric vehicle policy.** There has been strong progress on mechanisms to deliver the transition to electric vehicles, through the commitment to introduce a zero-emission vehicle (ZEV) mandate from 2024 and the publication of a strategy for deployment of public charging infrastructure. The focus should now be on delivering an effective mandate, with annual targets that are sufficiently strong to drive on progress from the strong uptake to date.
 - The implementation of the mandate should ensure that electric vehicles (EVs) are produced based on sustainable and ethical supply chains and that the emissions embedded within EV production are minimised. This could include incentivising sale of smaller vehicles and introducing regulations requiring reusability and recyclability of batteries.
 - Further Government intervention in this subsector should focus on putting in place the conditions to enable this market to continue to scale up rapidly and equitably. This includes addressing market failures and barriers to EV uptake as these emerge, supporting retraining and upskilling to allow workers access to new job opportunities, and monitoring costs to ensure a fair transition across society.
 - The Government has also confirmed phase-out dates for new conventional buses and heavy goods vehicles (HGVs), which will ensure that all new vehicles must be fully zero-emission by 2040.

- **Limiting traffic growth.** Electric vehicles must not be the sole focus, with action also needed on demand and modal shift. The Government has made the significant step of acknowledging the need to limit traffic growth and has provided significant funding to some key areas, but it has not set a specific ambition or used all its available levers. It now needs to go further to set this aspect of the sectoral pathway in motion. Reducing traffic is important as it can offer immediate emissions reductions while the fleet is transitioning to ZEVs, reduce the emissions associated with ZEV production, and deliver a range of ongoing co-benefits including lower congestion, better air quality, and cost savings.
 - The car is the main mode of travel for almost three-fifths of journeys, while bus usage has fallen over the past decade as fares have risen faster than the costs of any other mode of transport. In the present context of high fuel prices and cost of living pressures, actions to provide affordable, appealing alternatives to car travel offer an opportunity to lower costs and reduce the UK's reliance on oil imports.
 - The UK Government and the devolved administrations should take actions to enable local places to design and implement transport systems that join together active travel, public transport, and shared mobility to provide consumers across the UK with options that can both reduce emissions and save them money.
- **Conventional vehicle efficiency.** Non-electric vehicles remain the most common choice of new cars and vans today, and are likely to make up nearly half of new sales between now and 2030. The average emissions from new petrol and diesel cars have risen for the past two years. Despite this, the Government is planning to introduce loose regulations on new car efficiency. As a minimum these should match the efficiency improvements required under EU legislation to avoid missing out on potential emissions improvements and to keep the transport sector on track.

This Chapter is set out in four sections:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

Surface transport emissions fell by 19% in 2020 due to lockdown restrictions. In 2021 emissions increased by 10% as travel rebounded.

Road transport is closer to pre-pandemic levels than public transport, which remains 20-30% lower. Increases in walking and cycling during lockdown periods continued during summer 2021.

The 29% smaller car market in 2021 was largely due to disruption to semiconductor supply chains and global economic impacts following the pandemic.

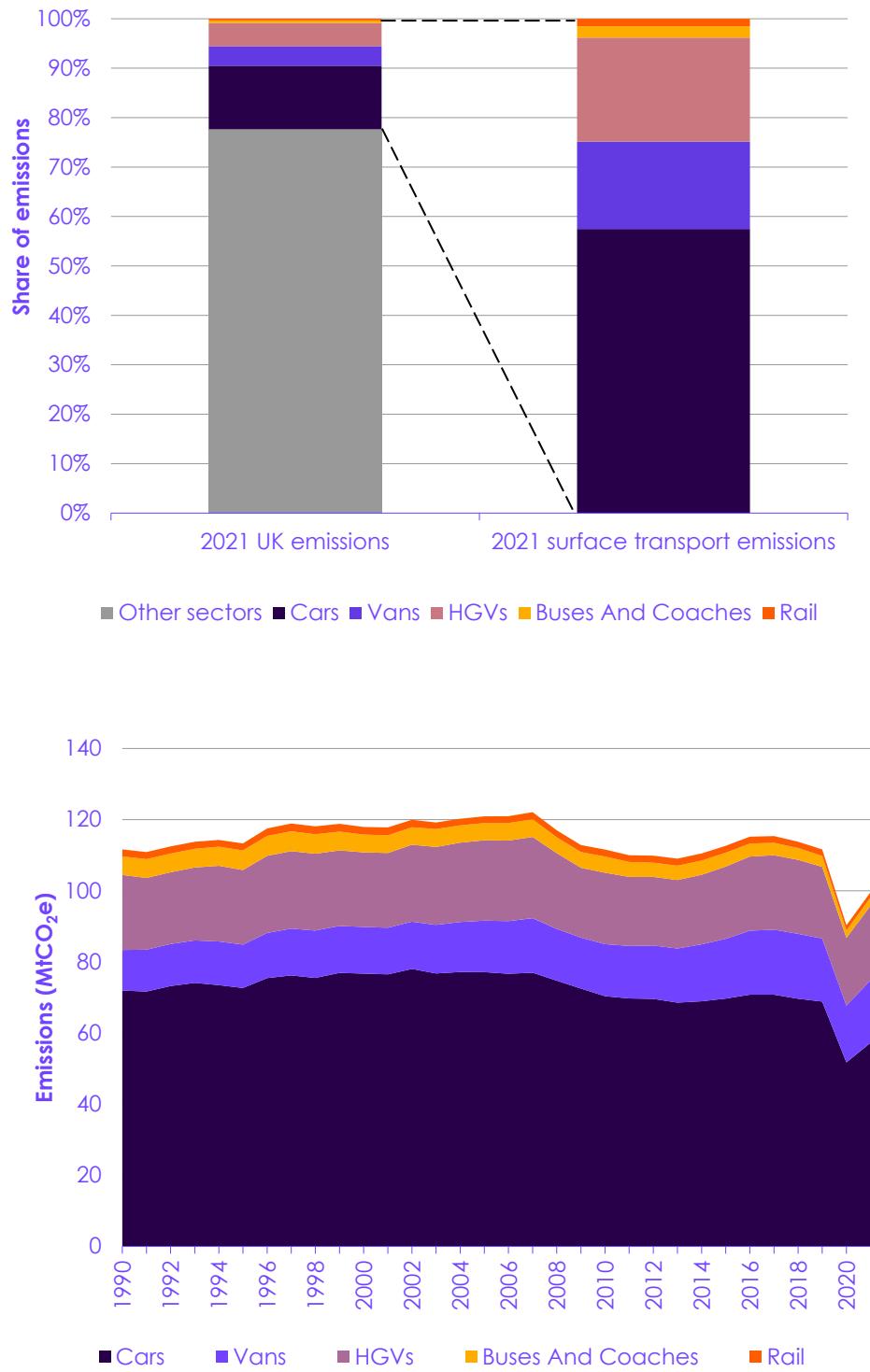
The surface transport sector contributed 23% (101 MtCO₂e) of total UK emissions in 2021, with cars being the biggest source of emissions (Figure 3.1).

- The flat trend in surface transport emissions between 2010 and 2019 was driven by trends towards both driving larger vehicles and driving more miles, which offset modest improvements in the efficiency of new cars.
- The dramatic 19% fall in surface transport emissions in 2020, as total road traffic fell by 76 billion vehicle-miles, was entirely due to travel restrictions and guidance in response to the COVID-19 pandemic (Figure 3.2). Emissions increased by 10% in 2021, but remained 11% below 2019 levels.
 - Overall vehicle traffic in 2021 remained lower in aggregate than before the pandemic, although car travel rebounded much more quickly and completely following the lifting of lockdown restrictions than public transport did.
 - Recent research¹ found that weekday peak car travel in October - November 2021 remained almost 10% lower than before the pandemic, despite GDP reverting to pre-pandemic levels. This shows that economic growth can be delivered hand-in-hand with reductions in car-dependence.
 - However, without proper policy to embed and build upon this, it is likely that overall road traffic will rebound to close to pre-pandemic levels from 2022 onwards. Moreover, the enduring suppressed demand for public transport represents a risk to the sector's ability to attract drivers away from cars.
 - Van and HGV traffic has rebounded to above pre-pandemic levels, driven largely by increases in home deliveries². This has exacerbated the substantial increases in urban delivery mileage over the decade prior to 2020. Options to mitigate this, including better consolidation loads, logistics measures, and the use of e-cargo bikes, should be explored to avoid detrimental impacts on congestion, air quality and emissions.
 - The number of people walking and cycling for leisure increased during lockdown periods. There is evidence³ that some of this, particularly increased walking, continued during summer 2021.
- Disruption to semiconductor supply chains and global economic impacts following the pandemic were key factors in the overall new car market in 2021 remaining 29% smaller than before the pandemic. If these challenges result in a permanently smaller car market, then the transition to electric vehicles (EVs) is likely to take longer, and emissions will be impacted, though the direction of change is uncertain and complex (Box 3.1).
 - There is also some evidence⁴ that a portion of this is due to households moving from two cars to one.

- Battery cell prices have consistently fallen year-on-year over the past decade, from \$914/kWh in 2011 to \$132/kWh in 2021. But supply chain issues, exacerbated by recent global events, have caused a surge in commodity prices in early 2022, leading battery prices to increase.⁵ Industry expectations^{6,7} are that this will be only temporary, and the long-term reducing trend in battery cell cost will resume within two years. It should be noted that commodity costs are also affecting conventional vehicle prices through the materials required for catalytic converters.

Surface transport is currently the UK's highest emitting sector, with cars being the biggest source of emissions.

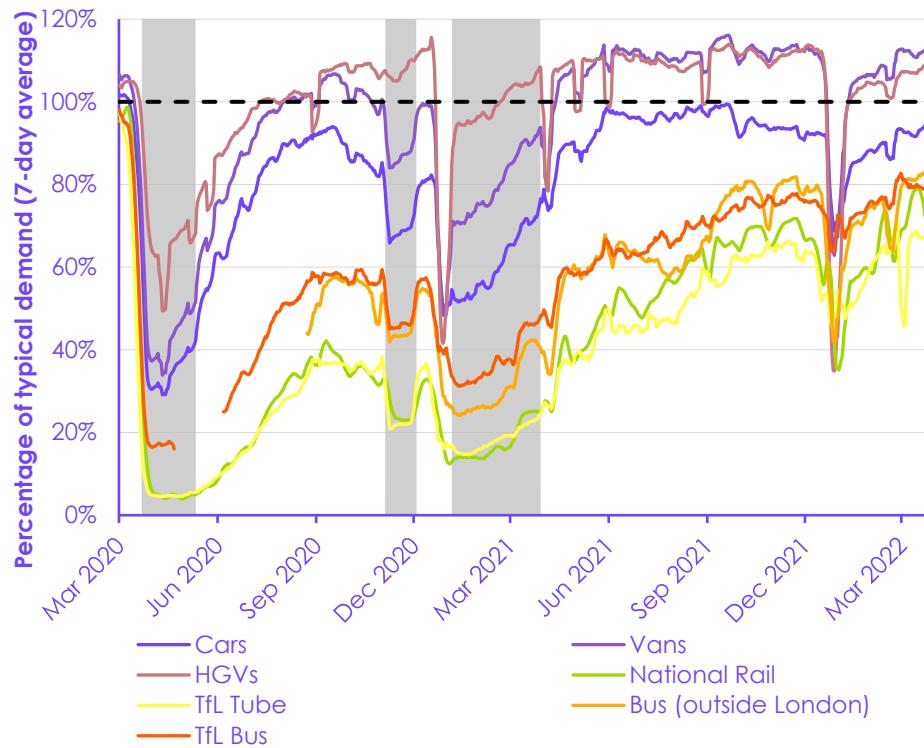
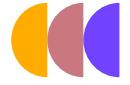
Figure 3.1 Surface transport emissions by subsector and as a share of UK total



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.
Notes: Global warming potentials from IPCC AR5 without feedback are used.

Travel on roads by cars, vans and HGVs rebounded more quickly than public transport.

Figure 3.2 Demand for travel by mode during the COVID-19 pandemic



Source: DfT (2021) Transport use during the coronavirus (COVID-19) pandemic; CCC analysis.

Notes: Figure shows travel relative to typical demand on an equivalent day pre-pandemic. For rail and TfL data, this equivalent day is the equivalent day of the same week in 2019, whereas for road transport and non-London bus travel, it is a day in early 2020. Therefore, these road and bus figures have not been normalised for any seasonality. The shaded regions represent the periods of national lockdown in England. TfL = Transport for London.

The overall impact of a smaller car market on emissions is uncertain. Fewer vehicles could reduce emissions, however it could take longer to switch over to EVs, which could increase emissions.

Box 3.1

The potential effects of lower overall car sales on emissions

New car sales in 2021 were 1% higher than in 2020, remaining 600,000 below 2019 levels. Certain popular brands, including Ford, appear to have been particularly badly impacted by post-pandemic supply chain disruptions. Industry sources⁸ anticipate these issues to continue affecting vehicle manufacture through much of 2022, before sales gradually recover. However, it is plausible that total car sales across the 2020s could be considerably lower than previously expected⁹, which could have a variety of impacts on emission projections.

- The production of fewer new cars per year would reduce the total embodied emissions associated with their manufacture. Furthermore, if this translates to a smaller overall car fleet, this could reduce overall vehicle-kilometres driven, also reducing total tailpipe emissions. If linked to a shift towards alternatives such as active travel, this could also bring a range of co-benefits including to health, congestion, and air quality.
- A smaller new car market means fewer new petrol and diesel vehicles entering the fleet today that will remain on the road well into the 2030s. However, it could also mean fewer EVs entering the fleet each year (e.g. for a given market share), and could lead to an older, less efficient fleet overall. If it takes longer to replace the fleet of existing petrol and diesel vehicles with EVs, and drivers choose to keep older cars for longer, then emissions will tend to be higher.
- In 2020 and 2021, it appears that lower sales have depressed the conventional car market more than the electric one. If this continues and growth in the new car market is driven primarily by EVs rather than a recovery for petrol and diesel vehicles, then this could further accelerate the EV transition.
- Constraints on the supply of new vehicles and robust resale values have led some fleet operators to extend contracts, delaying the point at which they sell their vehicles to the second-hand market. If continued, this could delay the supply of EVs to the used car market and make them more expensive when they do get there, potentially hindering EV availability and affordability for wide sections of society.

The overall impact of these changes on emissions and the pace of the EV transition is complex and uncertain. It emphasises the importance of a robust supply chain for EVs.

In the longer-term, investment in sustainable alternatives should aim to enable people to see the car only as one element of a wider transport ecosystem. A variety of shared mobility options are already growing. These include car-sharing schemes, ride-sharing apps, demand-responsive transit, and car clubs, whereby members can book shared vehicles when they need access to a car. In 2020, there were 229,000 active car club members across Great Britain,¹⁰ and for lower-mileage drivers these vehicles can already make financial sense. Such shared solutions should be seen as a valuable part of our future transport system, allowing communities to maximise their use of new active and public transport facilities but still providing access to a car when needed.

Different solutions are likely to be viable for urban and rural places. The Government should therefore work with local government to explore how to introduce and extend solutions that will work best for their communities. For instance, through inclusion in guidance to local authorities and better accommodation in the planning system, to provide consumers with alternatives to purchasing a private car. The current new car market challenges and high cost of petrol amplify the opportunities that this could provide.

2. Indicators of progress

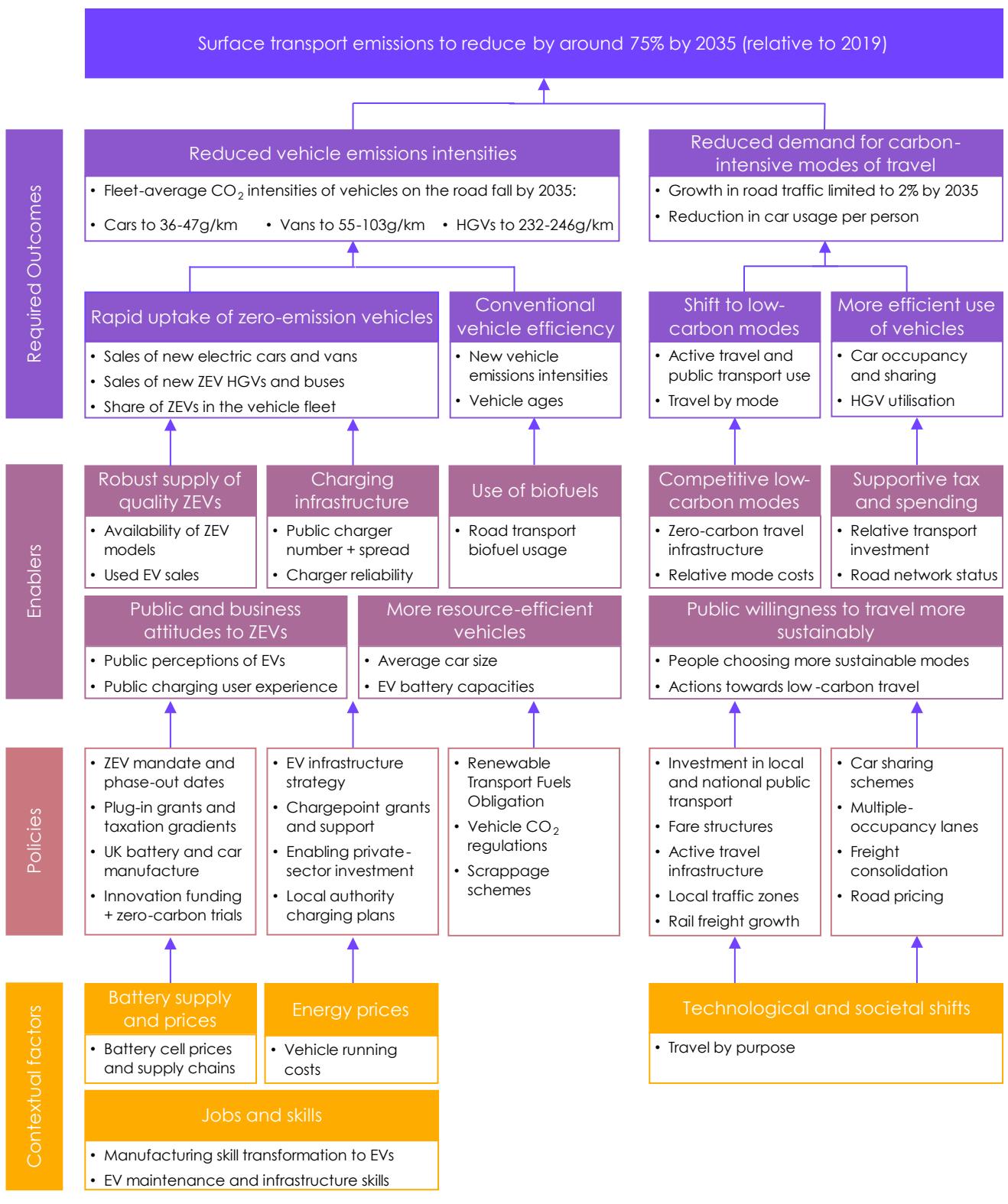
This section highlights some of the key indicators of progress within the surface transport sector. These show strong progress in early adoption of zero-emission technologies, but more concerning trends on demand for high-carbon travel.

The range of actions and conditions that combine to enable decarbonisation of surface transport is summarised in Figure 3.3. The details of how these work together to deliver the sector's decarbonisation pathway, along with a full set of data indicators designed to track each of these elements, are introduced in our accompanying Monitoring Framework, together with a high-level overview on what good policy should look like.

Progress this year on the key indicators is shown in Table 3.1 and Figures 3.4-3.12. Progress on the full set of indicators is shown in the supporting data to this report.

- Zero-emission vehicle sales are beginning to scale up at pace across a range of market segments (Figures 3.4-3.5). 2021 was a record year for electric cars, with battery-electric vehicles (BEVs) making up 12% of all new cars sold and plug-in hybrids (PHEVs) contributing a further 7%. This momentum appears to have continued into the early months of 2022.
 - Almost all major manufacturers have now committed to transitioning their supply chains to focus on EVs, and there are now over 50 models of electric car and ten models of electric van available (Figure 3.6). Furthermore, consumer knowledge of EVs has risen to 90% and intent to buy an EV has almost doubled over the past two years (Figure 3.7). These factors suggest that EVs are progressing towards mass-market appeal.
 - There are now almost 30,000 public EV charge points across the UK, with 7,600 added last year (Figures 3.8). The rate at which these are installed will need to increase quickly to meet the Government's commitment of at least 300,000 by 2030. The geographical distribution of charge points across the country is uneven (Figure 3.9), with Scotland and urban areas of south-east England considerably ahead of the rest of the country. Recent progress appears fastest in areas where provision is already strong.
- Demand for road travel had been steadily increasing until the pandemic (Figure 3.10). Lockdown restrictions led to bigger reductions in public transport than in car, van and HGV use.
 - Without policy action to embed a reduction in the need to travel or grow the availability of alternative lower-carbon modes, the reductions seen during the pandemic are likely to be relatively transient.
- The Government has stated ambitions to increase participation in walking and cycling (Figure 3.11) and expand the use of rail freight (Figure 3.12). Meeting these will require effective policy to enable people and businesses to shift journeys away from higher-carbon modes of travel.

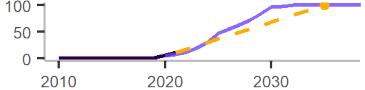
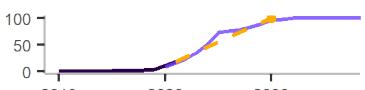
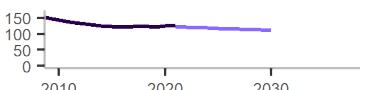
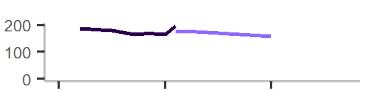
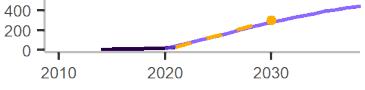
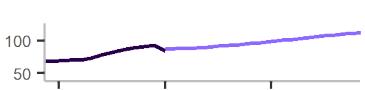
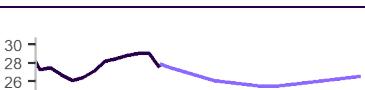
Figure 3.3 Monitoring map for surface transport



Source: CCC analysis; milestones based on Net Zero Strategy and CCC pathways.

Table 3.1

Surface transport key indicators

Surface transport indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Zero-emission vehicle uptake	Battery Electric Vehicles - % of new car sales	2021	12%; CCC benchmark: 7.7%	+78% from 2020	
	All plug-in Electric Vehicles - % of new car sales	2021	19%; CCC benchmark: 15%	+75% from 2020	
	Battery Electric Vehicles - % of new van sales	2021	3.6%; CCC benchmark: 8%	+87% from 2020	
	All plug-in Electric Vehicles - % of new van sales	2021	3.8%; CCC benchmark: 11%	+87% from 2020	
Vehicle efficiency	New Internal Combustion Engine car CO ₂ intensity	2021	130 gCO ₂ /km; CCC benchmark: 120	+1% from 2020	
	New Internal Combustion Engine van CO ₂ intensity	2021	200 gCO ₂ /km; CCC benchmark: 180		
Electric vehicle charging infrastructure	Number of public charge points	2021	28 thousand; CCC benchmark: 39	+37% from 2020	
Travel demand	Km travelled by cars	2020	350 billion km; CCC benchmark: 430	-25% from 2019	
	Km travelled by vans	2020	84 billion km; CCC benchmark: 87	-9% from 2019	
	Km travelled by Heavy Goods Vehicles	2020	27 billion km; CCC benchmark: 28	-6% from 2019	

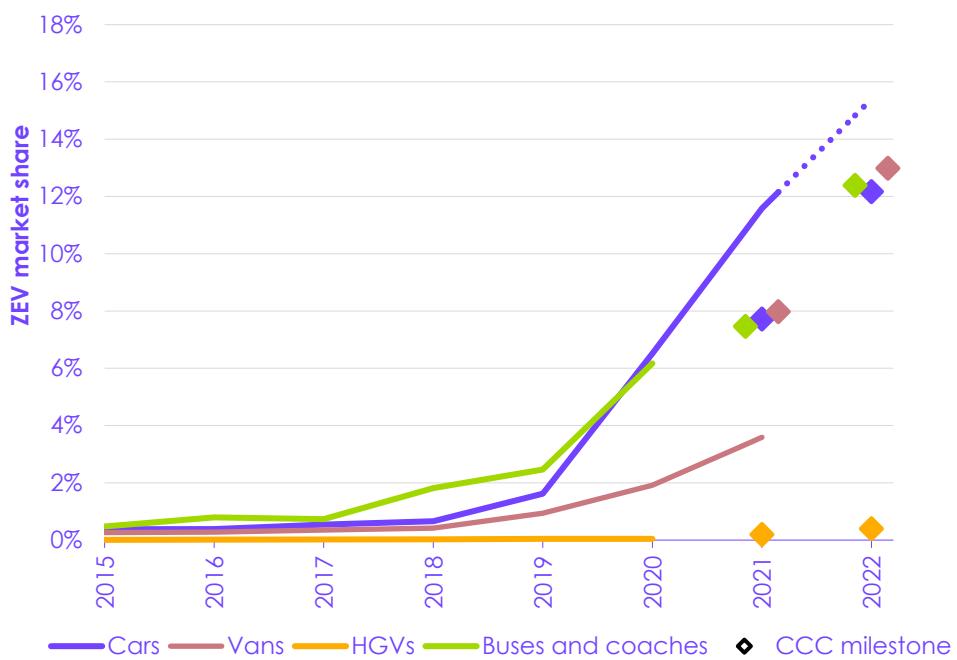
Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.

Notes: All values are rounded to 2 significant figures; Solid lines represent pathways; Points represent in-year benchmarks; Dotted lines show the linear rate of change required to meet in-year benchmarks; Testing for van CO₂ intensity in 2021 largely shifted from NEDC to WLTP testing, making it incomparable to previous data and causing a jump in the series.

New zero-emission vehicle sales

Zero-emission car and bus uptake is increasing fast, around one year ahead of the CCC benchmark. Zero-emission van uptake is slower, but supply is increasing. Zero-emissions HGV trials are now beginning.

Figure 3.4 Market share of zero-emission vehicles

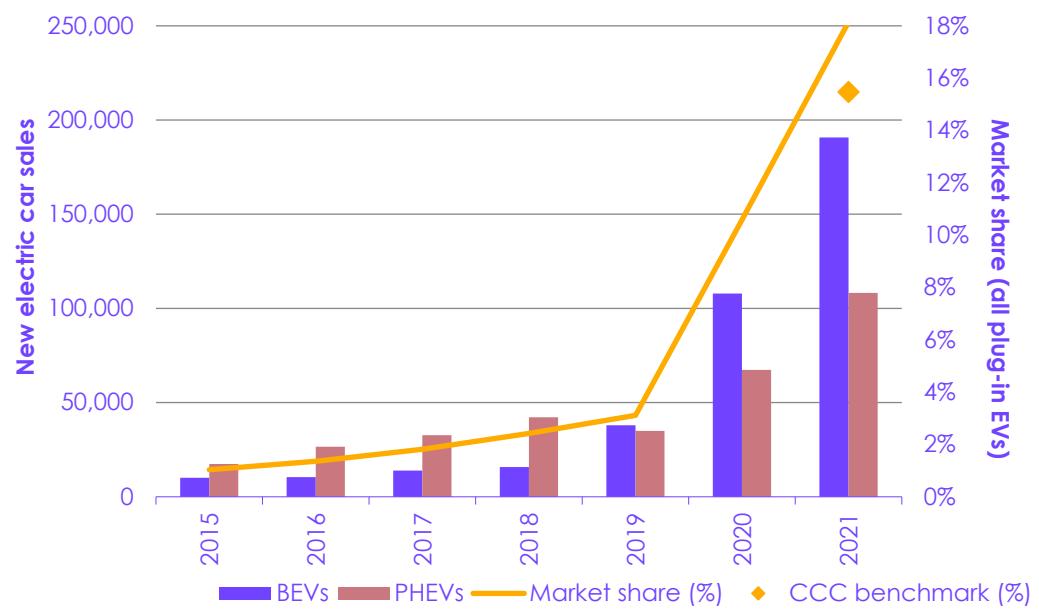


Source: DfT (2022) Vehicle statistics and SMMT (2022) Vehicle data, car registrations; CCC analysis.

Notes: Market share is the sales of ZEVs as a proportion of all new sales of the relevant vehicle type in the given year. The 2022 year-to-date figure (shown by the dashed line) is based on SMMT new car registrations data up to the end of March and is available only for cars. The CCC milestones show the uptake trajectories in our Sixth Carbon Budget Balanced Pathway.

In recent years fully battery-electric vehicle sales have substantially outpaced hybrid sales. They offer greater emissions savings and are more cost efficient.

Figure 3.5 Number of UK new electric car sales and market share of total new car sales

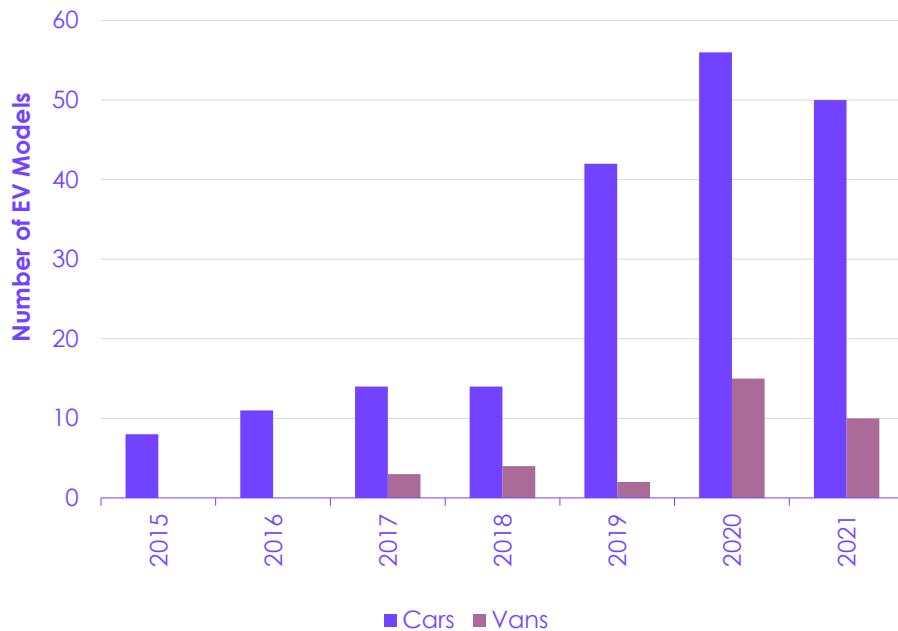


Source: DfT (2022) Vehicle statistics and SMMT (2022) Vehicle data, car registrations; CCC analysis.

Notes: Market share, shown on the right-hand axis, represents the combined sales of BEVs and PHEVs as a proportion of all new car sales in the given year. The CCC milestone is the share of new BEVs and PHEVs in our CCC Balanced Pathway.

Major manufacturers are committed to focusing their supply chains on EVs.

Figure 3.6 Number of new EV models coming onto the market per year

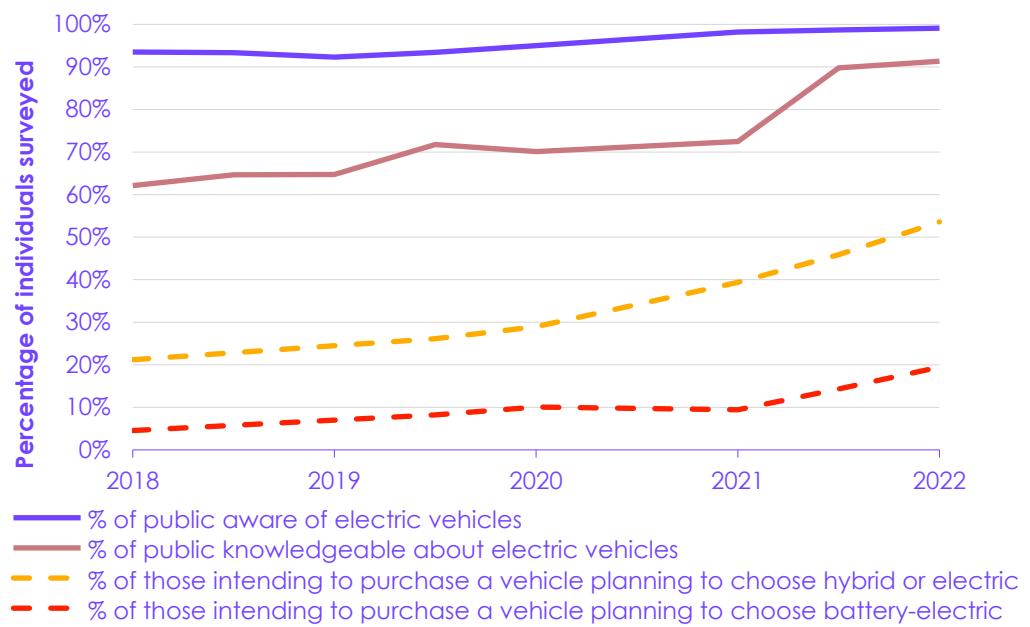


Source: OZEV (2022)

Notes: This data has been provided by OZEV based on their database of vehicles eligible for the plug-in car grant or the electric vehicle home charge scheme. There may be a data gap for those that haven't applied to and/or.

Awareness and knowledge of electric vehicles is increasing, alongside those intending to purchase an electric vehicle.

Figure 3.7 Public awareness of electric vehicles, and next vehicle intention



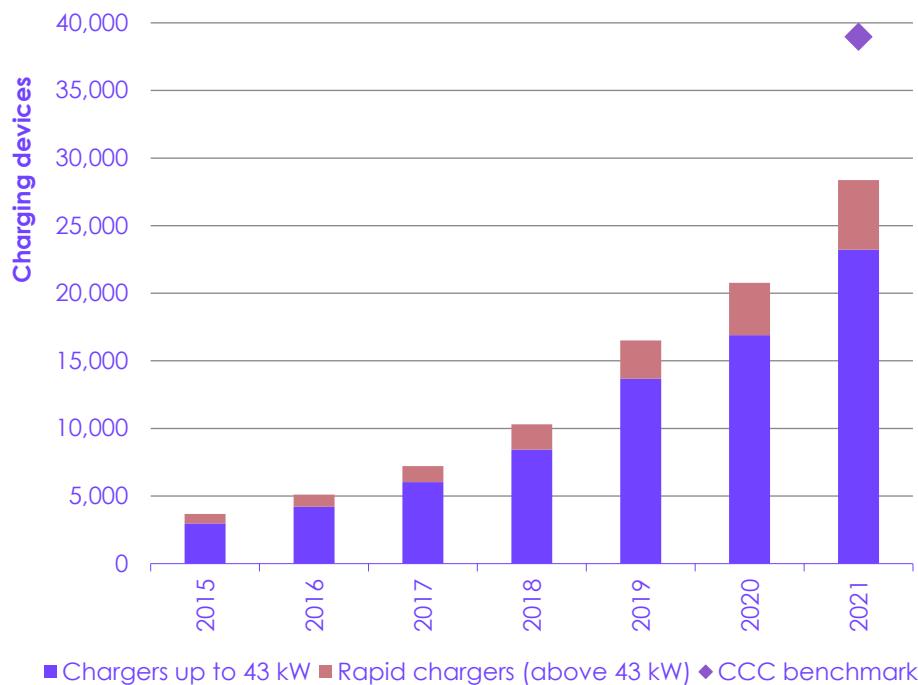
Source: DfT (2022) Public attitudes tracker; CCC analysis.

Notes: Chart shows two sets of data: (1) in solid lines, the proportion of all individuals surveyed that say they are aware of and have some knowledge of electric vehicles; and (2) in dashed lines, the proportion of surveyed individuals who said that they plan to buy or replace a car or van who say they are planning to choose a hybrid/electric or a battery-electric option. Data are based on DfT's Transport and Transport Technology survey, which is conducted in June and December of each year. June results are plotted at the mid-point of the year in question, and December figures are plotted at the start of the following year.

Electric vehicle charging infrastructure

The number of charging devices is off-track and the rate at which they are installed needs to increase by a factor of four.

Figure 3.8 Total publicly accessible charging devices installed across the UK

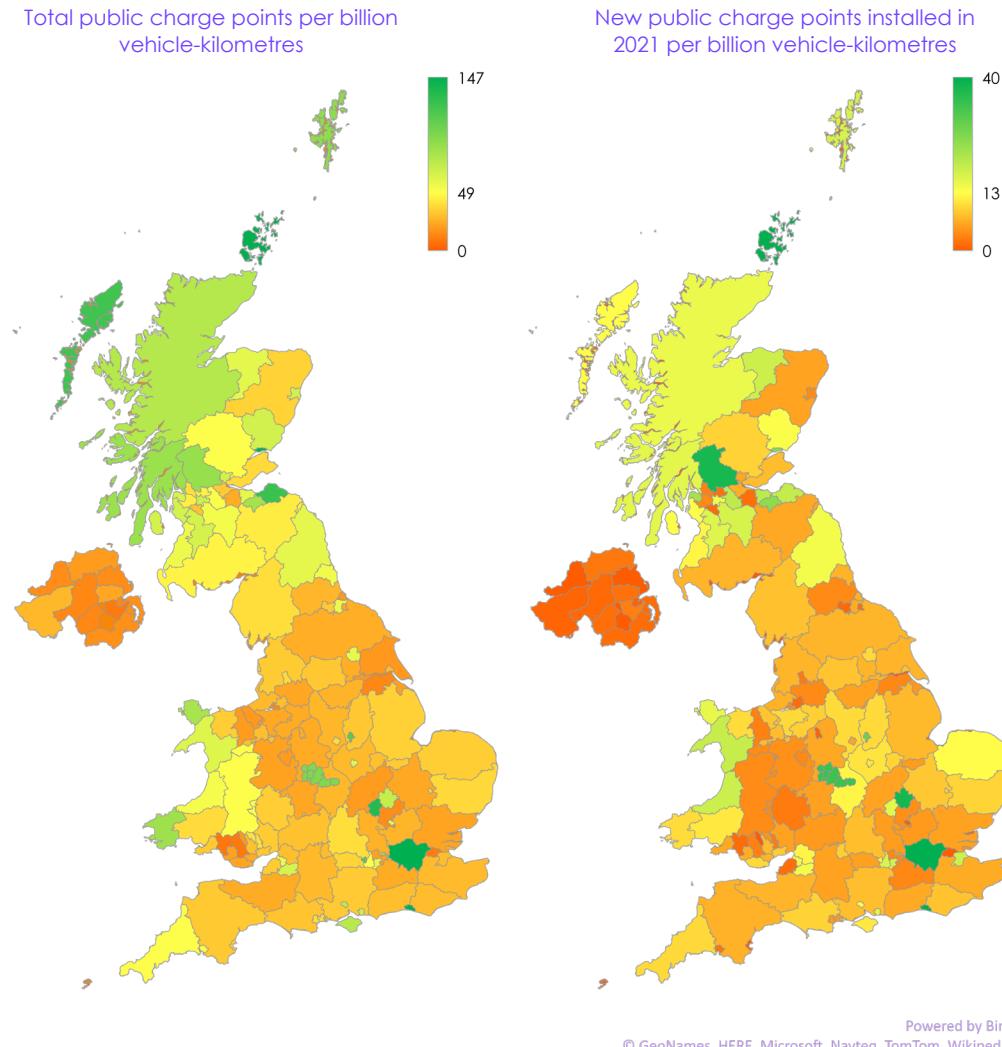


Source: DfT and OZEV (2022) *Electric vehicle charging device statistics*; CCC analysis.

Notes: Includes all publicly accessible charge points across the UK at the end of the year in question. The CCC milestone is the number of public charge points required at the end of 2021 in the Committee's Sixth Carbon Budget modelling.

There is significant variation in provision of public charging infrastructure, and the strongest progress is being made in areas that are already furthest ahead. The maps give a stylised picture that cannot account for all differences between regions.

Figure 3.9 Geographic distribution of public charge points and new installations in the past year, shown per billion vehicle-kilometres driven



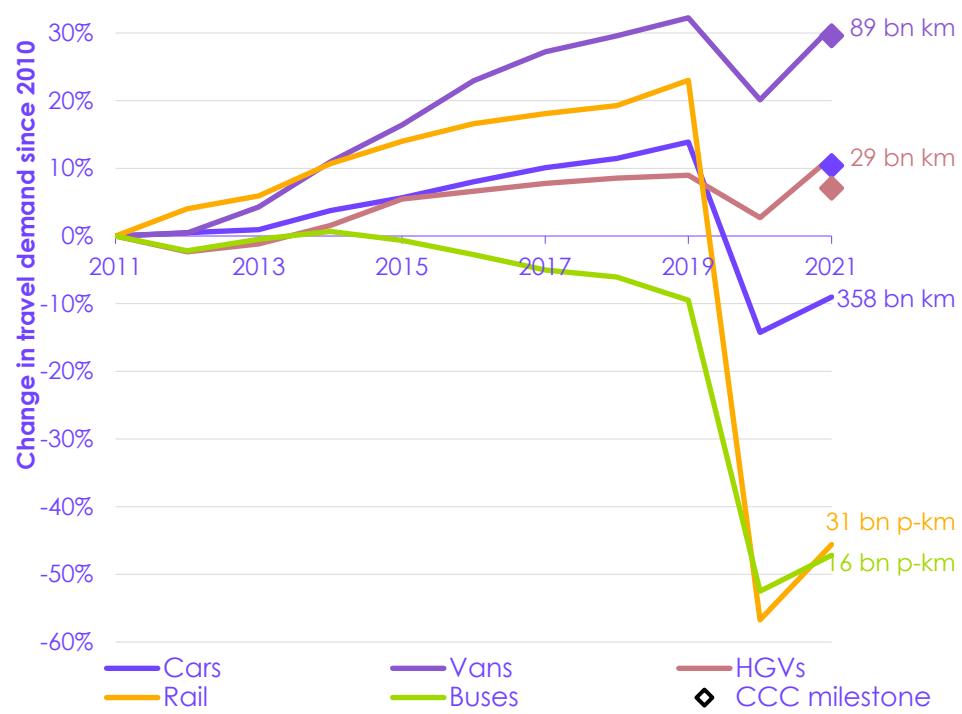
Source: DfT and OZEV (2022) Electric vehicle charging device statistics; CCC analysis.

Notes: These charts show the number of publicly accessible charge points in each local transport authority and the number that have been newly installed in the past year, both divided by the total number of vehicle-kilometres driven in that authority in 2019. This division aims to account for the differing need for charge points in each authority, which will be related to the number of drivers living in the region, the amount of driving they do, and the volume of visiting or through-traffic. It does not capture all relevant factors, for example there is likely to be more need for public charge points in areas with less off-street parking. Traffic volumes for Northern Ireland have been estimated as 4% of the total for Great Britain, and have been distributed among authorities based on population. Green shades represent authorities that are ahead of the national average; red shades represent those that are behind.

Demand for travel by mode

The total kilometres driven by cars in 2021 is eight times higher than the equivalent distance travelled by rail and bus. While a shift to more public transport is clearly needed, bus fares have risen by more than wages and by more than the cost of any other mode of transport over the past decade.

Figure 3.10 Demand for travel by mode since 2011

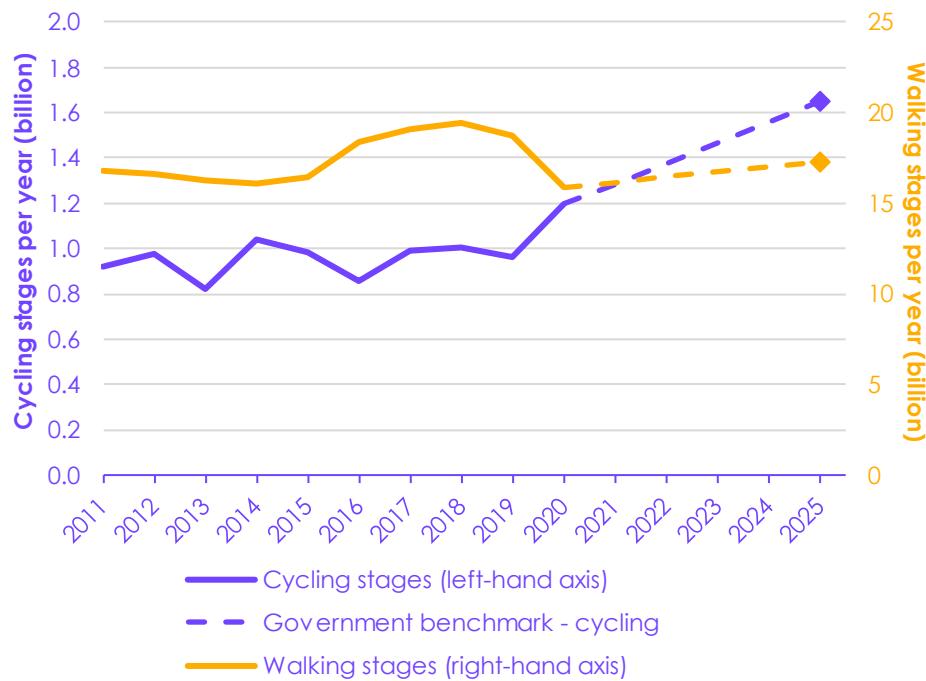


Source: DfT (2022) Road traffic statistics and Bus statistics; ORR (2022) Passenger rail usage statistics; CCC analysis.

Notes: Changes in demand are shown relative to levels in 2011. The data labels on the right-hand side show the actual levels of demand (vehicle-kilometres for cars, vans, and HGVs; passenger-kilometres (p-km) for rail and buses) in 2021. 2021 figures are year-to-date up to Q3. Bus data for 2021 had to be inferred from the reported reduction in demand for services. The CCC milestone is the change in demand (for cars, vans, and buses only) in our CCC Balanced Pathway.

The pandemic saw an increase in participation in cycling. Policy will need to build upon this to meet the target of doubling cycling by 2025.

Figure 3.11 Walking and cycling stages in England



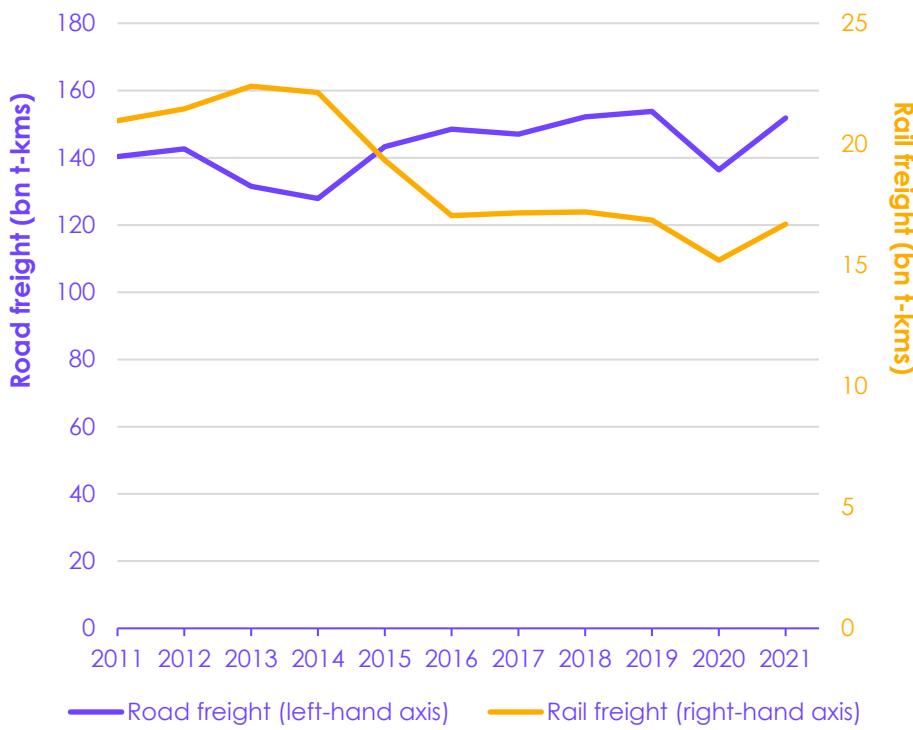
Source: DfT (2022) *Cycling and walking statistics*; CCC analysis.

Notes: Chart shows the number of cycling (left-hand axis) and walking (right-hand axis) stages per year in England. A stage is a portion of any journey undertaken using the transport mode specified. These are compared against the Government objectives to double total cycling stages compared to 2013 and to increase per-person walking stages to 300 by 2025. The decline in walking stages during the pandemic was largely due to reductions in people walking as part of their commutes – evidence suggests that walks taken for leisure purposes increased.

Use of road and rail for freight

The share of goods moved by road in Great Britain has increased over the last decade to 90%. The Government has committed to setting a rail freight growth target, but the target level is unconfirmed.

Figure 3.12 Goods moved by road and rail in GB



Source: DfT (2022) *Road freight statistics* and ORR (2022) *Freight moved statistics*.

Notes: Road freight includes only domestic journeys. For ease of comparison of trends, road freight is shown on the left-hand axis, and rail freight on the right-hand axis.

3. Policy progress, assessment and next steps

The publication of the Transport Decarbonisation Plan (TDP) in July 2021 represented a positive step for the sector, setting out the Government's vision for how the sector's emissions can be abated. This has been built upon through various recent detailed publications, including the Charging Infrastructure Strategy and a consultation on the details of the ZEV mandate.

These publications represent notable policy progress in the surface transport sector, with credible delivery plans beginning to be developed to implement the transition to ZEVs. In further developing and implementing these, the Government must ensure that they are suitably ambitious to deliver the emissions trajectory required and swiftly resolve any barriers or market failures that could prevent this ambition being realised. Affordability of EVs, widespread provision of suitable charging infrastructure, and ZEV HGV innovation are likely to be key areas requiring Government attention over the coming years. Transport decarbonisation policy must also consider resilience to climate change impacts, for example designing and locating new charging infrastructure to be protected from flooding and ensuring power supplies are resilient to extreme weather.

The recognition of the need to reduce traffic growth, alongside funding for improved local public transport and active travel, are also positive steps. However, the Government has not yet set out a clear vision of the extent of traffic reduction that is desirable, nor a coherent set of policies to deliver this. Actions and funding need to be more joined-up across the country and between transportation modes, and key enablers such as spatial planning and transport appraisal methodologies must be better aligned to the objective of providing widely available, cost-competitive, sustainable alternatives to private car travel.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

Electric cars and vans, and conventional efficiency

Sales of electric cars and vans need to ramp up quickly through the 2020s to achieve the end of sales of new petrol and diesel vehicles by 2030. Progress has been made in the last year on the planned ZEV mandate, which should support market growth as upfront grants are withdrawn. However, the accompanying CO₂ regime for conventional cars seems insufficiently ambitious.

The ZEV mandate is the main mechanism that will deliver both the ramp up of sales of electric cars and vans through the 2020s and the end of sales of new petrol and diesel vehicles by 2030.

- **ZEV mandate.** The Government has confirmed that the main mechanism to deliver this will be the introduction of a ZEV mandate from 2024. DfT launched a consultation on the details of this scheme in April 2022.
 - The Government intends to use the mandate to set legally binding annual targets for sales of zero-emission cars and vans that are at least as ambitious as the trajectories modelled in the TDP.

These targets could potentially be made more ambitious, particularly in the early years, given the current high levels of EV sales.

- The consultation proposes that the targets for vans will increase more gradually than for cars, recognising the early stage of this market. It expresses confidence that supply will increase rapidly during 2022.
 - It is promising to see DfT considering using the mandate's certificate regime to incentivise provision of certain vehicle attributes or environmental factors. Improvements in these aspects, in particular vehicle size/weight, price point, battery recyclability, and supply chain sustainability, need to be incentivised and addressed, either through the mandate or separately.
 - Only vehicles that are fully zero-emission at the tailpipe will count within the ZEV mandate. Therefore, hybrid vehicles will not be eligible for compliance certificates. The Government has indicated that it expects to determine what constitutes 'significant zero-emission capability' so that it could allow some hybrids to continue being sold between 2030 and 2035. This would be based on what is required to deliver the necessary emissions savings depending on the finalised ZEV mandate uptake trajectory.
- **Upfront grants.** In June 2022 the Government ended upfront purchase grants for electric cars. This followed the plug-in car grant being cut twice during 2021 – from £3,000 to £2,500 in March, then to £1,500 in December – and restricted to lower priced EVs. The Government has indicated that it will redirect funds to other vehicle types (e.g. vans, taxis) and to the public charging network.

There has been substantial growth in EV sales despite reductions in grant value. A strengthened public charging network and taxation gradients are likely to be needed to continue driving EV adoption.

- The substantial growth in EV sales despite the reductions in grant value and in the share of EVs qualifying for a grant gives some confidence that the sector should be able to continue scaling up even as support is phased out. However, the Government must make sure that changes to grant support do not undermine its clear messaging in favour of the EV transition.
- Strengthening of the public charging network, targeted support and taxation gradients are likely to be needed to continue driving EV adoption and to ensure broad access to the benefits of EVs across society. Interventions in the used car market, such as Scotland's Low-Carbon Transport loan scheme which extends to used cars, could be helpful in enabling more consumers to switch, as could targeted support for EV leasing (e.g. as recently proposed in France).
- Plug-in van grant rates have also been cut, to £2,500 for vehicles up to 2.5 gross tonnes and £5,000 for vehicles of 2.5-4.25 gross tonnes. DfT has confirmed that the grants will be available until 2025.

It is important that the CO₂ regime for new conventional vehicles is ambitious enough to meet improvements in the Net Zero Strategy baseline. Weaker regulations than the EU could see the UK become a dumping ground for less efficient models.

- **Conventional efficiency.** The ZEV mandate consultation also included proposals for an accompanying CO₂ regime for new conventional cars and vans that continue to be sold. The Government's intention is for this to require only nominal improvements, to enable manufacturers to focus investment on EV development.

- This seems insufficiently ambitious. In the past, efficiency improvements have been lost to shifts towards larger, heavier vehicles such as Sports Utility Vehicles (SUVs), and the Government should consider how this can be avoided.
- The Net Zero Strategy baseline assumes that manufacturers continue to improve conventional vehicle efficiencies in line with EU regulations and that hybrids with significant zero-emission range will make up a growing and substantial portion of the new car market. DfT must ensure that regulations and market conditions are sufficient to deliver this. Otherwise, policy outcomes may fall short of meeting the sector's contribution to the Net Zero Strategy emissions pathway.
- **Supply chains.** Delivering the ZEV mandate will require robust supply chains that ensure key components and raw materials can be sourced sustainably, ethically and cost-effectively.
 - In January 2022 the Government committed £100 million of funding from the Automotive Transformation Fund to support the planned Britishvolt gigafactory. This has helped the company leverage £1.7 billion in private investment.¹¹
 - The Government has established a Critical Minerals Expert Committee, consisting of minerals experts from across academia and industry, to advise on how supplies of key raw materials can be cost-effectively and sustainably scaled up, including embedding recycling into the supply chain.

Electric vehicle charging infrastructure

DfT and Office for Zero Emissions Vehicles (OZEV) have recently published their Electric Vehicle Charging Infrastructure Strategy¹², setting out an ambition for at least 300,000 public charge points across the UK by 2030. This aligns with our assessment of how many will be needed, but the strategy also recognises that this is highly uncertain, and that provision will need to reflect local need in order to enable the mass-market transition to EVs. There has also been a welcome shift in focus to drivers who are unable to charge at home.

The Government has set a sensible 2030 ambition for EV charge points, backed by a delivery plan.

- **A credible delivery plan.** Importantly, the strategy presents a credible delivery plan for realising this scale-up, identifying key roles and responsibilities and proposing approaches to overcome existing barriers to provision and use.
 - The strategy recognises the key role played by local authorities in delivering charge points in their communities. To enable this, local authorities will be supported to develop local charging infrastructure strategies (including through a new guidance hub and a £50 million fund to support local delivery).
 - The strategy recognises the importance of effective coordination across a range of actors, for example electricity network operators, neighbouring authorities and all tiers of government. DfT should ensure that local authority guidance enables this to take place effectively.

- DfT plans to develop a set of metrics to monitor implementation of the strategy, allowing it to take action where needed and to keep the strategy updated. Setting out milestones could be helpful to ensure that local charging strategies are aligned to the level of ambition required.
- **A market-led approach.** The Infrastructure Strategy signalled a move towards a more market-driven approach to charging infrastructure provision.
 - In many locations, there are clear business cases for the private-sector to invest in the charging network, as demonstrated by commitments such as Shell's recent announcement of plans to install 100,000 chargers by 2030. The Government sees its role as being to help the market to scale-up these solutions and support or de-risk investments where the commercial case is more challenging.
 - However, there are already large regional disparities in charge point provision. The Government must act quickly to ensure that no regions are left behind in the EV transition.
 - The Government will work with service area operators to deliver a network of over 6,000 rapid chargers across the major road network by 2035. Our Sixth Carbon Budget analysis estimated that closer to 10,000 such charge points would be needed, suggesting that these plans could be insufficiently ambitious.
 - In the shorter term, there is a commitment to at least six rapid chargers at each motorway service area by the end of 2023.
 - Later this year, the Government plans to consult on the design of the Rapid Charging Fund. This will be a £950 million scheme to support upgrading the electricity grid along major roads to future-proof grid capacity for ultra-rapid charging at service areas.
- **Drivers without off-street parking.** Government support is increasingly focussing on ensuring that the public charging network is suitable to meet the requirements of drivers who are unable to charge at home.
 - From April 2022, the EV Homecharge scheme's focus has shifted to rented properties and flats. This is a welcome step and will need to be supported by clear engagement with both landlords and tenants.
 - The On-Street Residential Chargepoint Scheme will continue to support local authorities to procure and install charge points for drivers without off-street parking.
 - Later in 2022, the Government plans to launch the first pilot projects within the Local Electric Vehicle Infrastructure fund. This scheme will provide £450 million in funding to support local authorities to secure private investment for larger local charging schemes, which could include improved on-street provision or rapid charging hubs.
 - The Government intends to rely primarily on competition to close the price gap between home and public charging. However, there is little evidence¹³ of this happening to date, and there remains a notable

Large regional disparities in charge point provision need to be addressed.

The plans for 6,000 rapid chargers across the major road network by 2035 could be insufficiently ambitious as our Sixth Carbon Budget analysis estimated a need for around 10,000 such charge points.

The shift in focus to support those who are unable to charge at home is welcome and necessary.

discrepancy in VAT rates (i.e. domestic electricity is charged 5% VAT, while electricity at public charge points is charged 20%).

- Alongside this report, we have published the findings from research we commissioned from Ricardo looking into the charging preferences of EV drivers without off-street parking and the infrastructure approaches that could meet these.¹⁴ The key findings were:

A mix of all charging types and legislation ensuring improved reliability and interoperability across the charging network is required to enable a full EV transition.

Public charging can cost around two to three times higher than home charging. Opportunities to rebalance these costs must be explored.

The Government plans to make public charging easier.

- The most attractive charging options reported are faster chargers that can work immediately, have a high level of reliability, and are readily available for use, not taking costs into account. However, there is not a single charging solution to suit all EV drivers' needs and preferences; a mix of all charging types is required to enable a full EV transition, alongside legislation ensuring improved reliability and interoperability across the public charging network.
 - Prices at public charge points will vary dependent on utilisation rates of the chargers. Slower lamppost chargers could offer the cheapest costs to those consumers without access to off-street charging, compared with rapid charging that has significantly higher per-kWh cost under low utilisation rates (i.e. when in use less than 50% of the time). As utilisation rates increase, costs to consumers are reduced and the cost differences between different charging options are also reduced.
 - Prices at typical on-street charge points can be around two to three times higher than home electricity. This is despite their slow-charging nature and relatively cheap installation price. Government should explore opportunities to rebalance these costs, for instance through subsidies and ensuring that cost savings (e.g. a reduction in VAT for commercial electricity) are passed onto the end-user. This will help with achieving a fair and inclusive transition to EVs.
- **Scottish plans.** The Scottish Government has also recently published its draft vision for the future of public EV charging. This places a similar focus on unlocking private-sector investment and established a £60 million fund to support local authorities in identifying and meeting the charging needs of their communities.

Consumer experience. Alongside the Infrastructure Strategy, DfT also published its response to its 2021 consultation on the consumer experience at public charge points¹⁵. This commits to introducing new regulations mandating easier payment, more transparency on pricing and data, and improved reliability.

- Consumers will have to be able to pay using non-brand-specific means at all new chargers and across the entire rapid network. Moreover, the industry will be required to develop payment roaming, ensuring compatibility between payment means and apps.
- All charge points will have to display prices in the common metric of pence per kWh. This will enable drivers to compare rival operators' prices, much as they can with petrol stations.
- All rapid charge points will have to meet a 99% minimum reliability target from the end of 2023, but no target has been proposed for the remainder

of the public charging network. All charge point operators must provide a 24/7 free helpline for consumers who experience charging issues.

Grid connections. Ofgem's decision to reduce overall grid connection charges and to socialise the costs of grid reinforcement is also welcome. This will help ensure that first-movers and companies switching large fleets are not hit by disproportionately high costs.

- Grid connection costs could still be an issue in certain circumstances, particularly where multiple new or expanded connections are required. This could be particularly relevant for companies seeking to make an early switch to zero-carbon HGVs.
- The Government should consider how to ensure this doesn't hinder ZEV adoption as it further develops its plans.

Decarbonising other surface vehicles

The Government also announced that all remaining new petrol and diesel sales will end for all vehicle types by 2040 at the latest.

Detailed delivery plans are required to set out how ending the sale of new diesel small HGVs by 2035 and large HGVs by 2040 will be achieved.

HGVs. The Government has committed to ending the sale of new diesel small HGVs (less than 26 tonnes) by 2035 and large HGVs (above 26 tonnes) by 2040. The Government will need to set out detailed delivery plans for how this will be achieved.

- In August 2021, DfT allocated the first funding (£19 million) for pre-deployment testing and small-scale trials of zero-carbon HGVs. The department has recently announced £200 million of funding for a three-year comparative demonstrator programme, building on the findings from this first phase.
 - This will begin with funding competitions to demonstrate battery-electric and hydrogen fuel cell technologies on UK roads.
 - They will need to continue scaling up, to reach commercial-scale by the mid-2020s. This will help drive forward market development and will generate real-world data to build fleet operator confidence in the commercial viability of zero-emission options.

Buses. For buses, local actions to address air quality concerns have already driven development of a significant market for battery-electric and hydrogen options, and DfT is now consulting on an earlier phase-out date between 2025 and 2032.

- Government has committed to fund the introduction of 4,000 zero-emission buses and infrastructure to support these nationwide. Deployment of these vehicles has been delayed due to the impacts of the pandemic on the industry, but the full number are still expected to be supported.
 - The first tranche of these are being delivered through the Zero-Emission Bus Regional Areas scheme, which confirmed £270 million in funding to 17 local transport authorities in March 2022.
 - In total, the funding announced through the scheme to date will fund 1,300 new electric and hydrogen buses along with the required supporting infrastructure. The Scottish Government runs a similar challenge fund, ScotZEB, which awarded £62 million in early 2022.

- Coventry has been announced as the UK's first zero-emission bus city. This should be used as a learning opportunity to demonstrate and share best-practice in how to deliver an ambitious transition to zero-emission buses.

A clear plan is needed for how the removal of all diesel-only trains from the rail network by 2040 will be achieved.

Trains. The Government aims to remove all diesel-only trains from the rail network by 2040. It needs to set out a clear plan for how this will be achieved, including an ongoing programme of track electrification and consideration of the role for hydrogen, battery-electric, and hybrid trains.

- Alongside the TDP, DfT published the Rail Environment Policy Statement¹⁶, setting out its priorities for how decarbonisation, sustainability, and environmental objectives will be met. These include periodically updating the Traction Decarbonisation Network Strategy to serve as a blueprint for decarbonisation of the system.
- DfT and Innovate UK have recently launched a £7.6 million First of a Kind competition, building on funding awarded in 2020 to innovative projects including the HydroFLEX hydrogen train prototype.

Modal shift

Clear policy and guidance is required to embed the shift to active travel seen throughout the pandemic.

Active travel (i.e. walking and cycling). The pandemic saw an increase in people walking and cycling for leisure.¹⁷ Clearer policy and guidance will be needed to realise the opportunity to embed some of these positive shifts.

- Many areas introduced temporary measures to increase the space available for walkers and cyclists during the pandemic. These schemes allowed more people to participate in active travel during lockdowns.
- There were reports of improved air quality in urban areas during the pandemic, and increased recognition of the value of green spaces and lower levels of traffic. As well as emissions savings, shifting journeys to walking and cycling brings significant co-benefits for health and wellbeing through exercise.
- The Government has made some moves to embed these changes.
 - The Minister of State for Transport wrote to local authority leaders in July 2021, encouraging them to leave schemes in place for long enough to evaluate their impact robustly. The findings from these evaluations should be used to inform future infrastructure planning.
 - Also in July 2021, DfT published a research paper by the Behavioural Insights Team¹⁸ setting out a range of soft and hard interventions that could help to embed recent increases in cycling for the longer term. Government should integrate these into its guidance to local authorities, supported by appropriate funding.

Targets have been set and initial funding allocated for increasing walking and cycling.

The TDP set out a goal for half of all journeys in towns and cities to be walked or cycled by 2030 and a separate target to double cycling (relative to 2013 levels) and increase levels of walking per person by 2025. This will require policies to build upon the increases seen during the pandemic.

- In January 2022, DfT launched Active Travel England, with Chris Boardman MBE announced as its first Commissioner. This body will be responsible for implementing the objectives and funding set out in the Gear Change strategy. As a statutory consultee, Active Travel England should make use of its opportunity to ensure that sustainable transport is factored into all major planning developments from the outset.
- Active Travel England has recently allocated the first £200 million of the £2 billion announced in 2020's Gear Change strategy. This includes funding for 134 schemes to improve local walking and cycling infrastructure across 46 local authorities and investment in 44 new off-road sections of the National Cycle Network.
- Revisions to the Highway Code at the beginning of 2022 have clarified the priority status of pedestrians and cyclists on UK roads.
- The Scottish Government's latest Programme for Government committed to increasing funding for active travel to at least £320 million or 10% of the total transport budget.

Electric bikes could have a valuable role in supporting an increase in cycling.

Electric bicycle sales rose by 70% in 2020 to 170,000, representing one in twenty bicycles sold.¹⁹ The new National E-Cycle Programme, run by Cycling UK, will aim to build on this by offering short- and long-term opportunities to try e-bikes. The first pilot scheme launched in May 2022, backed by £8 million of Active Travel England funding.

- E-bikes can extend the scope of modal shift to active travel to a wider base of consumers and a broader subset of journeys. Increasing provision of dedicated cycle lanes and provision of e-bike sharing schemes could help achieve this.
- Comparisons with the Netherlands,²⁰ where cycling is ingrained in society and over 400,000 e-bikes were sold in 2018, suggest that there is potential for these sales to grow rapidly.

Improving air quality was recently listed as one of the target areas for the second round of the Levelling-Up Fund. Active travel can both improve air quality and benefit from such improvements, as participation becomes more appealing.*

Public transport

Several strategies state ambitions for improved, affordable, integrated public transport services. These promises need to be turned into clear plans for delivery, to ensure that the funding committed delivers maximum value.

Places. The TDP included a promising focus on place-based solutions to developing low-carbon transport systems. This was re-emphasised in the Levelling-Up White Paper, which committed that by 2030, local public transport connectivity will be significantly closer in standard to London. These promises need to be turned into clear plans for delivery, to ensure that the committed funding delivers maximum value.

- The Williams-Shapps Plan for Rail has promised improvements to services, simplification of fare structures and more integrated ticketing (including better interfacing between the rail and bus systems).

* It is important to note that non-exhaust emissions (from brake, tyre, and road wear) make up around 10% of particulate matter caused by road transport. These will continue to be produced by EVs, with the increased weight of the battery potentially increasing them. Therefore, reducing driving will continue to offer air quality benefits throughout the EV transition.

- Budget 2021 included £43 million of new funding to help seven city regions outside London begin preparations to implement the £5.7 billion previously allocated for improving local transport systems. The final allocations from this £5.7 billion were confirmed in April 2022.
- In January 2022, the Scottish Government extended free bus travel to everyone aged under 22. This aims to increase access to public transport and encourage more young people away from private car travel.
- The Welsh Government published a White Paper in March 2022 aiming to unify bus services under a single network, with simpler and more affordable ticketing. This plan aims to make bus travel a more viable alternative to the private car.

Buses and trains. Government has committed significant investment to improving public transport provision across the country over recent years. While this is positive, a more coherent vision for how these investments will work together to deliver an improved overall transport system is needed. Allocations and approaches are frequently inconsistent and not joined-up at present.

- **Buses.** The £3 billion previously allocated for improving bus services and bus decarbonisation nationwide has been recast to also include funding for ongoing COVID-19 recovery support, meaning the pot available for service improvement was reduced to £1.2 billion. DfT has recently set out how this money will be spent, based on local authorities' Bus Service Improvement Plans.
 - DfT has provided local authorities with financial support and guidance to develop these plans, as well as funding for a new officer to implement them.
 - 31 local authorities will receive a total of over £1 billion to deliver on their improvement plans. This includes implementing enhanced bus partnerships, while some (notably Greater Manchester) are exploring introducing a franchised model. Unfortunately, around 40 further authorities have received no funding to support their plans.
 - This funding aims to improve bus services, make systems better integrated, and make fares more affordable.
- **Trains.** The Integrated Rail Plan was published in November 2021, confirming £96 billion of funding for rail connectivity. While this set out a plan for better connectivity to and within the North and the Midlands, it attracted criticism due to the paring back of previous plans for HS2.
 - The Integrated Rail Plan was not accompanied by any form of environmental impact assessment. As such, it is not clear what impacts the changes to previous proposals will have on emissions.

Support was provided to public transport operators due to suppressed demand throughout the pandemic. Consideration is needed on how to avoid service provision being affected once support ends.

Pandemic support. Section 2 above on indicators showed the impact of the COVID-19 pandemic on public transport demand. Government provided considerable support to operators during this period and needs to consider how to avoid service provision being affected once support ends.

- Bus operators have received between £1.5-2 billion through the Bus Service Support Grant and the Bus Recovery Grant. These avoided services being reduced, or fares being increased. The latter scheme has recently been extended to October 2022.
- Rail services were effectively brought back under public control, with Government covering franchisees' losses and paying them a fixed fee to continue operating services. This arrangement has also allowed DfT to introduce new forms of ticketing, such as flexible season tickets.
- Demand remains at around 60-80% of pre-pandemic levels. Government ran a sale across the rail network over Easter 2022, designed to attract customers back. This needs to be extended into a clear public messaging campaign to rebuild public confidence, otherwise operators' ability to improve (or even sustain) service quality and decarbonise simultaneously could be at risk once support ends.

Reducing traffic growth

The roles demand reduction and modal shift play in reducing traffic growth should be made clear.

The TDP and Net Zero Strategy represented a big step forward in recognising the need to reduce traffic growth. The UK Government now needs to be clearer on the extent of the role it sees demand reduction and modal shift playing and both UK and devolved Governments need more concrete policy to deliver this.

- The TDP included a commitment to increase average car occupancy, but the extent of this ambition was not quantified. DfT has also recently launched a consultation on a code-of-practice for mobility as a service.
- The Scottish Government has committed to reducing overall car mileage by 20% by 2030. It has begun taking steps to enable this, through focus on 20-minute neighbourhoods within its revised National Planning Policy Framework, extending free bus travel to those under 22, and guaranteeing funding for active travel.
- The Welsh Government has also recently committed to reducing the car miles driven per person by 10% by 2030, to be achieved through increasing modal shift to active travel and public transport.

While the recent Spending Review saw the total budget for Roads Investment Scheme 2 (RIS2) cut by £3 billion to £24 billion, this still provides considerable funding for new roads which will induce increased demand.

- DfT has listed "Improved environmental outcomes" as one of the objectives of RIS3, but the scoping document does not explicitly acknowledge the role of road enhancements in inducing increased demand or the fact that a majority of cars driving during the RIS3 period will still be carbon-emitting.
- Substantial investment in roadbuilding should only proceed if it can be justified how it fits within a broader suite of policies that are compatible with the UK's Net Zero trajectory. Both the Scottish and Welsh Governments have recently committed to no longer invest in road-building to cater for unconstrained increases in traffic volumes.

(b) Assessment of policies and plans

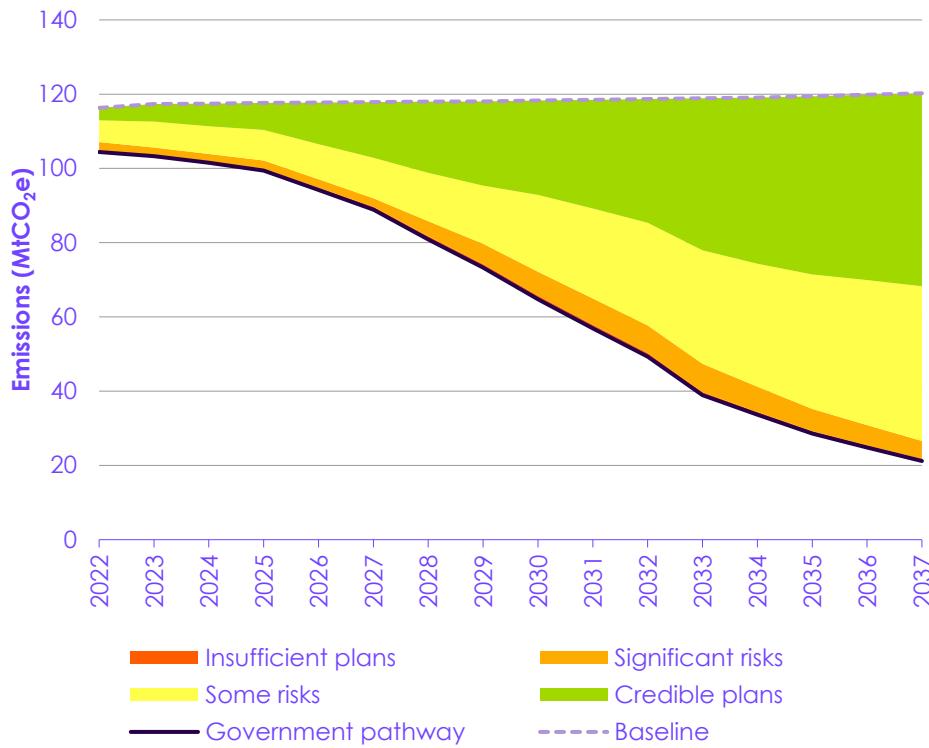
Policy progress is relatively strong in the surface transport sector, particularly the technology side, with significant risks and gaps on the demand side.

Policy progress is relatively strong in the surface transport sector, with credible policies in place or being developed to meet over half of the required abatement (Figure 3.13 and Table 3.2).

- Policy progress is strongest on the technology side, with the introduction of the ZEV mandate expected to drive uptake of electric cars and vans to meet the required phase-out dates. There remain some risks around vehicle costs and infrastructure provision, as well as for vehicles such as HGVs that are in the earlier stages of technological development.
- More significant risks and gaps remain on the demand side. The Government has taken the welcome step of acknowledging the need to reduce traffic growth and has allocated investment to improve active travel and public transport provision. However, it has not specified a level of ambition, which makes it hard to translate the broad intention into key instruments such as the planning framework or actions by local decision-makers.
- Through the policy documents detailed in the previous section, the Government has made progress on the highest priority recommendations in the Committee's 2021 Progress report. Progress is more mixed on other recommendations. Our assessment of specific recommendations is published in the supplementary materials alongside this report.
 - Of the three priority recommendations, we assess that Government has achieved the recommendation relating to developing a policy package to deliver the EV transition, has partly achieved strengthening support for and provision of active travel and public transport schemes, and is making sufficient progress towards the ongoing recommendation around supporting widespread deployment of EV charging infrastructure.
 - For the full set of recommendations for actions that we expected to see progress on in the last year we assess that UK Government and the devolved administrations have fully achieved four and partially achieved five, but not achieved seven.
 - A further six recommendations were of an ongoing nature, and we assess that there is sufficient progress towards three of these, insufficient progress towards two, and no progress towards one.

Government has credible delivery policy for the transition to electric vehicles, although emerging risks will need to be monitored, particularly later in the transition. Significant risks remain in policy tackling demand reduction.

Figure 3.13 Assessment of policies and plans for surface transport



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) Energy and emissions projections: *Net Zero Strategy baseline*; CCC analysis.

Notes: We have adjusted the baseline from that published in the Net Zero Strategy to exclude the impact of policies on conventional vehicle efficiency and early uptake of electric vehicles. This allows us to assess the impact of these policies in delivering the emissions reductions required. This is important because, over recent years, the abatement from these improvements has largely been lost to a shift towards larger vehicles such as SUVs. This trend will need to be reversed to realise these emissions savings, so we include them in our assessment to recognise this need for action.

Table 3.2

Policy scorecard for surface transport

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Cars – zero-emission vehicles 58% of 2035 abatement	G	G -First half	Y- First half	G	G - First half*
		Y - Second half	O - Second half		Y - Second half
			<ul style="list-style-type: none"> Plug-in cars made up 19% of all new sales in 2021 (12% BEV; 7% PHEV), and the ZEV mandate and Infrastructure Strategy set out a credible delivery plan to build on this strong foundation. Roles and responsibilities have been clearly identified. The proposed details of the ZEV mandate appear sensible, and DfT must now ensure that the annual targets are set at a level that will drive suitable ambition within the market. There are sensible plans to focus public funding on targeted support where it is most needed, for example for on-street chargers. Government will need to monitor progress to ensure that areas that need support are identified early. Some concerns are being addressed (e.g. consumer experience) but others remain (e.g. inconsistent charging provision and price disparities between home and public charging). These are likely to pose bigger risks as the transition reaches the later portion of the consumer base. 		
Vans – zero-emission vehicles 12% of 2035 abatement	G	G	O	G	G
			<ul style="list-style-type: none"> While electric van sales are behind those for cars, major manufacturers are expanding their ranges and sales are increasing. The ZEV mandate is a credible plan for driving this market forward. The charging needs of van users are not as well understood as those of car drivers, so there are risks as to the suitability of the charging network. 		
HGVs – zero-emission vehicles 7% of 2035 abatement	Y	G	O	G	Y
					<ul style="list-style-type: none"> Phase-out dates (2035 for lighter HGVs; 2040 for heavier HGVs) are appropriate. There are more risks for this subsector as the technology is at an early stage of development. However, technology trials have begun and are being scaled up (with significantly increased funding) to test battery, hydrogen, and catenary vehicles on UK roads. These need to expand to commercial scale by the mid-2020s. A comprehensive policy package (including incentives and infrastructure plans) for delivering the phase-out needs to be developed based on emerging findings from the trials and feedback on the ZEV mandate details for cars and vans.

* The technology adoption curve describes the typical uptake of a new innovation. It divides consumers into five groups – innovators, early adopters, early majority, late majority, and laggards – each of whom have differing propensity to adopt the technology. Risks to the rollout are likely to become more pronounced as it reaches the later groups, which we have reflected by ascribing separate assessments for the first and second halves of this curve.

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Buses – zero-emission vehicles	Y	G	Y	G	G
1% of 2035 abatement	<ul style="list-style-type: none"> Zero-emission buses are already in operation in a number of towns and cities across the UK. The Transport Decarbonisation Plan committed to support delivery of 4,000 new zero-emission buses and the supporting infrastructure. Deployment has been slowed as the industry recovers from the pandemic, but funding for the next tranche of almost 1,000 was confirmed in March 2022. Government has recently consulted on setting a specific phase-out date for new non-zero-emission buses between 2025-2032. The consultation also considers how to deliver this and deploy the necessary charging infrastructure. Coaches face similar decarbonisation challenges to HGVs. 				
Rail – efficiency and technology	Y	G	O	G	Y
1% of 2035 abatement	<ul style="list-style-type: none"> Government intends to remove diesel-only trains from the network by 2040, with the system being Net Zero by 2050. The TDP sets out Network Rail's Traction Decarbonisation Network Strategy as a blueprint for how this will be achieved. A comprehensive delivery plan is now needed, outlining which lines will be electrified and when and providing guidance on investment in new technologies and procurement of zero-emission trains. 				
Conventional vehicle efficiency	Y	O	R	Y	O
10% of 2035 abatement	<ul style="list-style-type: none"> A CO₂ emissions regime is proposed to accompany the ZEV mandate. This is important to reduce emissions from remaining conventional vehicle sales, and required for the Government's goals. The recent consultation proposes that this will only require nominal or small improvements. While it is sensible to ensure investment is focussed on ZEVs rather than on ICEs, this could miss an opportunity to incentivise low-cost improvements and could risk sales of hybrids being used to offset less efficient ICE sales. Over recent years, the positive effects of efficiency improvements have been offset by a trend towards larger, heavier vehicles. No specific action has been taken to address this. 				
Freight – demand reduction and modal shift	O	O	O	O	O
3% of 2035 abatement	<ul style="list-style-type: none"> Modal shift of freight was supported within the TDP, and DfT intends to consult on a rail freight growth target. The TDP also pledged to explore the legalities and practicalities around traffic regulation and consolidation schemes that could reduce van and truck movements in urban areas. 				

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Cars – modal shift to public transport 3% of 2035 abatement	O	Y	R	Y	O
		<ul style="list-style-type: none"> Government's ambition is to improve public transport systems across the country to be similar to London. City-region funding deals and the levelling-up agenda are supporting this ambition. However, a coherent overall approach is lacking. More quantified targets are required for modal shift's role in reducing car usage. Great British Railways and new Enhanced Bus Partnerships aim to make public transport networks more joined-up and to simplify fares. However, there are no clear plans to make public transport more affordable relative to driving. 			
Cars – modal shift to active travel 2% of 2035 abatement	Y	Y	O	Y	Y
		<ul style="list-style-type: none"> The aim for half of urban journeys to be walked and cycled by 2030 and the commitment to monitor walking and cycling levels against 2025 targets are welcome steps forward. To enable this, key enabling policies such as the planning system and the roads investment scheme need to reflect these ambitions better. The establishment of Active Travel England and the commitment to provide guidance to local authorities on place-based approaches to decarbonisation provide an opportunity to better integrate active travel into planning decisions. Sustainable transport needs to be considered from the outset of all new developments. 			
Cars – increased occupancy 1% of 2035 abatement	O	Y	O	R	O
		<ul style="list-style-type: none"> The TDP committed to increase average car occupancy by 2030. However, this target was not quantified, and limited policies were proposed to achieve it. Government has recognised the role of shared mobility and is consulting on a mobility-as-a-service code of practice. Guidance will be provided for local authorities on how to support car- and lift-sharing schemes. 			
Cars – reduced travel 1% of 2035 abatement	R	R	O	R	R
		<ul style="list-style-type: none"> The TDP recognised the role for reducing traffic growth, but Government has not quantified the extent of the role that this should play. Without this clear vision, it is difficult to fully embed the Net Zero pathway within crucial policy documents such as the planning framework and roadbuilding proposals. Societal shifts such as home-working can play a role in this. Policy needs to ensure that these shifts help rather than hinder the emissions trajectory. 			
Overall sector assessment	G	Y	O	G	Y
<p>Notes: 1. Demand-side measures are likely to be more important than implied by these figures. They would be larger in earlier years and these figures do not include indirect emissions benefits such as through reduced resource use and lower electricity demand; nor do they capture co-benefits such as improved air quality. Abatement figures for demand-side measures will also vary depending on whether they are calculated before or after the impact of electric vehicles. These figures are based on estimated contributions to the pathway for transport in the Net Zero Strategy, which appears to assess demand-side impacts after technological ones, thus reducing their apparent magnitude. 2. The majority of the abatement due to improvements in conventional vehicle efficiency is included within the baseline in the Net Zero Strategy. We have adjusted the baseline for our assessment to exclude these improvements. This allows us to consider them instead as part of the delivery pathway, and therefore to assess the suitability and credibility of Government's policies in delivering the emissions reductions required.</p>					

(c) Recommendations

Our recommendations are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department. Our priority recommendations for surface transport cover both the demand side (the biggest policy shortfall) and the switch to electric vehicles (the biggest source of emissions reduction). Impacts on jobs in the surface transport sector as a result of the transition will be discussed in a separate analytical report on workers and skills to be published later in the year.

Active travel and public transport

Key shortfalls that must be addressed are on the demand side. A clear vision, measurable targets and a delivery plan are required for the role of demand within our future transport system.

The biggest policy shortfalls in the surface transport sector are on the demand side. The decarbonisation pathway should not be all about replacing fossil-fuelled vehicles with electric ones, it also offers an important opportunity to change the way people view mobility. Enabling delivery of well-integrated, affordable, and appealing transport systems can free communities from car dependence, saving them money, reducing congestion, and continuing to improve air quality and health even once all cars are electric. Demand-side reductions can also lead to emissions savings across the economy, by lowering the amount of electricity needing to be generated and reducing the number of electric cars that need to be manufactured. Realising these benefits will depend on the Government setting out a clear vision for the role of demand within our future transport system, how this system will be delivered and addressing barriers to implementation.

- Fundamentally, the Government must set out measurable targets for the contribution that reducing car travel will play in delivering the Net Zero pathway. Realising this can be simplified by ensuring that the upcoming Planning Bill and the Transport Appraisal Guidance both reflect these aims and take an integrated, whole-system approach to transport development.
- The establishment of new bus partnerships and Great British Railways, alongside the Transport Decarbonisation Plan, the Williams-Shapps Plan for Rail and strategies such as Bus Back Better that specify wanting an easier, simpler and better integrated network, similar to London's, present an opportunity to introduce a new transparent fare structure that offers more affordable, reliable, and joined-up public transport (Box 3.2).
- The Great British Rail Sale initiative, a summer discount sale of train tickets that offered up to half price off one million advance travel tickets, could present opportunities for future fare reductions if demand increases keep revenues neutral.
- Coventry – as the UK's first all-electric bus city – and the upcoming decision on the UK's first zero-emission transport city present opportunities to test new approaches and share effective practice in reducing car dependency in urban settings. Active Travel England should also look to share best-practice and provide clear guidance on what local areas can do to increase walking and cycling.
- DfT and National Highways are currently developing their approach to Roads Investment Scheme 3. In doing so, they must ensure that induced demand and lifetime emissions impacts are adequately assessed. The strategy should not aim to cater for unconstrained growth in road traffic and must be compatible with Net Zero.

Public transport strategies call for a more affordable, transparent, integrated, reliable system. Focus on delivering these strategies is needed, with emphasis on seeking to rebalance costs between public and private transport.

Box 3.2

Public transport pricing

Public transport prices have been rising year-on-year over the past decade, at a rate higher than average wages and higher than the cost of private transport. Bus and coach prices have more than doubled, whilst rail fares have increased by about a third²¹.

Typically, bus and rail fare increases are directed by the Retail Price Index each year with complex ticketing systems, options and pricing for passengers to choose from. Both bus and rail have become complicated and expensive for passengers and require reform.

Government has recently published two strategies, on buses and rail, that both call for a more affordable, transparent and reliable system:

- **Bus Back Better**²² strives for more frequent, reliable, better coordinated, zero-emission and cheaper services, with a central aim of getting overall patronage back to pre-pandemic levels, and then exceeding that. Franchising and Enhanced Partnerships are being favoured to allow Local Transport Authorities (LTAs) to take over the role of registering bus services and to allow for multi-operator ticketing.
- **Great British Railways.**²³ This new public body will run and plan the rail network, own the infrastructure, procure passenger services, set most fares and timetables and be accountable for making the whole system work. It aims to deliver more affordable, efficient, punctual, reliable and easier-to-use services while maintaining their safety.

These strategies, alongside the committed funding and stated intention are welcome and timely, following decreasing public transport use due to rising prices and the pandemic. Focus is needed through to the mid-2020s on delivering these strategies, and setting out targets, timelines and monitoring progress to reach the goals laid out.

Our research and stakeholder engagement have emphasised that a successful public transport system, that encourages modal shift and the transition to Net Zero, should involve:

- **An integrated service** with simple, multi-modal, through tickets available on all services, irrespective of operator or mode of public transport, with bus, coach and tram routes serving railway stations.
- **Affordability and transparent pricing.** New public transport fare structures should allow for tickets and fares to be simple and accept contactless payment, with daily, weekly and monthly capping, across all modes of transport. The fare structure should be designed so that passengers pay for the journey from start to destination, not for the route they take or the number of transport modes they use. The new fare structure should also seek to rebalance the costs between public and private transport.
- **Improvements to frequency and reliability** across all public transport modes are required, with transport that runs more often and services that remain on time. Expansion of network routes and catering to the needs of rural areas are essential.
- **Transitioning to zero-emission vehicles** is important to meet the required emissions reductions to achieve Net Zero, as set out in our Sixth Carbon Budget advice and the UK Net Zero Strategy.
- **Continued Government investment** is required to ensure the success of a reformed transport system and to enable operators to keep public transport modes affordable, frequent and reliable.
- **Guidance for local authorities**, specifically for buses, is necessary to ensure Local Transport Authorities have the tools and resources they need to deliver a reformed system and ensure effective connectivity between areas and integration across all modes of public transport, active travel, and shared mobility.

Transport for London provides an example of an integrated service, across several transport modes, with multi-modal tickets and transparent pricing that is capped at a daily rate with the option for contactless payment.

Zero-emission vehicles

Policy must drive uptake at the pace required. The ZEV mandate must be confirmed in regulation, with ambitious targets driving rapid growth in EV sales.

Our new recommendations around the transition to zero-emission vehicles primarily aim to ensure that Government translates its promising strategies and credible plans into effective delivery. While the market is already scaling up at pace, Government policy must build upon this success and drive uptake at the pace needed, as well as to address market failures and mitigate any barriers to effective and fair implementation.

- The ZEV mandate must be confirmed in regulation, with ambitious targets driving rapid growth in EV sales. Targeted support and taxation gradients should create a compelling environment for consumers to choose electric options once this mandate comes into force.
 - As the roll-out progresses, targeted support should be introduced, ensuring they benefit those for whom the currently higher upfront cost of an EV is a significant barrier. As the second-hand EV market grows, Government should consider whether interventions in this market would be helpful in widening access to the EV transition.
 - Alongside the ZEV mandate, DfT must ensure that supporting regulations will deliver the emissions reductions that are required from the remainder of the market. This should include:
 - Robust enforcement of the 2030 phase-out date coupled with a high definition of significant zero-emission capability to ensure that from this point all purchases can be driven using solely electric power and genuinely reduce emissions.
 - CO₂ regulations that are sufficiently ambitious to achieve the share of emissions reduction required through the uptake of hybrids and to avoid the risk of the UK becoming a dumping ground for inefficient end-of-life conventional vehicles.
- Local authorities will need support – both through resource funding and using clear guidance – to develop deliverable local charging strategies and implement the actions required of them in the Charging Infrastructure Strategy. This will be vital to delivering the tenfold scale-up to at least 300,000 public charge points by 2030.
- Government should review and strengthen its ambitions on rolling out rapid charge points, to ensure that these anticipate need so that drivers have the confidence that they can find reliable, available chargers during longer journeys as EV uptake grows. This confidence will be key to maintaining positive public perceptions of the transition, and also offers the potential to improve resource efficiency by allowing drivers to opt for smaller batteries.
- Price disparities between public and home charging remain a significant concern and could undermine the fairness of the transition. The Infrastructure Strategy recognises this, and options now need to be developed to mitigate it.

Local authorities require funding and guidance to develop local charging strategies. Ambitions on the roll-out of rapid chargers should be strengthened.

Options to rebalance costs between public and home charging should be explored.

- The commencement of the Zero-Emission Road Freight trials is a promising step. They now need to develop into full commercial-scale demonstrations by the mid-2020s. Government should build on the emerging findings from these as well as feedback on the details of the ZEV mandate to develop a comprehensive policy package to deliver the phase-out dates for all non-zero-emission road vehicles.
- Ensuring a robust supply of vehicles will be crucial to enabling these transitions. DfT's 2035 Delivery Plan mentioned actions to localise more of the EV supply chain in the UK and to ensure responsible sourcing of raw materials. It also promised a consultation on battery recycling legislation, but this has yet to be published. Further work is required in each of these areas.

In the longer-term, it will be necessary for the UK to introduce some form of road pricing to fill the fiscal hole that will be left by the erosion of fuel duty, and to prevent the low costs of electric vehicles leading to increased congestion. Government should start scoping out policy options now, including consulting with consumer and motoring representatives to secure informed consent, so that such a scheme is ready for implementation later this decade (Box 3.3).

Road pricing of some sort is likely to be needed as electric vehicles become dominant. Preparations should begin now.

Box 3.3

Principles to follow in designing a road pricing scheme

In 2019, the exchequer received £28 billion in fuel duty, with over half of that coming from petrol and diesel sales to car drivers. Electricity, by contrast, is not subject to fuel duty. Furthermore, VAT on fuel sales is levied at 20%, whereas domestic electricity incurs only 5%. Electric cars are currently zero-rated for vehicle excise duty. All told, these differences mean that the transition to EVs is likely to leave a significant hole in the public finances if replacement taxation schemes are not introduced.

- A sensible and fair policy approach would be to ensure that this shortfall is made up from drivers, to avoid further subsidising the costs of driving from general taxation. Current taxation already does not cover the full external costs of driving (e.g. congestion, air pollution). This will remain the case even with the mitigation of emissions through EV uptake.
- Without any tax on driving, the considerable operational savings offered by EVs can be expected to significantly increase congestion as the costs to drivers of each extra mile driven is lower. The extent of this is uncertain but thought to be 10-30% (i.e. for each 10% reduction in cost per mile drivers tend to drive 1-3% more miles),²⁴ although research suggests that this can be mitigated through environmentally-friendly behavioural changes.²⁵

Therefore, our assessment is that it will be necessary to introduce some form of road pricing, whereby drivers (of any vehicle type) are charged for how much (and possibly when/where) they drive. Under any sensible formulation, the greater efficiency of EVs should still make them cheaper to run than petrol or diesel cars.

- It would be prudent to develop options for addressing this at an early stage; otherwise, there are potential political dangers that could hinder introduction:
 - Drivers could begin to assume that EV driving will always be tax-free.
 - There may be a perception that EVs were tax-free when richer consumers could afford them, but will be taxed once they are available to the mass market.
- There are a variety of potential approaches to road pricing, ranging from a simple charge per mile driven, which could be levied based on annual odometer checks, to more sophisticated schemes that vary the charge based on the time of day or the location/type of road being used, based on vehicle tracking technologies.

- Simple approaches such as flat charges per mile or road/geographic tolling are familiar to consumers and easier to understand, which may make them more straightforward to implement.
- However, more dynamic schemes offer more ability to internalise some of the costs of driving and tailor prices to reduce congestion or disincentivise harmful behaviours.
- All types of scheme could offer exemptions and allowances, although more dynamic approaches would offer greater potential for more nuanced adjustments to minimise distributional impacts and shape demand based on the alternative modes of transport that are available in each location and at each time.

Effective design of a road pricing scheme should follow the following key principles:

- **Public consent.** Approaches should be designed with input from key consumer groups. It is important that the changes aren't seen as an attempt to penalise motorists, so benefits to drivers (e.g. reductions in congestion) and allowances for reasonable/necessary motoring should be highlighted.
- **Fairness.** Analysis should consider the distributional impacts of potential options. There are inequalities embedded within the existing fuel duty system, so moving to road pricing offers an opportunity to rebalance these through well-designed incentives and allowances.
- **Public understanding.** Fuel duty is a relatively simple tax, levied uniformly at the point of sale. Its replacement will need to be similarly understandable, either through innate simplicity or through clear communications and consumer tools to explain how the system works in practice.
- **Clear incentives.** If varied or dynamic prices are used, the rationale behind these must be clear. Moreover, drivers must be easily able to understand the potential costs for their various travel options. Otherwise, they will not be able to respond to the intended price signals, risking unintended consequences and worse outcomes.
- **Integration with the wider transport system.** Road pricing should be designed in line with a vision for the role that driving will play in the future transport system. This means that it should consider the needs of both drivers and non-drivers, and should incentivise the use of alternative modes of travel where these are available. Linking the introduction with sizeable investments in active travel and public transport infrastructure across the country can help make these linkages clearer.
- **Privacy and security.** The prevalence of route-planning apps shows that drivers are willing to share their travel data where there are clear benefits. The means of data collection for a road pricing scheme should ensure that only the minimum amount of data necessary is captured and ideally be detached from central Government. Sharing of location data should be on an opt-in basis, with less intrusive options available for consumers who are unwilling or unable to do so.

4. Major risks

Table 3.3

Major risks and required mitigating actions for surface transport

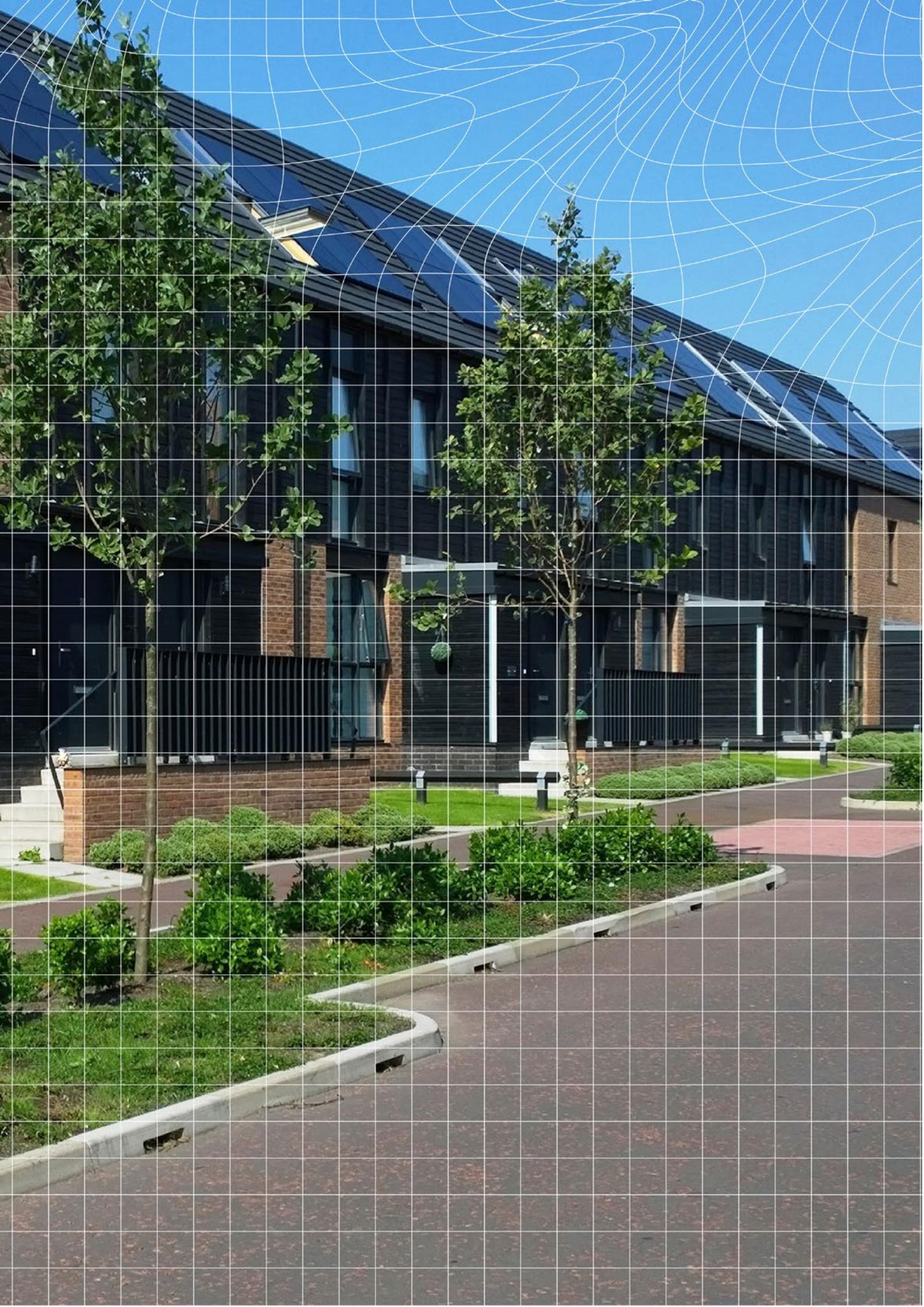
Risk category	Description	Mitigating actions	
		Details	In place?
Modal shift to public transport	<p>This risk is two-fold:</p> <ul style="list-style-type: none"> Continued suppressed demand for public transport following the pandemic. Public transport prices continue to be more expensive than private transport, inhibiting the shift away from cars. 	Continued support and effective messaging is required to encourage travellers back to public transport. The Government should ensure operators are able to deliver the improved, more affordable, lower-carbon public transport systems necessary to attract drivers to shift their journeys in order to reduce emissions.	Partly
EV charging infrastructure	The current roll-out of charging infrastructure is not at the pace required to reach the 2030 target of 300,000 public charge points, and current provision is uneven across the country. Moreover, as more people begin to transition to EVs, the uptake of EVs could outpace the roll-out of EV charging infrastructure, leading to drivers having difficulty charging their vehicles. This could deter future buyers from choosing EVs.	The UK Electric Vehicle Infrastructure Strategy is a positive step towards ensuring the required infrastructure is in place for the transition to EVs. Continued support, investment and focus on delivery are now important. The amount of public charge points needs to increase by around 30,000 per year to meet the required 300,000 public charge points by 2030.	Partly
EV accessibility	<p>This risk is two-fold:</p> <ul style="list-style-type: none"> EVs are not fairly available to everyone, the upfront cost is currently more expensive than conventional vehicles and there is not yet a strong second-hand market. If a strong second-hand market does not develop, there is a risk people will continue to drive old cars. Current charging infrastructure models mean that it is more expensive for those without a driveway or access to private parking to charge, therefore higher-income households that have access to private parking are benefitting more from the transition. 	Continued financial incentives are required for EVs, such as targeted grants and lower vehicle excise duty, to help facilitate the shift. Government must also explore opportunities to rebalance the costs between home charging and public charge points for local residents without private off-street parking, perhaps through contract schemes or subsidies, to ensure a fair transition.	Partly
EV supply chains	If battery manufacturing gigafactories aren't located in the UK then it is unlikely that vehicle manufacturers will manufacture EVs in the UK. This means that the UK will have little control over lifecycle, imported and embedded emissions in battery and EV manufacturing. It would also be detrimental to the job opportunities available to UK workers.	There have been some announcements around gigafactories being developed and located in the UK - if the overall capacity is around 140 GWh by 2040, this is less likely to be a risk. Based on current announcements, it is expected to be at least around 68 GWh/year by 2028.	Partly

	<p>Disruption to semiconductor supply chains and impacts following the pandemic has resulted in a 29% smaller new car market in 2021, compared with pre-pandemic levels. If this continues, the transition to EVs is likely to take longer and emissions will be impacted.</p>	<p>New car sales are likely to recover due to demand. However, semi-conductor supply chain issues are expected to continue in at least the short term, therefore more supply chain resilience is needed, particularly when designing the new supply chains required for producing EVs.</p>	No
Conventional vehicle efficiency	<p>If UK regulations on the CO₂ intensities of new conventional vehicles are weaker than those in other markets, then there is a risk that manufacturers view the UK as a dumping ground for older, less efficient models or those produced using out-dated production lines. Alternatively, manufacturers may aim to 'upsell' larger, more expensive (and less efficient) vehicles to the UK market. This could jeopardise achieving the emissions reductions required from this segment of the market.</p>	<p>Ensuring that the UK's CO₂ regulations are at least as strong as comparable markets, particularly the EU. These should be designed in such a way that they achieve the share of emissions reductions required through the uptake of hybrids and ensure sufficient progress on remaining sales of petrol and diesel vehicles.</p>	No

Endnotes

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Chapter 4: Buildings

89 MtCO₂e, 20% of UK emissions, in 2021

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Introduction and key messages

Buildings are the UK's second largest source of emissions (after surface transport). There has been no sustained reduction in emissions from buildings in the last decade reflecting low levels of annual home energy efficiency improvements. The Government's **Heat and Buildings Strategy** set out a range of policy mechanisms to decarbonise the sector, including a rapid scale-up of low-carbon heat supply chains through a market-based approach.¹ However, plans are not yet fully comprehensive or complete and significant delivery risks remain for many policy areas covered by the Strategy.

This chapter reviews progress in reducing emissions from UK buildings and outlines the next steps required to deliver key outcomes in the sector and to meet future carbon budgets.

Our key messages are:

- **Low-carbon heat.** The first pivotal outcome for the buildings sector is for the Government to create the conditions for sustained growth of new markets for low-carbon heat so that at least 600,000 heat pumps are installed each year by 2028, and up to 1.9 million by 2035:
 - The heat pump market is still far from this goal. Despite a 47% increase in 2021, annual heat pump installations were still at just 55,000 for the year.
 - A core part of the Government's approach for low-carbon heat is a proposed obligation on boiler manufacturers to sell a growing number of heat pumps each year. The Government set out the broad principles of this mechanism in May 2022 and intends to consult further.² These policies must be finalised and implemented within the next year if they are to drive the necessary growth in heat pump supply chains and cost reductions targeted by Government.
- **Driving decarbonisation in the context of high energy prices.** Record-high energy prices and the Government's commitment to move away from oil and gas make the case for energy efficiency and electrification in buildings stronger than ever. The second pivotal outcome in buildings is for as many homes as possible to reach EPC C by 2035. But current policy is insufficient to achieve this goal. The Government's responses to rapidly rising energy bills have so far missed the opportunity to address these issues:
 - Government schemes supported energy efficiency upgrades in more than 150,000 homes in 2021, a 12% increase from 2020. However, the number of homes receiving energy efficiency upgrades needs to increase to 500,000 homes per year by 2025, and one million per year by 2030 in the Government's pathway. The current pace of change is too slow.
 - Energy efficiency, particularly in owner-occupied buildings, is still a significant policy gap. These represent the majority of homes across the UK. However, the only policy proposal to cover this is a voluntary target for mortgage lenders to encourage borrowers to improve the energy efficiency of properties. This proposal has limited oversight and no enforcement mechanisms.

- Although the Energy Security Strategy recognised the need for demand reduction, it failed to offer any solutions. Policies to drive improvements in energy efficiency can help cut household energy bills as well as drive decarbonisation. Government should consider increasing funding and accelerating plans for energy efficiency policies, particularly in fuel poor homes.
- While HM Treasury has promised a consultation on reforming gas and electricity pricing, this has not yet been published. A clear policy decision must be made before next winter. This should allow for a ratio of gas to electricity prices that incentivises heat pumps, ensuring they will be cheaper to run than gas boilers.
- **Public awareness.** The Government has a critical role in raising public awareness of the need to decarbonise the UK's buildings and facilitating access to lower-emission options to households and businesses. The Government should use its forthcoming energy advice service to provide trusted information and access to qualified traders and providers in local areas. The service should be accompanied by a widespread publicity campaign to reach all households, and continuously monitored for reach and effectiveness.
- **Non-residential buildings.** There are also key policy gaps in non-residential buildings. Committed Government funding to decarbonise public buildings covers less than a half of the upfront costs of achieving the Government's 2037 target to reduce emissions from public buildings by 75% compared to 2017 levels. Plans also lack sufficient regulatory levers to drive the transition away from gas boilers in commercial buildings and the phase-out date for new gas boilers in non-residential buildings is too late.
- **Data and monitoring progress.** Data gaps or limitations in several areas are hindering the Government's ability to effectively develop, target and implement policies, and the Committee's ability to track progress. The Government should continue to work with the ONS to address the data gaps set out in this report and the accompanying Monitoring Framework. It should also set up an overarching monitoring and evaluation framework for the Heat and Buildings Strategy, to track progress against the many new policies and programmes it includes.
- **Integrating action on adaptation.** There is now policy to mitigate overheating risk for new build homes, which is a significant step forward. However, there remains a gap to incentivise adaptation action in existing buildings and to ensure overheating is considered in energy efficiency retrofits. There is also a need to further understand overheating in non-residential buildings, and for policy to incentivise action. The planning system needs to ensure that new developments consider all types of flood risk.

The rest of this chapter is laid out as follows:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

Buildings accounted for 20% of the UK's emissions in 2021, second only to surface transport which represented 23%.

The buildings sector contributed 20% of total UK emissions in 2021, of which the majority came from homes (Figure 4.1). Burning oil and gas to provide heating and hot water in homes is the biggest source of buildings emissions in the UK.

Direct emissions from buildings (on a temperature adjusted basis* i.e. allowing for the severity of winters) did not change significantly from 2015 to 2019 (Figure 4.1). In part this reflects that the number of homes receiving energy efficiency improvements each year fell dramatically after 2012, following changes to supporting policies (see section 2).

The COVID-19 pandemic drove an increase in home-working (Figure 4.2). This affected the normal patterns of building occupancy and emissions from homes and commercial buildings changed as a result. Temperature-adjusted buildings emissions increased by 5.4% between 2019 and 2020 and fell back down to near 2019 levels in 2021:

As more people work remotely emissions from homes have increased. This has not been offset by a corresponding reduction in emissions from non-residential buildings.

- Home working drove an increase in residential energy use in 2020, accompanied by a smaller fall in energy use in offices and other workplaces. This resulted in a 7.7% increase in emissions from homes and a 5% reduction in emissions from commercial buildings. Emissions from public buildings increased by 2.3%.
- Emissions from homes fell by 4.7% in 2021 (but are still above 2019 levels). The partial return to offices in 2021 is likely to have played a part in the reduction in emissions from homes.
- Commercial (1.1%) and public (0.4%) buildings emissions both fell in 2021, but this cannot yet be attributed to climate action.
- In March 2022 the proportion of home workers was back to pre-pandemic levels (Figure 4.2). However, this data does not indicate whether the number of days of home working (which would have an impact on energy use) has increased for those working from home. Recent surveys suggest that both businesses and workers expect higher levels of hybrid working after the pandemic.³

The effects of these behavioural changes on economy-wide emissions will depend on the amount by which energy consumption increases in residential buildings relative to decreases in non-residential buildings. The relative efficiencies of residential and non-residential building stock is also a factor, as well as secondary impacts on patterns of travel and transport emissions.

A shift to home-based working may also exacerbate the impacts of overheating within homes. This behavioural shift could lengthen the time that people are exposed to high temperatures indoors and negatively impact the productivity of homeworkers.⁴

* Temperature-adjustment removes the year-to-year effects of differing winter weather conditions on emissions. We updated our approach to temperature-adjustment of emissions this year – see Box 4.1 for further details.

Rising fuel costs may affect building emissions in 2022 if households and businesses respond to price rises by reducing their energy consumption.

Fuel costs started to rise significantly in 2021 and Ofgem increased the energy price cap in October as a result (Figure 4.3). This squeeze on household budgets may have reduced household energy consumption towards the end of 2021. While this is unlikely to have had a significant impact on 2021 buildings emissions, it may play a role in 2022. In January 2022, around a third of people who stated that their cost of living had increased in the last month said they were reducing their gas or electricity consumption as a result.⁵

Box 4.1

Changes to buildings emissions estimates since 2021

There have been two changes to buildings emissions figures this year, which impact on consistency with previous reports: a change in the CCC's approach to temperature-adjusting emissions; and a significant change to inputs to the emissions inventory for recent years.

Temperature adjustment methodology

Energy consumption and emissions in the buildings sector are strongly influenced by weather conditions – particularly temperatures during the winter. To allow meaningful evaluation of trends in emissions, the figures need to be temperature-adjusted. We temperature-adjust emissions figures by analysing the relationship between emissions data and quarterly Heating Degree Days (HDD).^{*} We use the difference between actual HDD figures and a long-term average to calculate the adjustment required.

Previous CCC analysis has relied on temperature-adjusted emissions data produced by BEIS. These values are based on the deviation of actual HDD figures from the 1981-2010 average. This average gives an adjustment which does not reflect underlying changes in the UK's climate over recent decades, resulting in emissions being over-adjusted upwards.

To address this issue, we have produced our own temperature-adjusted emissions figures, using 15 year moving averages of quarterly HDD data. The use of a moving average means that annual fluctuations in emissions due to changes in weather patterns are removed, while the impacts of longer-term climate trends on emissions from buildings remain visible.

The change in the methodology used for temperature-adjustment means that the temperature-adjusted emissions figures used in this report should not be compared with figures in previous CCC reports.

Changes to the emissions inventory

The stated figures for emissions from buildings for 2018, 2019 and 2020 differ between the 2020 and 2021 versions of the official emissions data in the emissions inventory. The latest figures for emissions in 2019 and 2020 are each around 4 MtCO₂e lower than previously reported.

The changes to the emissions data are largely due to revisions to the figures for consumption of 'petroleum products', 'natural gas', and 'bioenergy & waste' (which includes some renewables) in the Digest of UK Energy Statistics (DUKES).

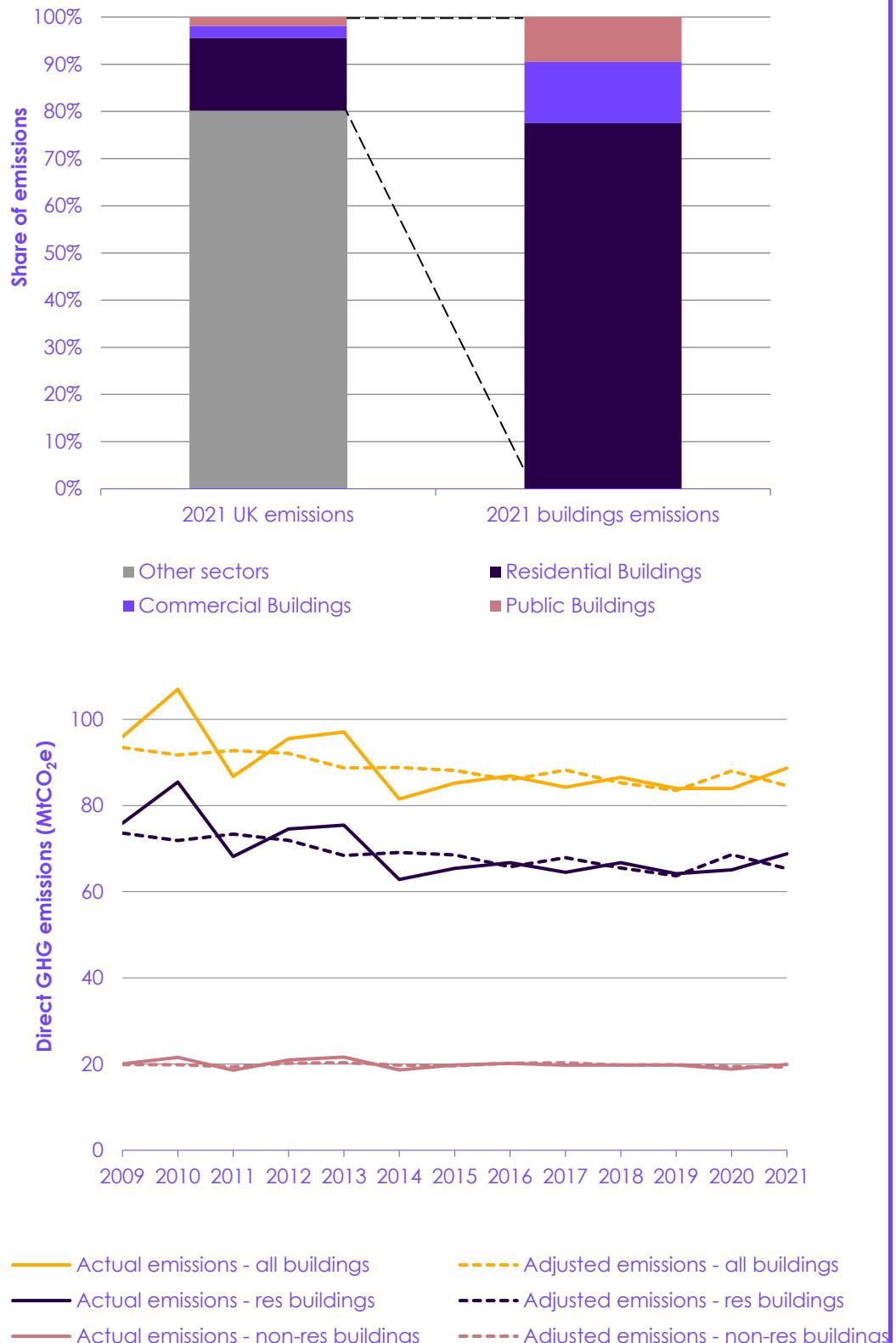
The revisions to the emissions data mean that some figures will not be consistent with those used in previous CCC reports, including the 2021 Progress Report.

Source: BEIS (2022) *Provisional UK greenhouse gas emissions national statistics 2021*; BEIS (2022) *Final UK greenhouse gas emissions national statistics: 1990 to 2020*; BEIS (2021) *Digest of UK Energy Statistics (DUKES) 2021*; BEIS (2022) *Average temperatures, heating degree-days and deviations from the long-term mean (ET 7.1)*; Energy Trends: UK weather; CCC analysis.

Notes: *Heating Degree Days are a measure of expected demand for heating, based on the average daily deviation of temperatures below a base temperature (typically 15.5°C), over a given time period, multiplied by the length of the period in days.

Homes produce the majority of emissions from buildings in the UK. Temperature-adjusted buildings emissions have been relatively flat since 2015.

Figure 4.1 Buildings emissions by sub-sector as a share of UK total

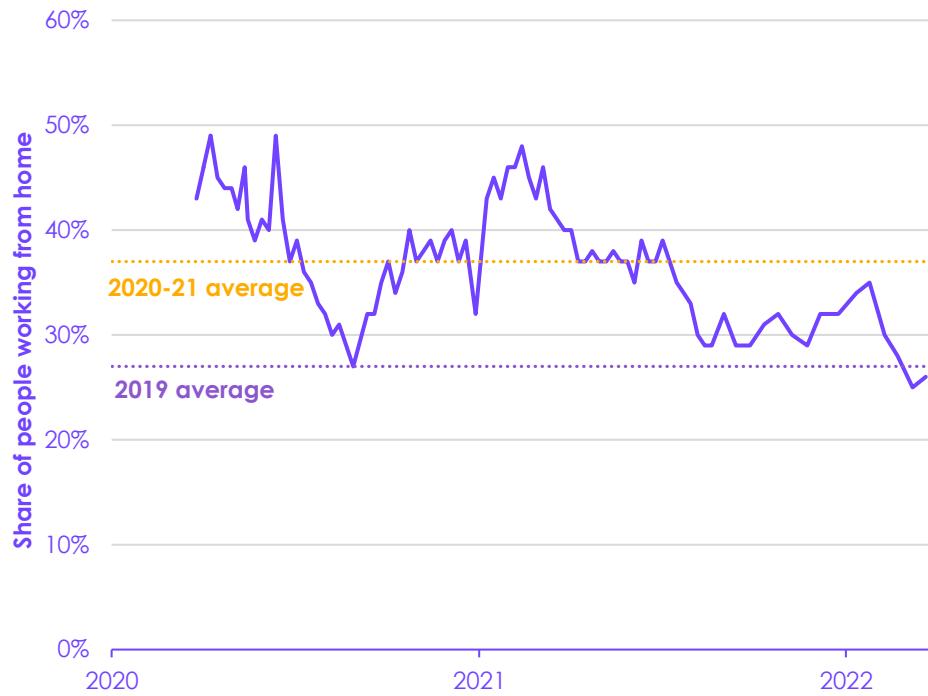


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; BEIS (2022) Average temperatures, heating degree-days and deviations from the long-term mean (ET 7.1); Energy Trends: UK weather; CCC analysis.

Notes: Relates to direct buildings emissions only. The bottom figure corresponds to temperature-adjusted emissions and is not directly comparable to the top figure. See Box 4.1 for more on temperature adjustment and changes in the emissions data for 2018, 2019 and 2020 in the latest emissions inventory.

There was a decrease in the percentage of people working from home in 2021, but numbers were still above pre-pandemic levels. By March 2022 the proportion of home workers returned to pre-pandemic levels, but this data does not specify the number of days worked from home.

Figure 4.2 Changes in working patterns since the start of the COVID-19 pandemic



Source: ONS (2022) *Coronavirus and the social impacts on Great Britain: 1 April 2022*; ONS (2021) *Coronavirus and the social impacts on Great Britain: 8 October 2021*; ONS (2021) *Business and individual attitudes towards the future of homeworking, UK: April to May 2021*.

Notes: Figures relate to the percentage of working age adults who have worked from home at any point in the past seven days.

The price of gas was more than six times higher in December 2021 than 2020. Households may respond to sustained high prices by reducing their gas consumption.

Figure 4.3 Changes in working patterns since the start of the COVID-19 pandemic



Source: ONS (2022) Dataset: System average price (SAP) of gas.

2. Indicators of progress

We have developed new indicators to understand how successful Government policies are in reducing emissions (or not). Our new indicators cover buildings energy supply and demand, and enablers such as public engagement and the workforce.

This section sets out key indicators of progress in the buildings sector. These cover heat demand in buildings, the supply of low-carbon heat to buildings and quantifiable enablers of success.

Figure 4.4 describes how policies should filter through to enabling factors (e.g. public engagement, the labour market) and to required outcomes, to drive a 55% reduction in buildings emissions by 2035. The details of how these work together to deliver the sector's decarbonisation pathway, along with a full set of data indicators designed to track each of these elements, are introduced in our accompanying Monitoring Framework. Progress this year on the key indicators is shown in Table 4.1 and Figures 4.5-4.15. Progress on the full set of indicators is shown in the supporting data to this report.

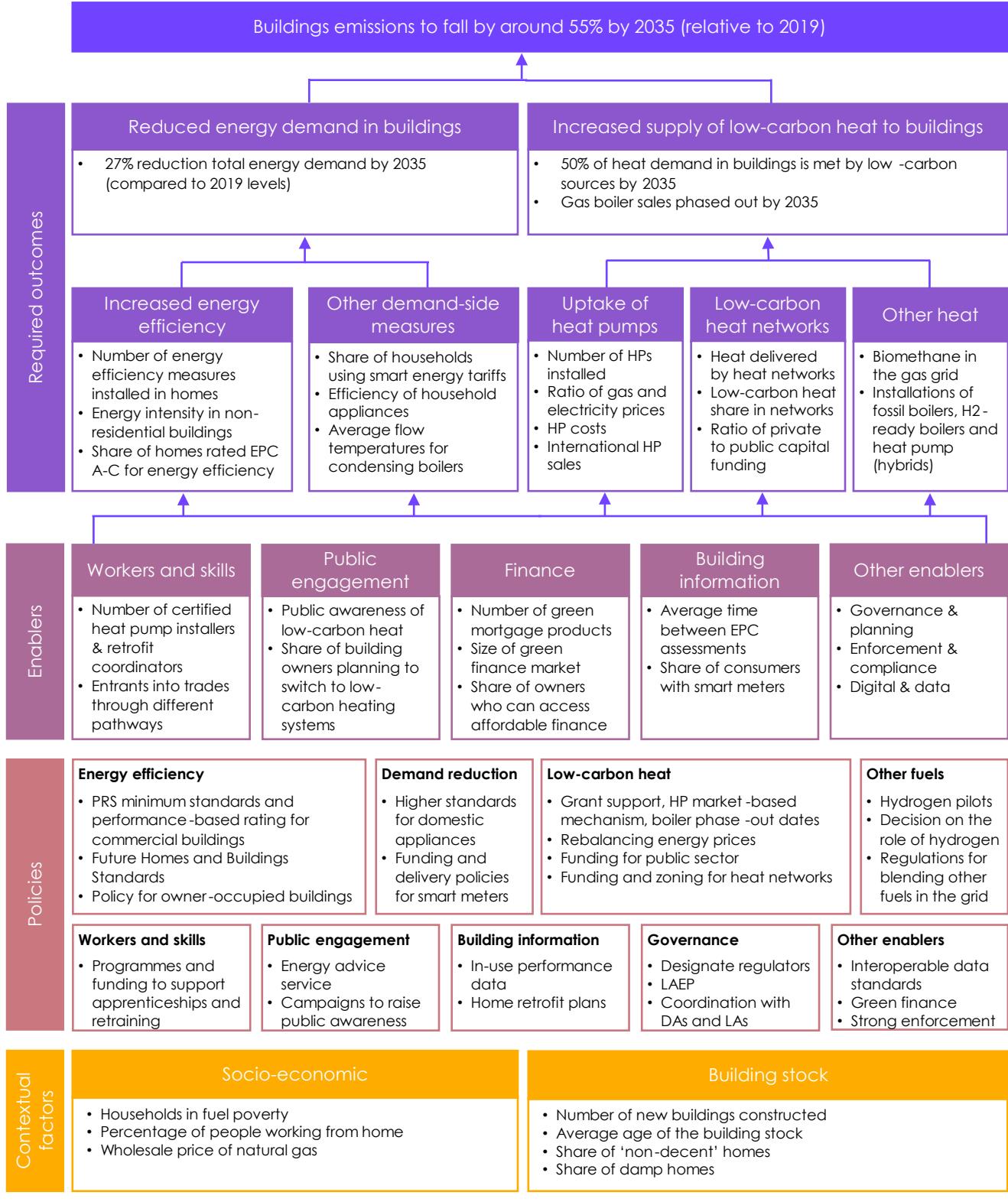
The key indicators describe a sector that is still in the early stages of a transition. While many indicators are trending in the right direction, improvements have generally been small:

- **Energy demand.** Energy demand in buildings has been relatively flat since 2015 (Figure 4.5). Progress in this area will require faster energy efficiency upgrades in homes (Figure 4.6). This should result in more buildings achieving an energy performance of EPC C or above (Figure 4.7). In non-residential buildings (many of which do not have EPC ratings), energy efficiency improvements should result in reductions in energy-intensity (i.e. the amount of energy used per unit of floor space) (Figure 4.8).
- **Supply of low-carbon heat.** The number of heat pump installations in the UK continues to grow but there is a long way to go to reach even near-term targets (Figure 4.10). As installations scale up costs should come down (Figure 4.11). The Government's ambition is to bring heat pump costs down by between 25-50% by 2025, and towards parity with gas boilers by 2030.
- **Enablers.** There are promising signs from some key enablers, such as public awareness of, and attitudes towards, low-carbon heat (Figure 4.15). Public willingness to make changes to their homes needs to ramp up quickly in the next few years and must be supported by Government action.
- **Data.** Reliable data in the buildings sector is particularly scarce. There are many data gaps, both in terms of coverage and frequency of reporting. As a fragmented sector, data is also often not compiled centrally, but held by several different organisations. This makes adequately tracking progress challenging.

Data gaps, including in terms of coverage and frequency, are a barrier to effectively tracking progress in the buildings sector.

We set out our summary of progress in three sections: energy demand in buildings, supply of low-carbon heat to buildings and enablers.

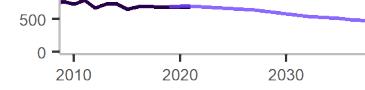
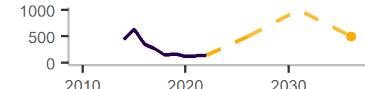
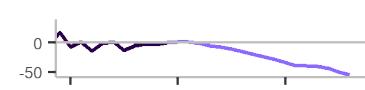
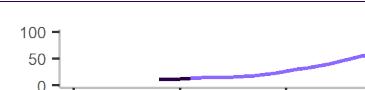
Figure 4.4 Monitoring map for buildings



Source: BEIS (2021) Heat and Buildings Strategy, BEIS (2021) Net Zero Strategy: Build Back Greener and accompanying documents; CCC analysis.
 Notes: We use the following acronyms: EPC - Energy Performance Certificates. H2-ready boilers - hydrogen-ready boilers. LAEP - local area energy planning. DAs - devolved administrations. LAs - local authorities. PRS - private rented sector. HPs - heat pumps. EE - energy efficiency.

Table 4.1

Key indicators for buildings

Buildings indicators		Most recent value			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Reduced energy demand	Energy demand in all buildings	2021	670 TWh	-1% from 2020	
	Homes treated with energy efficiency measures	2022	150 thousand	+12% from 2021	
	Energy intensity in non-residential buildings	2020	0% change from 2018	0% from 2019	
Increased supply of low-carbon heat	Percentage of heat demand met by low-carbon sources	2021	12%	+2% from 2020	
	Heat pump installations in homes	2022	54 thousand	+46% from 2021	
	Heat pump capital and installation costs	2023	£12,000	-7% from 2019	
	Heat supplied by low-carbon district heat networks	2019	1 TWh		
	Ratio of consumer electricity to gas prices	2022	5.2	+8% from 2021	
Workers and skills	Retrofit coordinators required	NA			
Public engagement	Share of homeowners who would replace their heating system with a heat pump	2022	24%		

Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.

Notes: All values are rounded to 2 significant figures; solid lines represent pathways; points represent in-year benchmarks; dotted lines show the linear rate of change required to meet in-year benchmarks; the dashed lines shown for the 'ratio of consumer electricity to gas prices' indicator represent the ratio below which heat pumps are as cheap to run as gas boilers, with the range representing different assumptions on heat pump and gas boiler efficiencies, which will influence the ratio where cost-parity is reached.

Energy demand in buildings

The main uses of energy in buildings are to provide heat and hot water. Buildings can be made more energy efficient by insulating them better and ensuring that machinery and appliances within them (such as white goods, lighting, and cooking equipment) are more efficient.

Energy demand in buildings has been broadly flat since 2015 (Figure 4.5). To meet Government targets a swift improvement in energy efficiency will be needed across all building types:

The Government substantially cut back its support for energy efficiency after 2012. As a result, too few homes across the UK are currently at or close to the required level of energy efficiency.

The energy intensity of non-residential buildings has not changed significantly since 2014. Progress on emissions will be seen when policies drive a sustained reduction in energy intensity.

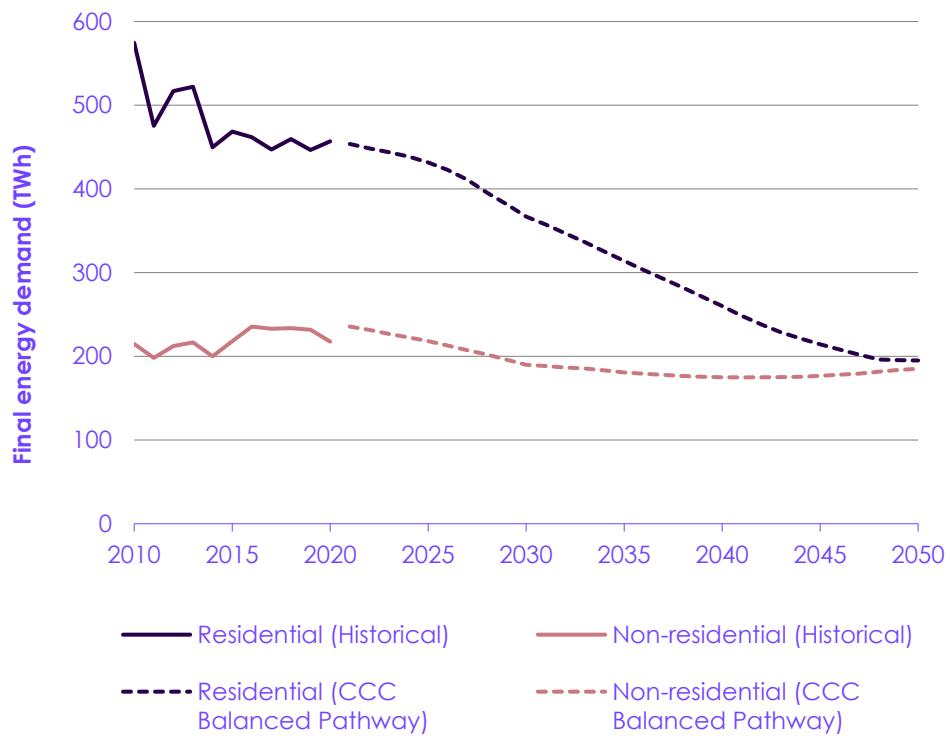
- Uptake of energy efficiency improvements in homes continues to stall (Figure 4.6) and is far below its peak in 2012, when Government started to scale down its schemes to support retrofits:
 - While already around two fifths of homes are estimated to be EPC C or higher (Figure 4.7), if the Government wants to meet its ambition for all homes to achieve Energy Performance Certificate (EPC) C by 2035*, the number of homes receiving energy efficiency upgrades needs to scale up substantially.
 - The available Government data on energy efficiency installations only corresponds to retrofits undertaken through public grants, and does not provide a complete picture of annual retrofits. It also does not tell us about the quality of the retrofits undertaken in homes, which will have an impact on the energy savings.
- For office and retail buildings (Figure 4.8) (which are some of the most significant sub-sectors of commercial buildings) there has been a slight increase in energy intensity since 2014.[†] The median energy intensity of various types of non-residential buildings tends to show a slight decrease in energy intensity since 2014.[‡] Improved Government data next year should allow us to track energy intensity for all non-residential buildings.

* "Where practical, cost-effective and affordable".

[†] Office and retail buildings are among the most significant sub-sectors for emissions from commercial buildings, along with buildings used for education, hospitality and storage. Estimates vary for the proportion of commercial building emissions they comprise, ranging from a fifth to a half.

Buildings energy demand must fall by around two fifths by 2050 to achieve decarbonisation targets, reflecting fabric efficiency improvements and highly efficient low-carbon heating technologies.

Figure 4.5 Energy demand in residential and non-residential buildings

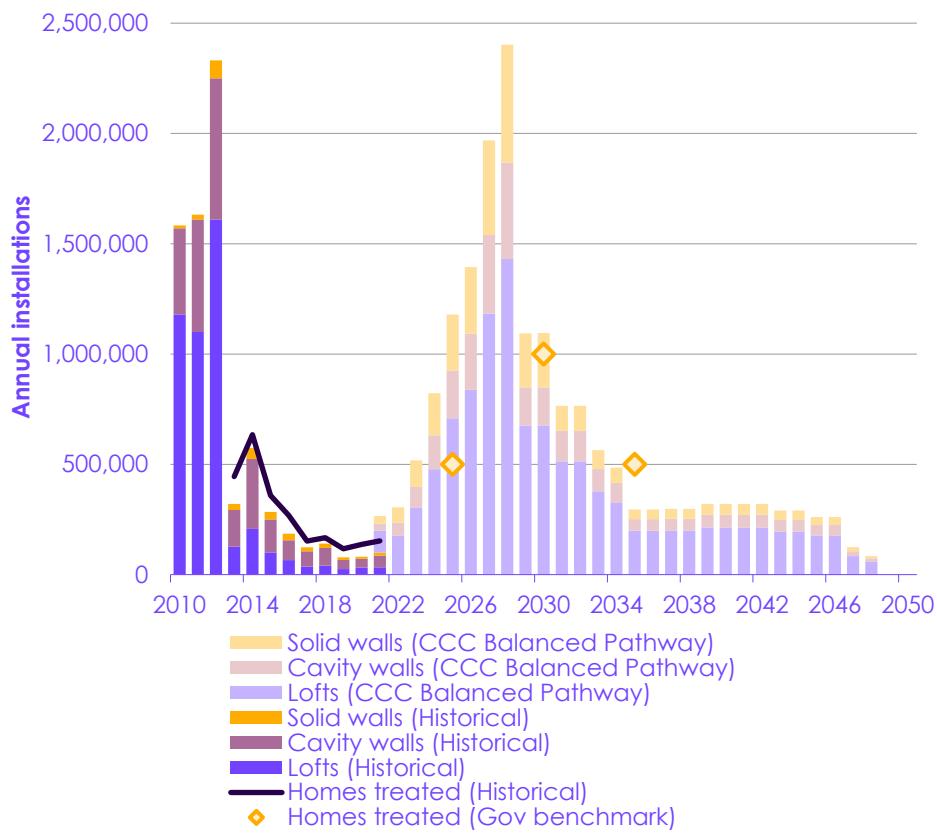


Source: BEIS (2021) *Energy consumption in the UK 2021*; BEIS (2021) *Digest of UK Energy Statistics (DUKES) 2021*; CCC (2020) *Sixth Carbon Budget*.

Notes: CCC pathways have been adjusted to align with actual energy demand in 2018.

Successive iterations of Government schemes have supported fewer installations of energy efficiency measures. The number of homes receiving upgrades needs to increase to close to levels last seen in 2012 in the CCC pathway. The Government pathway sees a million homes treated per year by 2030.

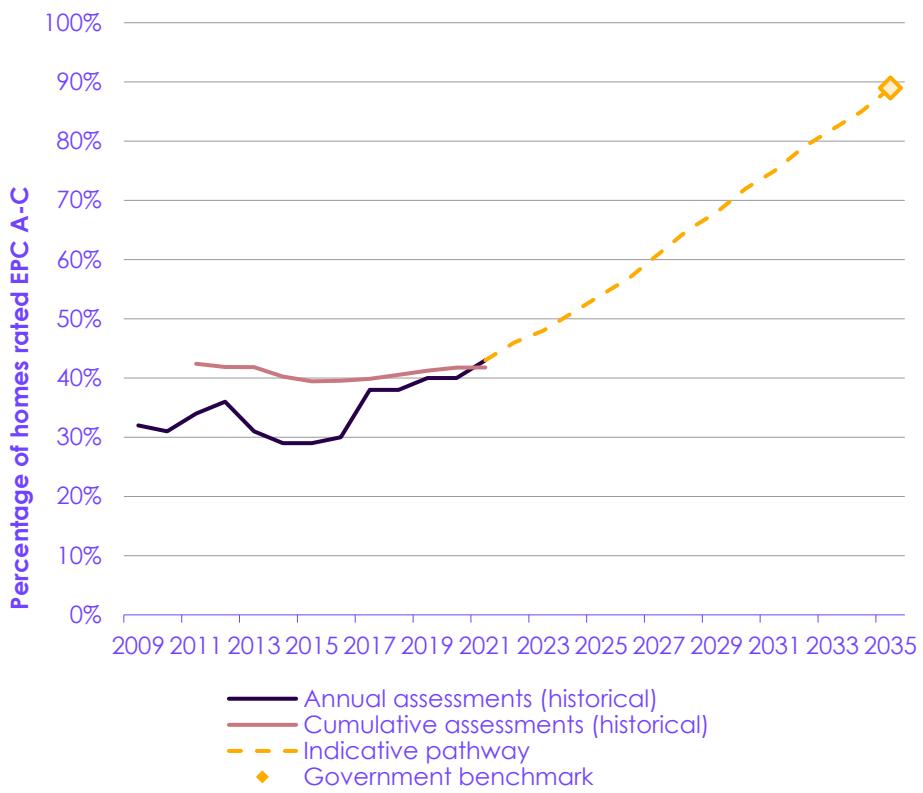
Figure 4.6 Home energy efficiency installations



Source: BEIS (2022) *Household Energy Efficiency Statistics*; BEIS (2021) *National Energy Efficiency Data-Framework (NEED)*; CCC (2020) *Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: charts and tables* (updated 5 April 2022). Notes: Historical data includes Government data on insulation measures delivered through the Green Deal, ECO and Local Authority Delivery scheme to capture solid wall, cavity wall and loft insulations. This means not all insulation measures are captured. For the LAD scheme data we only capture insulation measures from Phase 1 as data on Phase 2 specific insulation measures is not yet published. Data on homes treated is not directly comparable with the sum total of number of loft, cavity wall and solid wall insulations, as a single house might have multiple measures, or measures other than loft, cavity and solid wall insulations.

Around two-fifths of homes are rated EPC C or higher. The Government has a goal for all homes to reach EPC C by 2035, where practical, cost-effective and affordable.

Figure 4.7 EPC ratings in homes

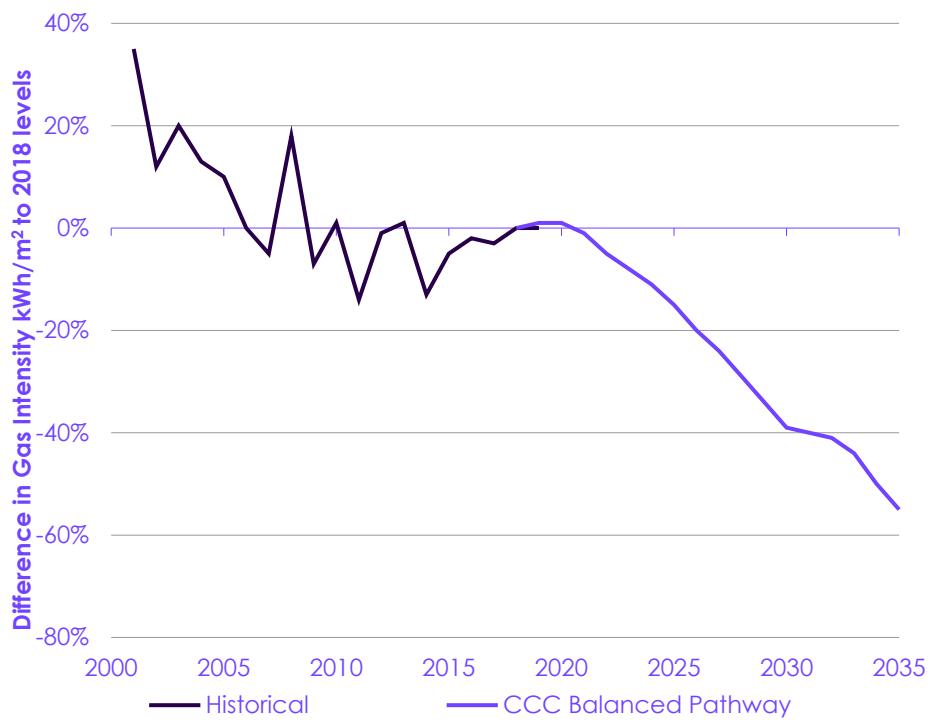


Source: Analysis by Eunomia for the CCC based on ONS, Energy Performance Certificate statistics for new and existing flats and houses and Government targets in the Heat and Buildings Strategy.

Notes: The annual historical pathway does not represent a snapshot of the state of the stock at any time – rather the percentage of EPCs lodged on the register during the time period in question. The cumulative historical pathway is based on ONS data for financial years up to March 2021. The Government target and indicative pathway to the target were produced based on Eunomia's assumption that 89% of homes in the stock can reach EPC C.

There has been no significant change in energy intensity in retail or office buildings since 2014. In the next decade a steep decline in gas intensity needs to take place.

Figure 4.8 Change in gas intensity for commercial retail and office buildings



Source: Analysis by Eunomia for the CCC based on ONS, Energy Performance Certificate statistics for new and existing flats and houses and Government targets in the Heat and Buildings Strategy.

Notes: The annual historical pathway does not represent a snapshot of the state of the stock at any time – rather the percentage of EPCs lodged on the register during the time period in question. The cumulative historical pathway is based on ONS data for financial years up to March 2021. The Government target and indicative pathway to the target were produced based on Eunomia's assumption that 89% of homes in the stock can reach EPC C.

Supply of low-carbon heat to buildings

Oil or gas boilers are currently the main fuel sources used to produce heat and hot water in buildings. The share of heat from low-carbon sources has been broadly flat since 2017 – a trend which needs to change.

Buildings produce direct emissions from boilers, stoves, and machinery; most of this comes from gas and oil, although coal and biomass still account for a small share of fuel use. Heat accounts for the largest single share of emissions from buildings – and decarbonisation depends on a successful transition to alternative sources, such as heat pumps, heat networks, hydrogen or biomethane.

The percentage of heat supplied to buildings which comes from low-carbon sources has been broadly flat since 2017 (Figure 4.9):

- **Heat pumps.** There has been an uptick in heat pump installations and a moderate fall in upfront costs, but faster progress will be needed. The costs of running a heat pump also need to come down:
 - Installations of heat pumps increased by 47% in 2021, but remain very low and need to increase more than tenfold over the next six years to meet Government targets (Figure 4.10). It is too early to say what is driving the 2021 increase. It could be part of a wider trend of growing heat pump demand, a response to the restart in the construction industry following a pandemic slowdown, or a rush to make use of the Renewable Heat Incentive (which ended in March 2022).⁷

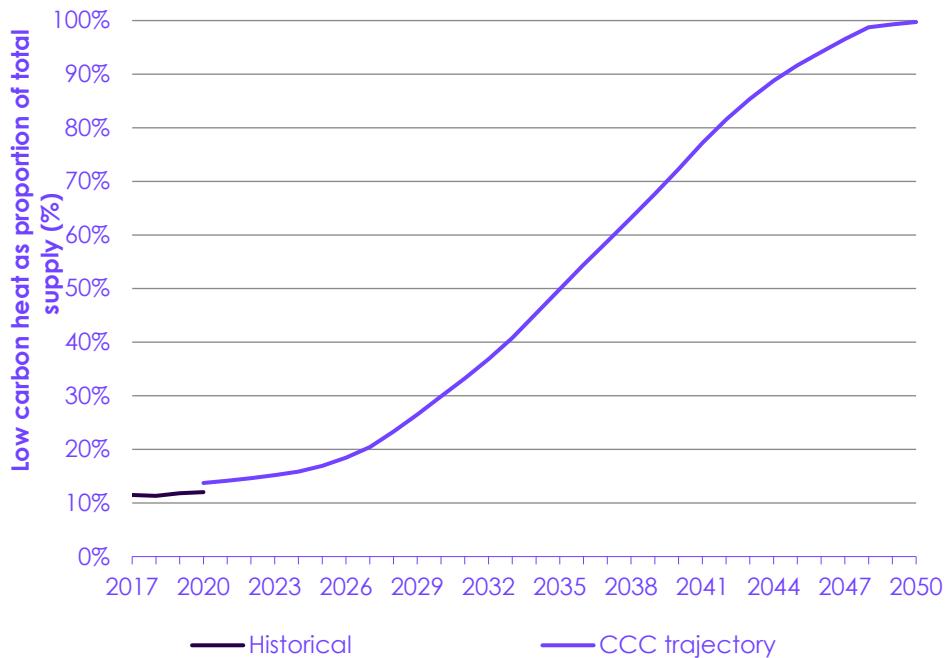
- As installation numbers ramp up, costs should come down – Government's ambition is to bring down heat pump capital and installation costs by 25-50% by 2025 and to reach cost parity with gas boilers by 2030. This will require a substantially faster reduction in costs than that seen since 2018 (Figure 4.11).
- Levies on energy prices are currently largely placed on electricity, making heat pumps more expensive to run than gas boilers. While current record high gas prices may have temporarily shifted the price ratio in favour of heat pumps, policy to remove current price distortions will be needed, particularly if Government is to achieve its aim of making heat pumps no more expensive to run than gas boilers by 2030 (Figure 4.12). See Box 4.3 and section on 'Fair funding and affordability' in chapter 14 for more on this.

More work is needed to fill data gaps relating to the growth of the heat pump market in the UK.

- To assess the success of the Government's market-based approach for heat pump roll-out requires forward indicators of how heat pump supply chains are developing. We commissioned Eunomia to develop forward indicators for heat pumps (see buildings chapter in the accompanying Monitoring Framework). While this has improved our understanding, given data limitations of the current market picture, there is more work to do to develop robust indicators of market build-up.
- **Heat networks.** The total amount of heat supplied by networks was 14 TWh in 2018 (10 TWh from district heat networks), the only year for which published Government data is available (Figure 4.13). The Government's Net Zero Strategy⁸ outlines a pathway for heat networks of all fuel types but does not yet have a published trajectory for low-carbon heat networks. By the 2030s the CCC pathway for low-carbon heat networks is more ambitious than the Government's trajectory for all heat networks.
- **Hydrogen and bioenergy.** The Government's plans for low-carbon heat include a role for bioenergy and may include a role for hydrogen, with a decision pending by 2026. Indicators of progress against these low-carbon heat sources are included in the accompanying Monitoring Framework.

The share of heat supplied from low-carbon sources has been broadly flat since 2017. This share must increase to 50% by 2035, and reach 100% before 2050.

Figure 4.9 Supply of low-carbon heat to buildings

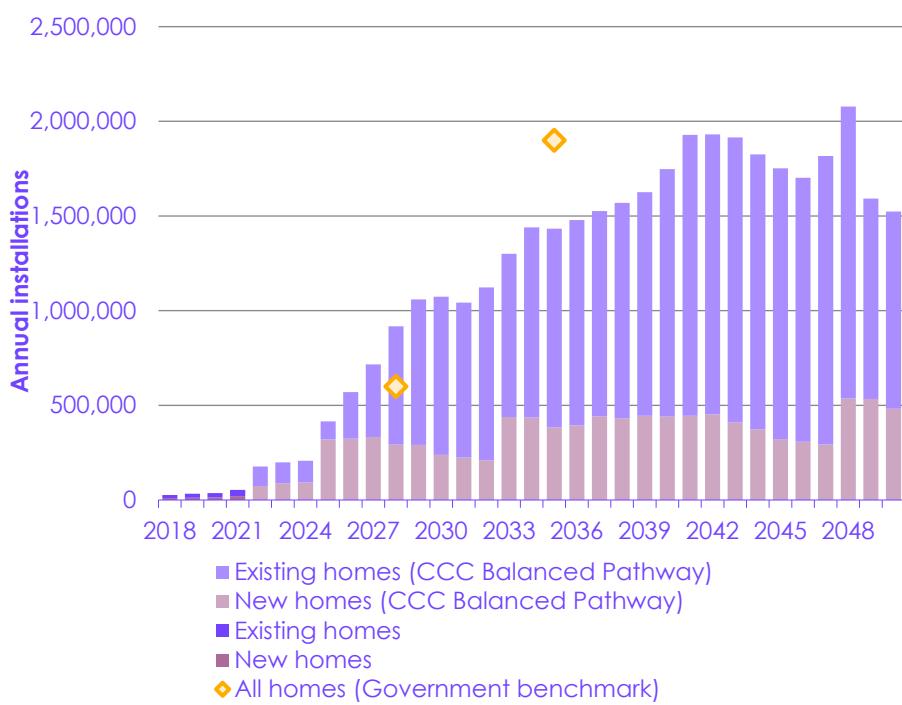


Source: BEIS (2021) Digest of UK Energy Statistics (DUKES) 2021; BEIS (2021) Energy Consumption in the UK (ECUK) 2021; CCC (2020) Sixth Carbon Budget; CCC analysis.

Notes: Low-carbon heat supplied includes all estimated consumption of electricity, renewables (including the 'renewable' input to heat pumps), and biomass, for space heating and hot water.

There were 54,000 heat pumps installed in homes across the UK in 2021. This contrasts to more than 1.7 million boilers. Government aims for at least 600,000 heat pumps to be installed annually by 2028.

Figure 4.10 Residential heat pump installations

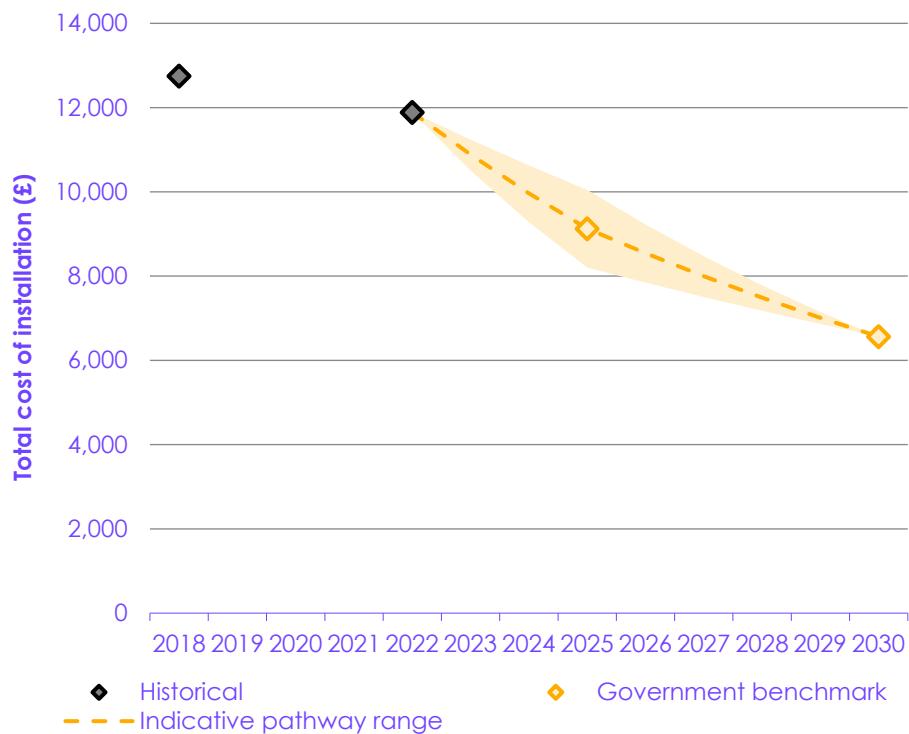


Source: BEIS (2021) Heat and Buildings Strategy; BEIS (2021) Net Zero Strategy: Build Back Greener; BSRIA (2022) Heat pumps market analysis 2021; CCC (2020) Sixth Carbon Budget.

Notes: Government benchmarks are for 2028 'at least' 600,000 heat pumps to be installed annually by 2028 and 'up to' 1.9 million by 2035.

Heat pump costs have come down by 7% since 2018.
Government aims to drive down the costs of installing a heat pump by 25-50% by 2025.

Figure 4.11 Average cost of buying and installing a heat pump

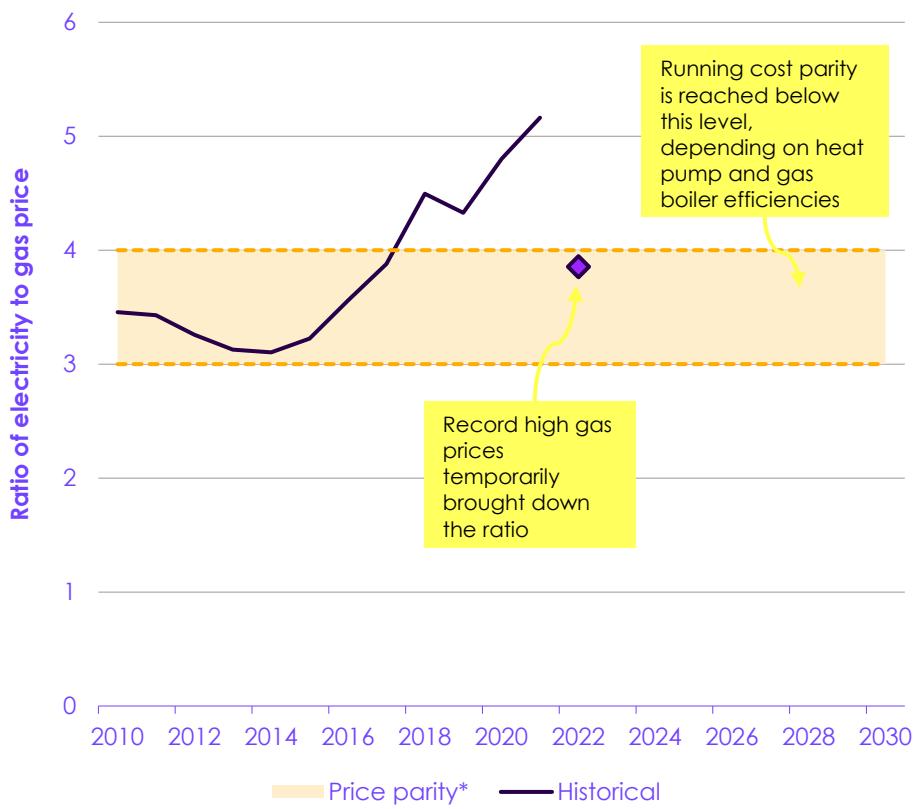


Source: Eunomia for BEIS for an upcoming project; Eunomia for the CCC.

Notes: Costs include heat pump unit costs, installation costs and costs of ancillary equipment (emitters, pipes, valves, thermostats etc) to get a view on full installation cost. Ancillary costs are not expected to come down as well established markets already. The Government pathway range was calculated by Eunomia for the CCC, based on a reduction of the unit and installation cost of 25-50% by 2025 and constant ancillary costs. The 2030 target is based on the current cost of purchasing and installing a gas boiler. If gas boiler costs change in future and price parity would be reached at a different level.

Levies currently placed on electricity prices mean that heat pumps are generally more expensive to run than gas boilers. Government aims for running cost parity to be reached by 2030, which implies a ratio of electricity to gas prices of around 3-4 or lower.

Figure 4.12 Ratio of gas and electricity prices

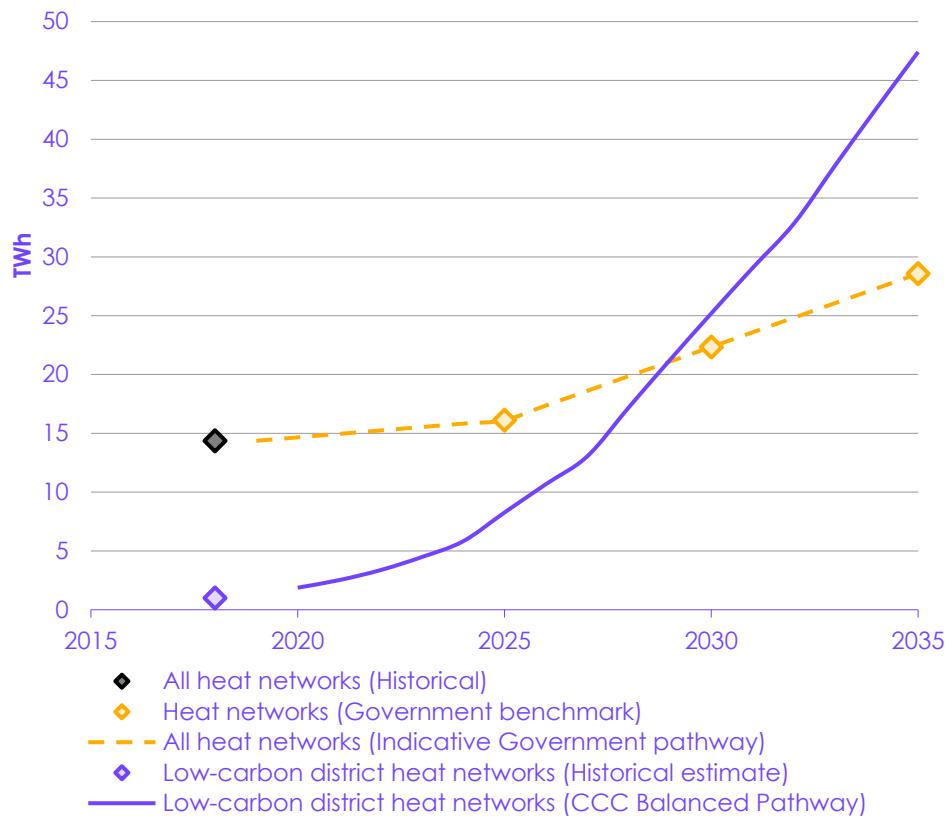


Source: Eunomia for the CCC; CCC (2020) Sixth Carbon Budget; Ofgem (2022) Default tariff cap level: 1 April 2022 to 30 September 2022; CCC analysis.

Notes: *The ratio below which the electricity to gas consumer price ratio results in running cost parity for heat pumps and gas boilers will depend on heat pump and gas boiler efficiencies. The range provided is indicative and based on gas boiler efficiency of 0.87 and heat pump efficiencies of 3.5 (efficiency reached by 2030 based on a flow temperature of 40°C) on the upper end, and 2.54 (efficiency in 2020 based on a flow temperature of 50°C) on the lower end. Electricity to gas prices for 2022 are based on Ofgem's price cap in April 2022.

Heat networks provided 14 TWh of heat in 2018, 10 TWh of which was from district heating and approximately 1 TWh estimated to be from low-carbon sources. Low-carbon heat networks provide more than 40 TWh of heat by 2035 in the CCC pathway.

Figure 4.13 Heat supplied by networks



Source: BEIS (2021) Experimental statistics on heat networks – data tables; BEIS (2021) Net Zero Strategy; CCC (2020) Sixth Carbon Budget; CCC analysis.

Notes: Heat networks include both district heat and communal heating. To estimate the heat supplied by low-carbon district heat networks, we take historical data on heat supplied by district heat networks and use assumptions from the Sixth Carbon Budget that 10% of existing district heat networks in 2018 were low-carbon.

Enablers

Improving buildings to be more efficient and use low-carbon heat sources requires a skilled workforce, access to affordable finance, public awareness, and good governance. We describe these factors (and others) as the 'enablers' of change.

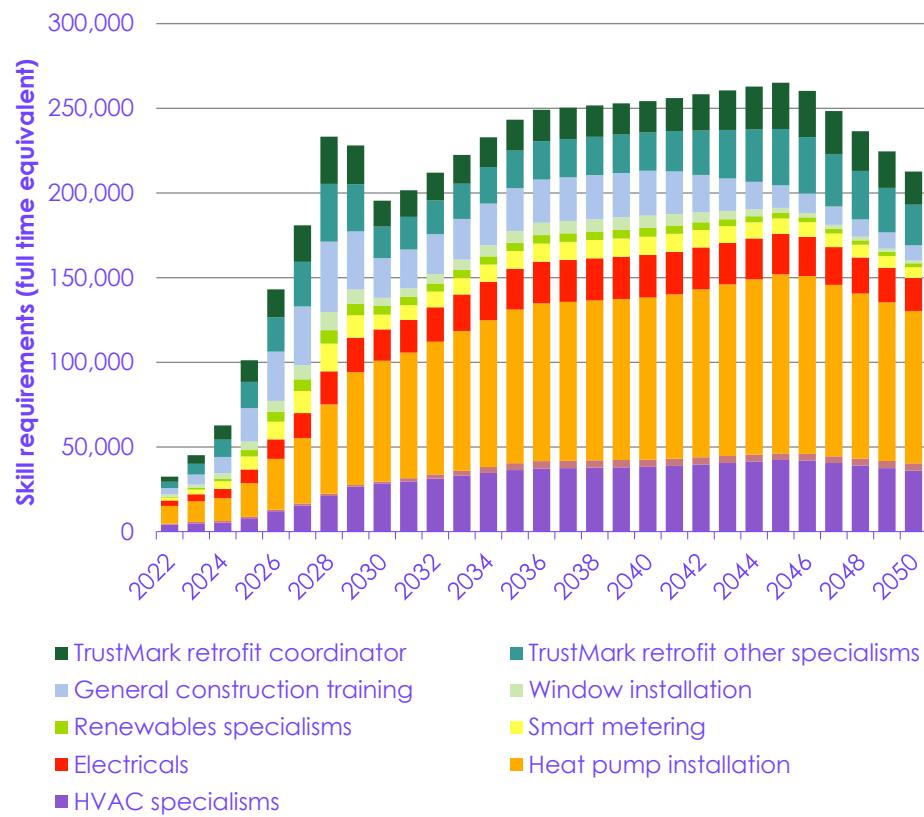
Enablers are a broad set of factors that have a significant bearing on the potential success of the Government's policies. Key enablers of success for the buildings sector include the availability of qualified workers and public attitudes towards policies and changes to buildings needed for decarbonisation:

- **Workers and skills.** The rapid roll-out of heat pumps, heat networks and energy efficiency retrofits will require thousands of skilled workers in construction and other related trades:
 - At present there is no publicly available data on the number of qualified heat pump installers in the UK. However, the ONS now includes heat pump installers within the Standard Occupational Classification (SOC) and data should be available from next year. There is also no publicly available data on the current number of retrofit coordinators, energy efficiency installers and assessors. The Government should consider the practicality of also including these trades within the SOC.

- We are also unable to track how many people are entering into these professions each year through different pathways (retraining or new entrants), as much of the relevant data is held by local colleges or private businesses and is not currently aggregated centrally.
- Despite a gap in understanding current employment in particular occupations, research by the Construction Industry Training Board suggest that decarbonisation measures in our Balanced Pathway could require more than 200,000 new jobs by the mid-2020s (Figure 4.14).
- **Public engagement.** By 2028 at least a fifth of homeowners replacing boilers at the end of their lifetimes will need to choose a heat pump for Government targets to be met, possibly more depending on the extent to which early heat pump sales rely on homeowners rather than those privately or socially renting:
 - As of 2021, almost a quarter of homeowners state that they would consider buying a heat pump when their boiler needs replacing (Figure 4.15). While this is encouraging, only 54,000 heat pumps were purchased for homes in 2021 (equivalent to 3% of households whose boilers it is assumed needed replacing).
 - Public engagement and access to quality information is needed to increase the proportion of homeowners likely to replace their boiler with a heat pump, and enable those who would consider purchasing a heat pump to follow through with the decision.

Decarbonisation measures in the CCC's Balanced Pathway could require more than 200,000 new jobs by the mid-2020s. There is currently no publicly available data on the size of this workforce.

Figure 4.14 Workforce requirements

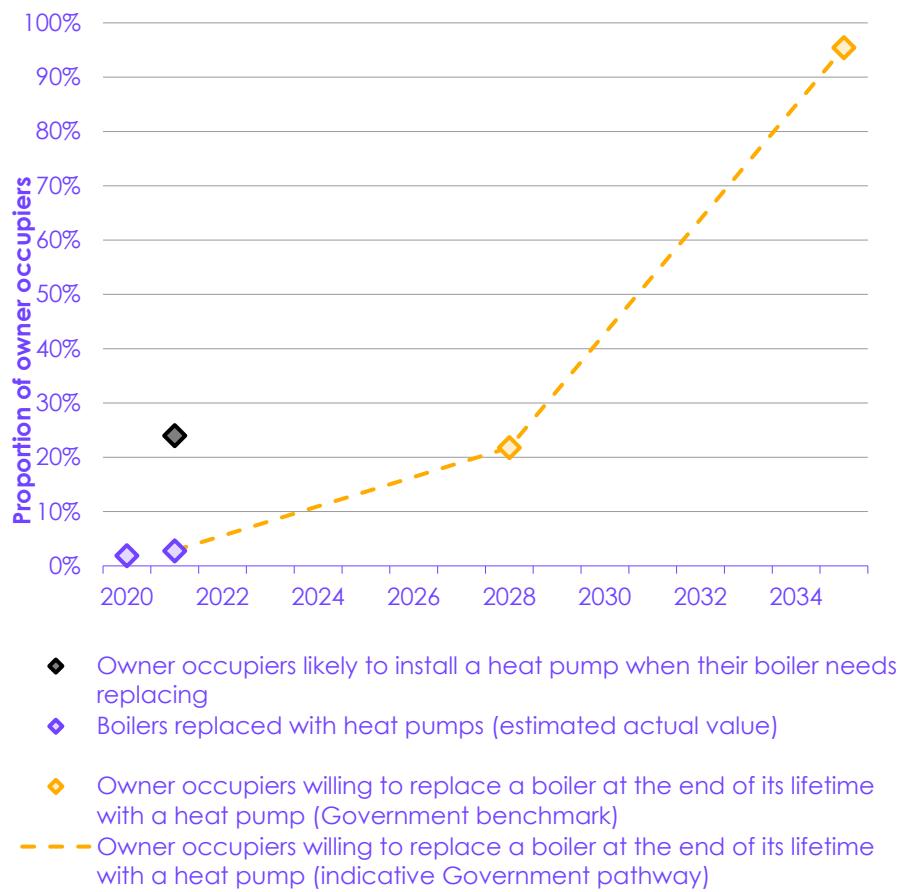


Source: CITB (2020) Building Skills for Net Zero; CCC analysis.

Notes: Figures adjusted to represent a 2-year rolling average. 'TrustMark retrofit other specialisms' includes retrofit designers, installers, advisers and assessors. FTE equivalent by skills do not sum exactly to equivalent numbers by trade due to mapping.

Currently almost a quarter of homeowners say they are likely to install a heat pump when replacing their heating system. However, there is a difference between reported likelihood and actual purchasing decisions, which are also affected by information, costs and convenience.

Figure 4.15 Homeowner readiness to install a heat pump when their boiler needs replacing



Source: BEIS (2022) Public Attitudes Tracker; CCC (2020) Sixth Carbon Budget; BEIS (2021) Heat and Buildings Strategy; CCC analysis.

Notes: 'Owner occupiers likely to install a heat pump when their boiler needs replacing' is based on BEIS survey data which covers individual homeowners, excluding those who said the choice of heating system was not their decision to make. We include those who said they were likely or very likely to install a heat pump when they need to replace their heating system. We do not include those who had already installed a heat pump. The Government benchmark is based on Government's stated ambition to install at least 400,000 heat pumps annually in existing homes by 2028 and 1.7 million by 2035. We estimate how many owner occupiers, out of those whose boilers need replacing in a given year, would need to buy a heat pump, in order for Government annual heat pump targets to be met. We assume boilers have a 15-year lifetime. We do not draw a distinction between homes on and off the gas grid. The estimated actual value of heat pump installations is based on BSRIA data, adjusted based on assumptions from the CCC's Sixth Carbon Budget about the proportion of heat pump purchases made by owner occupiers.

3. Policy progress, assessment and next steps

The Government has laid out a comprehensive set of policies to decarbonise buildings. These represent a meaningful step forward in ambition and offer much-needed detail about how the sector will change over the next decade.

The UK Government has set out its plans to decarbonise the buildings sector in the **Heat and Buildings Strategy, Net Zero Strategy** and accompanying consultations and proposed regulations. The Committee published a comprehensive assessment of these strategies in March 2022 (see our report Independent Assessment: The UK's Heat and Buildings Strategy).⁹

This Progress Report provides a summary of those conclusions and sets out updates where they have occurred since March. It also provides additional detail on policy progress in Scotland, Wales and Northern Ireland.

Overall we have seen a meaningful step forward in both the ambition and detail of policies put forwards by the Government since our last Progress Report. While there is a lot of work still to be done, we now have a clearer picture of how Government intends to reduce emissions from buildings in line with the Net Zero target:

- **Progress.** Clear progress has been made on policies for low-carbon heat, with new frameworks for heat networks, and a proposed market-based approach to grow supply chains for heat pumps. The Government has sent clear signals about the standards that will be required from new buildings in the future and launched a framework for improving the efficiency of home appliances which should bring about significant improvements and emissions savings.
- **Policy gaps.** However, key policy gaps remain. Most critically, there are no policies for energy efficiency in owner-occupier households (which are not fuel poor). But the UK Government has also not done enough to provide a long-term funding settlement for public buildings; nor has it taken strong enough action on boiler phase-out dates, particularly for commercial buildings.
- **Enablers of success.** There are related policy areas which are critical enablers of success. These include workers and skills and public engagement. The Government needs to devote more time and focus to key questions in these areas, coordinating work across many departments. Otherwise, there are serious risks that good policies for low-carbon heat and energy efficiency are undermined by the lack of key enablers.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of plans and policies
- (c) Recommendations

(a) Policy progress

Residential buildings (71% of buildings abatement in 2035)

Increasing the adoption of heat pumps will be driven by a market-based approach, supported by boiler phase-out dates, some limited funding, and action on the costs of energy.

Heat pumps and fossil fuel phase-out

The UK and devolved governments have indicated that they expect heat pumps to be the major low-carbon heating technology in homes in the future:

- **UK.** The UK Government's approach to incentivising heat pumps, set out in the Heat and Buildings Strategy and subsequent documents, relies on four key levers for existing homes:
 - **Boiler phase out.** Future phase out dates for new fossil fuel boilers, depending on ownership and housing type. This will allow households to replace their heating systems in line with the expected lifecycle of existing boilers.
 - **Heat pump market growth.** A market-based approach to significantly increase the number of installations of heat pumps across the UK. The Government's May 2022 response to the market-based mechanism consultation indicates that this would involve placing an obligation on boiler manufacturers to sell a rising proportion of heat pumps relative to fossil fuel boiler sales. The Government is continuing development of the mechanism design and intends to consult again prior to implementation.¹⁰
 - **Government grants.** Limited demand-side stimulus in the form of the £450 million Boiler Upgrade Scheme,* available to non-fuel poor homes and small businesses both on and off the gas grid. This should support around 90,000 heat pump installations in total, or 30,000 per year over the next three years. Other allocations to fuel poor households should also stimulate the market (see below).
 - **Rebalancing running costs.** To support the new market frameworks the Government intends to rebalance consumer gas and electricity prices, to make heat pumps cheaper to run and more appealing to consumers relative to gas boilers. Despite committing to consult on the issue, Government has made no progress on energy levies since the publication of the Net Zero Strategy in October 2021.
- **Scotland.** Scotland aims to phase-out the installation of new or replacement boilers in its 450,000 homes which are off the gas grid from 2025. The Scottish Government will also produce a Supply Chain Delivery Plan which will include proposals to develop markets for zero emissions heat in Scottish buildings.
- **Wales.** No plans for a fossil fuel boiler phase-out have been proposed for Wales. The proposed manufacturer obligation for heat pumps would apply to Wales.

* The £450 million Boiler Upgrade Scheme will provide £5,000 towards the cost of an air source heat pump or biomass boiler, or £6,000 towards the cost of a ground source heat pump. While the scheme will run from 2022 to 2025, there is no limit on the number of grants which can be awarded in a given year other than the total amount of funding available for the scheme.

- **Northern Ireland.** Northern Ireland recognises heat pumps as a key low-carbon technology in its energy strategy. The domestic energy efficiency retrofit pilot schemes announced (see below) will also take into account heat pump requirements. It has also made a commitment to launch a consultation on decarbonising heat.

Heat networks

A series of meaningful actions to support the development of heat networks have been taken by UK and devolved governments. However, there is currently a patchwork approach to the development of heat networks across the country, with different levels of ambition and pace across the UK nations:

Heat Networks will be a key technology in heat dense areas like cities, or around anchor loads such as schools and hospitals. The Government has introduced new policies to support the wider development of heat networks, such as zoning regulations and new funding through the Green Heat Networks Fund.

- **UK.** The UK Government has appointed Ofgem as the heat networks regulator for Great Britain and provided new funding through the Green Heat Networks Fund, which covers England and Wales. This follows the Heat Networks Investment Programme, with a key change being that all new networks need to use low-carbon heat sources. In England, local authorities will also receive new powers to designate heat network zones, with new homes and commercial buildings within the zones required to connect to the network.
- **Scotland.** The Scottish Government has gone further with its own proposals for heat networks, recently developing new regulations for heat network zoning following the passage of the Heat Networks (Scotland) Act 2021. The Scottish Government will also consult on how it can use new and existing powers to introduce mandatory connections for large and publicly-owned buildings, and to de-risk investment in heat networks.
- **Wales.** The Welsh Government highlighted priority areas for heat networks in its National Plan 2040, published in 2021. It recommends planning authorities explore opportunities for district heat networks, particularly in priority areas. Plans to provide further support for implementation have been announced since.
- **Northern Ireland.** The Government of Northern Ireland consulted on a heat networks market framework in January 2022. This included new proposals to legislate for greater consumer protections for people connected to heat networks and to support the growth of the heat network sector. The consultation proposes to develop the role of the Northern Ireland Authority for Utility Regulation as heat networks regulator.¹¹

New building standards will come in from 2025 which will require high levels of efficiency and low-carbon heat in all new builds.

New homes

The UK continues to build new homes to standards which do not align with the Net Zero target. Ensuring that new homes produce no direct emissions and are coupled with high levels of fabric efficiency is an essential and no-regrets step. Governments across the UK have now acknowledged this point in their strategies:

- **UK.** The UK Government's response to the Future Homes Standard consultation confirmed that the standard will require both low-carbon heating and high levels of fabric efficiency in new homes from 2025 (although these do not meet ultra-high efficiency standards).¹² Since then the Government has introduced interim building standards to help manage the transition.¹³ However these can still be met without low-carbon heating – relying on high fabric efficiency and solar PV to reach the requirement.

Between now and 2025 an interim set of building standards will require higher levels of efficiency. But these can still be met with a condensing boiler, where homes reach the requirement through high levels of fabric efficiency and solar PV installations.

- **Scotland.** From 2024 new homes in Scotland will be required to use heat sources that produce zero direct emissions and have high levels of fabric efficiency.*
- **Wales.** In July 2021 the Welsh Government confirmed new social homes would need to be EPC A and not rely on fossil fuel heating. It intends for a similar standard to apply to all new homes from 2025.
- **Northern Ireland.** Northern Ireland is introducing a phased approach to improve new build standards, starting with an interim uplift to standards on the emissions intensity of new homes, coming into effect in June 2022.¹⁴ It has set out an intent to bring standards in line with proposals in the Future Homes and Buildings Standards (which apply to England) a year later,[†] while taking into account specific circumstances in Northern Ireland.¹⁵ Northern Ireland's energy strategy, The Path To Net Zero Energy, published in December 2021, includes a commitment to ensure all new buildings are Net Zero ready by 2026/27 or earlier, if practicable.

Energy efficiency continues to be a neglected policy area, despite offering near-term benefits to households by helping to lower bills, and long-term benefits by enabling lower emissions.

Energy Efficiency

There has been limited UK-wide progress on policies to improve the fabric efficiency of homes. This is a significant policy gap, in particular for owner-occupiers. Energy efficiency measures are needed both to support the deployment of low-carbon heating systems, as well as help households manage the costs of energy, both in the near term and the future. More progress has happened in Scotland in the last year:

- **UK.** The Government's overarching target is for most homes to achieve EPC C by 2035, but there are not yet firm policies or consultations on how this will be achieved for the majority of the housing stock. Positive progress includes additional funding for the Social Housing Decarbonisation Fund through 2025. A commitment to finalise proposals made in 2020 to increase minimum energy efficiency standards for the private rented sector to EPC C by 2030 is over a year behind schedule.
- **Scotland.** In October 2021 the Scottish Government confirmed it is working with the private rented sector to introduce minimum EPC C at change in tenancy, with a backstop of 2028. It also committed to consult on requiring EPC C in owner occupied homes at key trigger points, ensuring all homes meet the standard by 2033. It committed to consult on options for requiring minimum EPC C in mixed tenure homes, to ensure all reached the standard by 2040-2045. It indicated a 'milestone' of 2032 for EPC B in social homes, and proposed to review the Energy Efficiency Standard for Social Housing by 2023.
- **Wales.** In May 2022 the Welsh Government published a consultation on a new Welsh Housing Quality Standard which will seek to bring all social housing as close to EPC A as possible by 2033, with a mandated process for each social landlord to follow.¹⁶ Beyond this, energy efficiency regulation is a reserved area of policy.

* This will apply to new homes for which a building warrant is applied for from 2024.

† 2022/23 for the interim uplift in standards and 2026/27 for the uplift in line with the Future Homes and Buildings Standards.

- **Northern Ireland.** Northern Ireland has made a commitment to launch a significant pilot scheme in 2022 for domestic energy efficiency retrofits, and to use the findings to inform new business models for ramping up delivery.¹⁷

The Government has made a commitment to support fuel poor homes through the Net Zero transition. As a result of recent energy price rises, the number of fuel poor households has increased dramatically.

Fuel poor homes

The UK and devolved governments have committed to support fuel poor households – providing funding for home improvements that reduce both emissions and energy bills:

- **UK.** The UK Government has provided further funding for energy efficiency and low-carbon heat retrofits in fuel poor homes. This includes £4 billion for the fourth round of the Energy Company Obligation¹⁸ (2022-2026), the Home Upgrade Grant (HUG), Social Housing Decarbonisation Fund and Local Authority Delivery (LAD) scheme, totalling nearly £8.2 billion in funding out to 2026.¹⁹
 - Recent record increases in energy prices mean that this allocation is unlikely to be sufficient, as it was based on fuel poverty estimates which predate price rises. Recent estimates suggest that an additional 2 to 4 million households (depending on the definition of fuel poverty used) may be pushed into fuel poverty.^{20,21}
 - There are also ongoing issues with the way that the UK Government targets this funding that limit the effectiveness, equity and reach of these schemes.²²
- **Scotland.** The Scottish Government set targets to get all fuel poor homes to EPC C by 2030 and EPC B by 2040. It continues to work towards these, prioritising those least able to pay for home upgrades in the design of new delivery programmes.
- **Wales.** The Welsh Government has committed to continue the Warm Homes Programme, which installs energy efficiency measures and new (often fossil fuel) heating for fuel poor households, until 2023. In early 2022 the Welsh Government held a consultation on the next iteration of the Warm Homes Programme.
- **Northern Ireland.** Fuel poverty alleviation is a specific objective and measure of progress in Northern Ireland's energy strategy. Although it has not provided new commitments, it set out an intention to provide financial support to encourage decarbonisation in low-income households.

The Government's Net Zero pathway expects biomethane to provide 2.8 TWh of heat by 2031.

Biomethane

The UK Heat and Buildings Strategy sets out plans to increase the amount of biomethane in the gas grid and aims for the Green Gas Support Scheme to deliver 2.8 TWh of renewable heat per year by 2031.

The Government continues to evaluate the potential for hydrogen as a low-carbon fuel for heating. It will take a strategic decision on hydrogen in 2026.

Hydrogen

The UK and devolved governments are taking steps to evaluate the potential of hydrogen as an energy source for buildings and keep it open as an option:

- The UK Government has committed up to £300 million until 2024 towards various pilot programmes and innovation schemes for hydrogen, with an intention to take a decision on the role of hydrogen in buildings by 2026. These include the 'Hydrogen Village' trial which will take place by 2025.²³

The Government confirmed in April 2022 its intent to go ahead with legislative amendments required to facilitate the trials, alongside measures to strengthen consumer protection for those involved.

- The UK Government's Hydrogen Strategy also provided details on how the Government is working with industry and regulators to evaluate the safety case, and technical and economic feasibility of blending hydrogen into the existing gas network. The goal is to take a final policy decision on this in 2023.²⁴
- **Wales.** The Welsh Government launched its Welsh Hydrogen Business Research and Innovation for Decarbonisation initiative to invest in innovative hydrogen projects across Wales. The Welsh Government is yet to publish its hydrogen pathway, following the conclusion of a consultation in April 2021.
- **Scotland.** The Scottish Government has published a draft Hydrogen Action Plan.²⁵ This proposes a range of initiatives to lay the groundwork to enable hydrogen as a heat source in buildings. Measures include ongoing support for the H100 Fife project, and other evidence-gathering activities which could support decision-making by the UK Government.
- **Northern Ireland.** Northern Ireland set out plans to create a 'Hydrogen Catapult', a hydrogen research centre in partnership with academia to bring together actors in the hydrogen economy.

Commercial and public buildings produce around a quarter of buildings direct emissions.

Commercial and public buildings (29% of buildings abatement in 2035)

Boiler phase out

The Government has proposed dates by when installations of gas and oil boilers will be phased out to provide direction for the market:

- **UK.** The UK Government announced proposals to phase out installation of new boilers in large non-residential buildings off the gas grid from 2024 in England, and to phase out installation of new gas boilers in 2035.
- **Scotland.** The Scottish Government proposed, subject to UK Government decisions in reserved areas, that boilers off the gas grid will be phased out in 2025, and installation of new gas boilers will be phased out in 2030, for owner occupied and privately rented homes.

The Government proposes to use large non-residential buildings to provide the 'anchor' demand for new heat networks.

Heat networks

The residential buildings section set out full progress on heat networks, which has implications for all buildings. The UK Government proposed that within heat network zones, large non-residential buildings should be required to connect to a heat network within a given timeframe (a recent consultation proposed a series of trigger points to connect, with a backstop deadline of ten years).²⁶

New commercial and public buildings

Requirements for new buildings to be low-carbon have also progressed for the non-residential sector:

- **UK.** In December 2021, the UK Government published the outcome of the Future Buildings Standard consultation, confirming their commitment to energy efficient new non-residential buildings which rely on low-carbon heat.

- **Scotland.** In 2021, Scotland committed to introducing the New Build Zero Emissions from Heat Standard, requiring new buildings to use zero emissions heating and to have high energy efficiency. These will apply to non-residential buildings applying for a warrant from 2024 and where it is technically feasible. In addition, it committed to use the voluntary Net Zero Carbon Public Buildings standard to introduce regulations across non-residential buildings from 2023-2025.
- **Wales.** In October 2021, Wales published a consultation on energy efficiency and ventilation requirements in building regulations for non-residential buildings.

Energy efficiency in existing commercial and public buildings

Proposals to improve energy efficiency in non-residential buildings are under development, but there has been no significant progress since last year:

- **UK.** The UK Government is developing promising proposals to introduce a performance-based rating scheme for large commercial buildings, and to require a minimum of EPC B by 2030 in privately rented non-residential buildings. However, no significant further announcements have been made for either of these proposals since our 2021 Progress Report.

The Government has announced a target to reduce emissions from public buildings by 75% by 2037. However, current funding levels are insufficient.

Public buildings

New targets have been set and some funding provided for decarbonising public buildings, although the level of funding falls far short of what will be needed:

- **UK.** The UK Government announced a new target of reducing emissions from public buildings by 75% by 2037:^{*}
 - It also committed a further £1.4 billion funding for the Public Sector Decarbonisation Scheme (PSDS) for the period 2022-25. This brings the total funding committed to England for the period 2020-25 to £2.5 billion.
 - It also announced its expectation that public sector organisations take steps to reduce emissions in the next five years and report progress against their plans and targets based on guidance that will be provided.
 - In November 2021 the Net Zero Estate Playbook was published to guide Government department and public sector bodies in how to transition to Net Zero buildings.
- **Scotland.** The Scottish Government committed to provide at least £200 million over the next five years for public sector estate decarbonisation. It committed to consult the Scottish public sector in 2022 to develop a series of phased targets for energy performance of public buildings, starting in 2024.
- **Wales.** The Welsh Government published plans for all public sector organisations to report their emissions and publish Net Zero plans by 2023.

^{*} Compared to a 2017 baseline.

- **Northern Ireland.** Northern Ireland is piloting funds to incentivise energy efficiency improvements in central government in line with its Energy Management Strategy and Action Plan for NI Central Government.²⁷

Enablers

Workers and skills

The Government's Heat and Buildings Strategy and Net Zero Strategy emphasise the need to invest in skills and outline steps that aim to grow the skills base needed to decarbonise the UK's buildings. The governments of Wales, Scotland and Northern Ireland have also taken steps to ensure Net Zero skills are available:

While some future skills needs will be met through training, most will need to come from retraining or upskilling existing workers.

- **UK.** The UK Government has launched the National Retraining Scheme, which, alongside the National Skills Fund, aims to support the development of construction training hubs. It is also reforming the skills system through programmes such as the Lifetime Skills Guarantee, which supports workers to reskill and retrain, including through Skills Bootcamps in areas like housing retrofit. It has promised an action plan for Net Zero skills in England by spring 2022, which has not yet been published.
- **Scotland.** The Scottish Government is currently assessing future workforce needs through its Heat in Buildings Workforce Assessment Project.
- **Wales.** In October 2021, the Welsh Government committed to publish a Net Zero Wales Skills Action Plan in spring 2022. At the time of finalising this report, nothing had yet been published.
- **Northern Ireland.** Northern Ireland launched its Skills Strategy in March 2022,²⁸ which focusses on the skills needs of priority areas in the energy sector. The Strategy sets out an intention to make use of existing training and education pathways in the short term and work with the Northern Ireland Skills Forum in the longer-term to identify skills gaps for low-carbon technologies.

The Government has a key role in informing people about the nature of the challenge, the benefits, and helping them to find the assistance they need to improve their homes.

Public engagement

The Government needs to engage widely to support its actions to decarbonise buildings. The purpose of engagement is partly to understand and build public consent for the process. But it is also about helping homeowners, tenants, landlords and others to understand what the transition entails, the actions they can or need to take, the support available, and the timing of changes.

The CCC has been working with academics at Lancaster University on the role of deliberative processes in climate policy, including by running a citizens' panel with a group of owner-occupiers, to explore their views on the changes and policies needed to support decarbonisation in their homes (see the 'Public engagement and choices' section in Chapter 14). The findings of this research will be published in due course.

Fundamentally, Government should make it easier for people to make low-carbon choices and take an active role in promoting public awareness. There has been some progress on these fronts:

- **UK.** The British Energy Security Strategy set out a new commitment to launch a comprehensive energy advice service by summer 2022. This will advise people on the best ways to improve the energy performance of their homes. Additional telephone support and specific local area advice will be provided alongside this.

The UK Government is launching a new advice service to help people find information about how to reduce energy bills. The devolved governments are all launching their own public awareness strategies.

- **Scotland.** The Scottish Government committed to establish a National Public Energy Agency which will be responsible for raising public awareness of the potential for energy efficiency and behavioural measures to reduce both emissions and energy bills for households. They are developing a public engagement strategy to raise the profile of energy efficiency and zero emissions heating options. The Scottish Government also confirmed plans to continue its support and advice services on these topics for households, the public sector and businesses.
- **Wales.** The Welsh Government committed to invest £350,000 in research into “winning hearts and minds” around installing low-carbon measures. It also committed to increase investment in trials of the Energy Wardens Scheme which helps residents understand how to use their energy systems optimally.
- **Northern Ireland.** Northern Ireland’s strategy commits to launching an awareness campaign to introduce low-carbon technologies and encourage standards and behaviours, and to establish a ‘one-stop-shop’, delivering trusted information and advice to consumers on decarbonising their homes.

Other enablers

Other supporting policy areas have a role to play in the buildings transition. These include facilitating access to finance, changes to governance and planning, stronger systems of regulatory compliance and enforcement, better information about buildings and their energy performance, and using digital methods and data to enable the design and delivery of other policies. The UK Government has taken some steps forward in this regard:

The Government has taken steps to develop new forms of green finance for low carbon heating systems and energy efficiency, including committing £20 million for green finance innovation.

- **Finance and investment.** There has been progress on policy to ensure households and businesses have access to finance to decarbonise their properties across the UK and to deliver low-carbon investment:
 - **UK.** Shortly after the Heat and Buildings Strategy was published, the Government confirmed plans to provide at least £10 million grant funding via the Green Home Finance Accelerator to support UK retail lenders to design, develop and pilot a range of financial propositions to encourage domestic energy efficiency and low-carbon heating retrofits. Since then the Government has committed to double total innovation funding for green finance products to £20 million.²⁹ The Government is engaging with the UK Infrastructure Bank (UKIB) to explore their wider role in scaling up green home retail finance.
 - **Scotland.** The Scottish Government committed to establish a National Public Energy Agency which will be responsible for coordinating delivery of investment.
 - **Wales.** The Welsh Government committed to work with UK Finance, The Development Bank of Wales and others to trial alternative finance products to support owner occupiers with retrofit works.

Building owners have limited access to high-quality information about how their buildings use energy, as EPCs are an imperfect guide. The UK Government's EPC Action Plan will help, but it is not enough. Scottish Government is consulting on reforms to the EPC system for homes.

The Government recognises how better data about buildings and energy use would improve policy making and help individuals and private sector organisations plan to invest in upgrades.

The Government has taken steps to strengthen governance. These include establishing the new Future System Operator and setting up the Local Net Zero Hubs and the Local Net Zero Forum.

- **Building information.** Building owners currently have limited options to understand the way that their buildings use energy. EPCs are an imperfect guide and are often implemented in an inconsistent way:
 - **UK.** The UK Government's EPC Action Plan progress report shows some progress in considering ways to improve EPC assessor competence, an update to the Standard Assessment Procedure to account for CO₂ emissions, and exploration of the potential for SMETERS* data to make EPCs more accurate.³⁰
 - **Scotland.** The Scottish Government is consulting on reforms to the EPC system for homes, exploring changes which would align the assessments with the type of advice and information that homeowners need to decarbonise their properties.³¹
- **Digital and data.** The UK Government's Energy Digitalisation Strategy set out a range of measures to support home decarbonisation.³² These include a range of initiatives to convene expertise and develop plans, principles and standards for the digitisation, collection and analysis of building data. This was accompanied by a Smart Systems and Flexibility plan which set out a new monitoring framework that covers flexible energy use in buildings.³³
- **Governance and planning.** Governance remains a challenge, but the UK Government has taken steps to clarify the roles and responsibilities of different organisations who will need to make decisions regarding buildings. This includes designating Ofgem as the regulator for Heat Networks, setting up the Future System Operator, and funding the establishment of five Local Net Zero Hubs.
- **Compliance and enforcement.** The burden of ensuring that building owners, landlords and others comply with regulations falls largely on local authorities, which need to be adequately resourced to enforce rules:
 - **UK.** The UK Government has provided £4.3 million to 57 local authorities (out of over 300 in England and Wales) to support enforcement efforts for minimum EPCs in the private-rented sector, with plans to scale this up in the coming years.
 - **Scotland.** The Scottish Government has announced that Scotland will adopt the UK PAS 2035/30 standards for their delivery programmes of home retrofit and are considering adopting the TrustMark quality assurance standard to ensure compliance.³⁴

* Smart Meter Enabled Thermal Efficiency Ratings.

Adapting the UK's buildings to a changing climate

Action to reduce emissions from buildings should also make them more resilient to future changes in climate. For example, if implemented correctly, improvements to fabric efficiency can reduce the risk of overheating. In tandem with decarbonisation, the Government needs to act on several fronts to ensure that the UK's buildings are adapted for future climate change, addressing risks of overheating in homes and other buildings as well as flooding risks.

The Government has made progress to reduce the risk of overheating in buildings by publishing a new standard within the Building Regulations. A gap remains in addressing overheating risks in existing buildings.

Overheating

There is now policy to mitigate overheating risk for new build homes, however there is still a gap in existing buildings requiring action by Government.

- **Building standards.** The publication of an overheating standard within Building Regulations (Approved Document O) is a significant step forward in addressing one of the most urgent climate risks, but only applies to new build homes. The regulation addresses previous CCC recommendations to mitigate overheating using passive cooling measures where possible and to ensure that developers consider energy, ventilation and overheating together.
- **Existing buildings.** Some existing residential and non-residential buildings are currently at risk of overheating or will be in the future climate. There are still no plans to increase understanding of overheating risk in existing buildings, nor action to retrofit these buildings with cooling measures where necessary. For existing homes, measures are also necessary to ensure that vulnerable or lower-income groups are able to retrofit their homes. The Government's plans to reduce emissions should include adaptation as a key priority.
- **Health and social care.** The Government should develop a plan to assess and respond to the extent of current and future overheating risks in care facilities and hospitals. The plan should also consider how the trend towards home-based care may alter the risks to patients and healthcare delivery from extreme weather.

Addressing the risk of flooding in homes continues to be a major policy gap, with homes continuing to be built on floodplains without appropriate advice or systems in place to address these risks.

Flooding

Homes continue to be built on floodplains without appropriate advice or systems in place to address increased flooding risks:

- **New developments.** A more forward-looking outlook on flood risk is required for new developments. If building on the floodplain continues at the current level, the funding required to build and maintain new defences will continue to rise.
- **Planning reform.** All types of flood risk should be included in policies to assess flood risk to new developments. The Government should ensure that the planning system incentivises 'green' Sustainable Drainage Systems. Where homes are built in areas at risk of surface water flooding, they should receive expert flood mitigation advice.

(c) Assessment of policies and plans

Government has partly achieved most of the buildings recommendations we made in last year's Progress Report, including the four priority recommendations.

Of the 14 buildings recommendations in our 2021 Progress Report,* one has been achieved, nine (including the four priority recommendations) have been partly achieved and four have not been achieved:

- **Achieved.** The Government has published proposals for fossil fuel boiler phase-out.
- **Partly achieved.** The Government has made partial progress against several of our recommendations, including the four priorities:
 - The Government published a strategy for heat in buildings[†] which starts to sketch out a framework for driving low-carbon heat deployment.[†] While more detail is needed this is a clear step towards decarbonising the sector.
 - Progress on building standards has been made, in particular on new builds, but enforcement continues to be an issue.
 - Although some changes to taxation have been made to favour low-carbon options (e.g. zero VAT on heat pumps and insulation), the consultation on rebalancing energy prices has not yet been published.[†]
 - While multi-year funding of £2.5 billion for public sector building decarbonisation has been committed, committed funds are less than half of what is needed to meet the Government's aims.
 - Funding allocations were made for heat networks but do not meet the full amount needed in the medium to long-term.
 - Progress in developing plans for decarbonising buildings has been made in Scotland, Wales and Northern Ireland, but key elements are still pending.
- **Not achieved.** There are several recommendations which have not been sufficiently addressed in the past year:
 - The target date for EPC C being reached in social homes has not been brought forward.
 - Requirements for all new gas boilers to be hydrogen ready by 2025 have not been put in place (despite the Government recognising their value in the Heat and Buildings Strategy).
 - Data on low-carbon heat networks is still pending.
 - While the Government's EPC Action Plan has proposed some small but useful reforms to EPCs, it has not yet undertaken the major steps needed to ensure EPCs can support delivery of both energy efficiency improvements and low-carbon heat.

* Applies to recommendations where buildings is the main sector. Where the same recommendation applies to two sectors we have only counted it once.

[†] Priority recommendations.

There has been mixed progress by Government departments in setting out plans to decarbonise their estate (which cover both buildings and surface transport). DfE and DHSC are further ahead, while DLUHC has not published any plans or details on progress.

We also made nine recommendations last year relating to the Government's estate, most of which apply to both buildings and surface transport. These included seven recommendations to specific Government departments to publish and implement plans to decarbonise their estate and vehicle fleets, as well as recommendations to Cabinet Office, Number 10 and HM Treasury to provide necessary resources and funding:

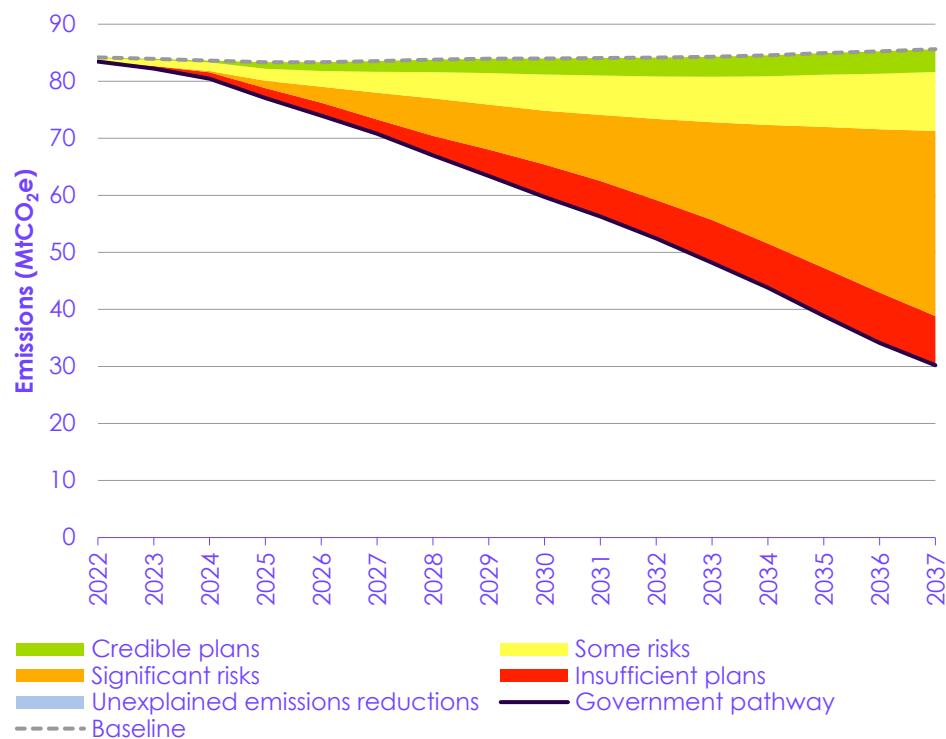
- **Achieved.** The Department for Education has published a sustainability strategy (April 2022) and at COP26 plans for each of the UK's national health services were outlined, supported by the Department for Health and Social Care.
- **Partly achieved.** Insufficient funds were committed by Cabinet Office, Number 10 and HM Treasury to support plans to make all public buildings and vehicles fleets zero carbon. The Department for Work and Pensions is developing a sustainability management plan. The Ministry of Defence published a high-level sustainability strategy, with little detail on buildings, but has an electric vehicle programme for certain fleets. The Ministry of Justice is developing a Net Zero carbon strategy and the Home Office is planning to commission studies into low-carbon technology and EV charging points.
- **Not achieved.** The Department for Levelling Up, Housing and Communities has not published any plans or details on progress in decarbonising its buildings or electric vehicle fleet. This is a missed opportunity for leadership from a department in charge of important policies for decarbonising buildings.

As a result of this progress, the majority of required emissions reduction out to 2035 is considered to be linked to policies with 'significant risks' (Figure 4.16). Some have lower or minimal risks and in some areas plans are insufficient.

In our assessment of the UK Government's Heat and Buildings Strategy in March 2022, we were not able to determine how 18% of the required emissions reductions expected by the Strategy in 2035 could be delivered. We have since worked with BEIS to clarify this 'unexplained emissions reduction' (Box 4.2).

The most significant policy gap in buildings results from insufficient policies for energy efficiency in owner-occupied buildings. There are policies in most other areas, but with significant delivery risks attached.

Figure 4.16 Assessment of policies and plans for buildings



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Box 4.2

FYXi Wjb['h Y 'Yj Y 'c ZD bYI d'U]bYX Ya]gg]c bgfYXi Wh]c bgN

H Y'; cj Yfba Ybhñ & &% **Heat and Buildings Strategy** k UgbchUWñt a dUb]YX 'VmXYHJ]YX Z] i fYg]c YI d'U]b H Y Wc bH]Vi h]c b'c Z]bX]]Xi U'dc]M]Yg]c k Ufxg]g]c j YfU''Ua V]h]c b''b]c i f A UfM & && UfU'mglgcZh]Y g]fUH]Y m] **Independent Assessment: The UK's Heat and Buildings Strategy** l k Y'k YfY i bUVY hc 'UWñt i bhZc f]g a Y'c Zh]Y YI dYWHYX Ya]gg]c bgfYXi Wh]c bgN Wh]c bg]b H Y fYg]X]YbH]U'Vi]X]b[gg]Wc f]H YgY D bYI d'U]bYX Ya]gg]c bgfYXi Wh]c bgN UWñt i bh]Y X'c Z]bX]Y I dYWHYX 'UVUH]a Ybh]b H Y'; cj Yfba Ybhñ dU]k Um]b & \$) ""

G]bW 'h Y di V]MUH]c b'c Zci fUggYgga Ybh]c Zh]Y **Heat and Buildings Strategy** k Y'Uj Y VYYb dfcj]XYX'k]h]UXX]h]c bU'XUH]VmH]Y'; cj Yfba Ybhñ'K]h]h]g]XUH]UzUbX Z]h]YfUbU'ng]g]k Y'Uj Y VYYb UVY hc 'UWñt i bhZc f]h]Y g]UfY'cZYa]gg]c bgfYXi Wh]c b'k \]M] k Ugd]fYj]ci gm i bYI d'U]bYX" H Y UX]h]c bU'XUH]d fcj]XYX'Vm; cj Yfba Ybh]WUf]Z]Yg]Wc bH]Vi h]c bg]c 'UVUH]a Ybh]Zca 'V]ca Yh]UbY]b YWh]c bZ]YUhd]i a d'XYd'cma Ybh]UbX dfcXi Wh]d]c]M]Yg

- H Y'; cj Yfba Ybh]Ug]Wc bZ]fa YX H Y YI dYWHYX XYd'cma Ybh]c ZV]ca Yh]UbY]b YWh]c b']b]c H Y' [Ug[f]X'UbX'WUf]Z]YX H Uh]H Y f]g]]b['Ya]gg]c bgfYXi Wh]c bg]v ci 'X'VY' UH]f]Vi H Y' hc 'H Y Vi]X]b[gg]Wc f]h]U']b'k]h] H Y' g]Wc dY'cZg]j]b[g]b H Y' <YUh]v' 6i]X]b[g]Ch]fUH]Y' m]
- H Y'; cj Yfba Ybh]Ug]YI d'U]bYX H Uh]H Y YI dYWHYX 'UVUH]a Ybh]XY] YfYX'Vm\YUh di a d']b]g]U'Uh]c bg]g]VUg]X'c b'Uggi a]b['h]U]b]g]U'Uh]c bg]UfY'X'g]f]Vi H Y X'Yj Yb'm' UWfcgg]h]Y'ci g]b['g]c W]Zf]U]Yf]h]Ub]H]f] Yh]X'Uh]ca Yg]k \]M] 'Uj Y'f]YW]j YX' Yb]Yf] mY Z]M]YbWh]a YUg] fYg]H]g]fYg] 'g]b[f]YUH]f'UVUH]a Ybh]d]Yf]b]g]U'Uh]c b' H U]b']b' ci f]UbU'ng]Zc f]h]Y'G]j H' 7 UfVcb'6i X[Yh]H'YfY'g]U'f]g]_H Uh]H]g]Uggi a d'h]c b' cj YfYg]a Uh]Yg]h]Y Ya]gg]c bgfYXi Wh]c bg]h]Uhk']'VY'UW]Yj YXZXYdYbX]b['c b' H Y' UWh' U'dU]H]fbgcZXYd'cma Ybh]'
- H Y'; cj Yfba Ybh]Ug]WUf]Z]YX H Y g]Wc dY'cZ] h]fY'dfcXi Wh]d]c]M]g]ci 'X' fYXi W'X'f]YWh]a]gg]c bgf]Ugg]WUH]YX'k]h] [Ug]Vc]Yf]g]Wc'_Yfg]UbX'c h]k Uh]f' Wc]bg a d'h]c b''K Y'Uj Y']b'Wc fd]c f]UH]YX H YgY YI dYWHYX Ya]gg]c bgfYXi Wh]c bg]b]c i f' UbU'mglg''
- H YfY'g]Wc bg]X]YfUV'Y i bW]f]U]b]m]Ufc i bX H Y'Yj Y'c ZUVUH]a Ybh]k \]M] k]'VY' XY']YfYX'VmYbYf] mY Z]M]YbWh]a YUg] fYg]H Y'; cj Yfba Ybh]Uggi a Yg]h]Uh[f]YUH]f' UVUH]a Ybh]WU'VY'UW]Yj YX'dYfa YUg] fY' h]U]b'ci f]G]j H' 7 UfVcb'6i X[Yh]UbU'mglg' K Y'Uggi a Yh]U]h]Ub]f]a U]b]b['i bYI d'U]bYX Ya]gg]c bgfYXi Wh]c bg]WU'VY'UH]f]Vi H X' h]h]Yg]Y'X'Z]Yf]b['Uggi a d'h]c bg'5g]b H Y'WUg] 'c Z]h]Y'UVUH]a Ybh]d]Yf'YUhd]i a d'z H YfY'g]U'f]g]_H Uh]H]Y'; cj Yfba Ybh]g]c j YfYg]a U]b]b['h]Y'Wc bH]Vi h]c b' hc 'Ya]gg]c bgfUVUH]a Ybh]Zca 'Yb]Yf] mY Z]M]YbWh]a YUg] fYg"

Table 4.2

Policy scorecard for buildings

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Low carbon heat in non-fuel poor homes 39% of 2035 abatement	O	O	O	O	O
<ul style="list-style-type: none"> While the Government's proposed market-based mechanism for low-carbon heat minimises the need for public funding and could drive down the unit costs for heating systems, it is complex and carries significant risks. Policy measures which aim to stimulate demand are clearer but may not go far enough – these include boiler phase out dates, tighter standards for new buildings and limited Government funding through the Boiler Upgrade Scheme. Despite a commitment to tackling the imbalance between electricity and gas prices, which currently hinders heat pump take up, a consultation on this has not yet been launched. Many policies are needed to support both the supply and demand side of the market, which the Government has not finished developing. 					
Heat networks 7% of 2035 abatement	Y	G - Until 2025 O - From 2026	Y	O	G - Until 2025 O - From 2026
<ul style="list-style-type: none"> Ofgem has been appointed as the regulator for heat networks and local authorities are getting new powers to create heat network zones. Buildings within these zones may be obliged to connect to the network, creating demand. £288 million of new capital grant funding through the Green Heat Networks Fund (GHNF) will help support early market growth for heat networks and retrofit existing heat networks. No public funding beyond 2025 is committed, and while market growth may help to reduce costs over time it is unclear that new projects will be economically viable without continued public support. The Government has announced plans for a competitive fund for training through the Heat Network Skills Programme, and the GHNF will require applicants to invest in local skills. As it stands, this is not enough to deliver the capabilities that will be needed in the coming years. The Heat Networks Investment Programme (HNIP) portfolio includes projects which use high-carbon sources, such as Gas-CHP, many of which are still under development or construction. New projects funded through GHNF will need to use low-carbon sources but there are not yet clear policies to require the decarbonisation of existing heat networks or prohibit the creation of new high-carbon networks which do not draw on public funds. 					
New homes 6% of 2035 abatement	O - Until 2024 O - From 2025	G	O	Y	O - Until 2024 Y - From 2025
<ul style="list-style-type: none"> From 2025 the Future Homes Standard will require new homes to meet high standards of fabric efficiency and use low-carbon heat sources. We are not confident that the interim building standards uplift will drive sufficient change in the new build sector prior to 2025, as standards can be met without low-carbon heat, adding to the stock of boilers which will need to be retrofitted in coming years. The policies for new homes do not require an explicit funding model and the approach is credible in that regard. What additional costs may arise will likely fall to landowners or developers and not onto taxpayers. These costs are relatively modest (particularly compared to retrofit) and in the context of high energy prices are likely to offer financial benefits to households. Government has not yet committed to end connections to the gas grid for new homes. There is also a risk the heat pump market does not grow fast enough to deliver around 200,000 heat pumps in new builds annually from 2028. While the Government has outlined a clear timeline for future policies, the risks of slower than expected market scale-up set out above may mean this needs to be revisited. 					

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Energy efficiency in non-fuel poor homes 7% of 2035 abatement	R	R	O	R	R
<ul style="list-style-type: none"> Energy efficiency in non-fuel poor homes is the most significant policy gap in the buildings sector, with only the private rented sector covered in the UK through a consultation on increasing the minimum standard for rental properties to EPC C by 2028. There is no funding to support home retrofits, and there are no regulations to drive improvements in standards. The Government is still considering a voluntary energy performance target for mortgage lenders, which is the only policy proposal that covers the 65%* of owner-occupied homes.³⁵ While recognising energy efficiency as the solution to high-energy bills, with a promise to tackle public understanding on actions needed to address them, the Energy Security Strategy failed to address the policy gap in this area. There is no clear timeline for policies which would support energy efficiency in non-fuel poor homes. While there are target dates for updated regulations for the Private Rented Sector, these have not been formally set by Government. 					
Fuel poor homes 5% of 2035 abatement	G	Y	Y	Y	Y
<ul style="list-style-type: none"> The Government has announced various schemes which will support energy efficiency upgrades and low-carbon heating installation for fuel poor homes including the Energy Company Obligation (ECO 4), Home Upgrade Grant (HUG), Social Housing Decarbonisation Fund and Local Authority Delivery (LAD) scheme. These policies will provide nearly £8.2 billion in public funding over the period out to 2026. The decision to extend well-established and successful schemes to decarbonise fuel poor homes, such as ECO, should minimise delivery risks. While the funding mechanism is wholly credible, the rapid growth in the number of fuel poor homes mean that the specific allocations made in October 2021 are not adequate to meet the current and near-term demand. There are issues with appropriately targeting existing funding towards fuel poor homes, for which there are not yet any proposals to address. The Government has a credible timeline for funding over the next few years, but has not set out when it will implement policies to improve the targeting of support to fuel poor homes. 					
Domestic product standards and appliance efficiency 7% of 2035 abatement	G	G	Y	G	G
<ul style="list-style-type: none"> The Government has implemented a robust framework for product standards which should contribute to emissions reductions over time. This uses a proven model (domestic appliance efficiency standards) to deliver its objectives. Some risks remain due to a lack of clarity around policies for domestic cooking appliances. We do not expect this scheme to create any particular requirements for public funding. The financial incentives for better, more efficient products will be driven by well-understood market behaviours. The Energy-Related Products Policy Framework sets out clear timings for the introduction of new policies, allowing time for appropriate consultation and development. 					
Biomethane 4% of 2035 abatement	O	O	Y	Y	O
<ul style="list-style-type: none"> The Government's approach on biomethane recognises that it is low-regrets overall but unlikely to play a major role in decarbonisation of buildings. The Net Zero Strategy pathway assumes that 12 TWh of biomethane is injected into the grid by 2030. However, the Government's Green Gas Support Scheme (GGSS) only aims to deliver 2.8 TWh of renewable heat per year by 2031. The Government sets out an intent to explore development of commercial-scale gasification and a biomethane support scheme to replace the GGSS after 2025. 					

* 65% of homes in England are owner occupied.

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Commercial buildings low-carbon heat 8% of 2035 abatement	○	Y	Y	○	○
		<ul style="list-style-type: none"> The Future Buildings Standard is intended to produce new buildings with low-carbon heat from 2025, although details on the Standard are limited, and the plans to start a full technical consultation in 2023 risk slow signals to the market. There, there are significant risks attached to the mechanism for growing the markets for low-carbon heat technology (as discussed above). The market mechanism for heat pumps is expected to affect smaller non-residential buildings. For larger non-residential buildings, heat pumps remain more expensive than gas boilers, and there is no planned policy to address this. See our assessment of enablers for low-carbon heat in non-fuel poor homes. Timelines for the phase-out of off-grid boilers in England, Scotland and Wales are broadly in line with the Sixth Carbon Budget. The proposed phase-out date for gas boilers is relatively late (2035) in England, but in line with the Sixth Carbon Budget in Scotland (2030). 			
Public buildings 10% of 2035 abatement	Y	○	Y	○	○
		<ul style="list-style-type: none"> The assessment above of low-carbon heat in commercial buildings applies similarly to low-carbon heat in public buildings. The expectation that public sector buildings report progress against their emissions reduction plan, and choose to apply for funding, goes some way to creating a credible delivery mechanism. This carries some risks of non-compliance and of limited centralised oversight on progress. Committed funding for the public sector up to 2025 comprises less than half of what we estimate is needed to meet the Government's ambitious emissions reduction pathway for public sector buildings. Beyond what we set out in our assessment of enablers for low-carbon heat in non-fuel poor homes and commercial buildings energy efficiency, the Government published the Net Zero Estate Playbook to guide department and public sector bodies in buildings decarbonisation. Proposed timelines for reducing public building emissions by 75% by 2037 are ambitious. While the emphasis on public sector leadership is welcome, more funding is needed to implement this ambition, both within the current 2022-2025 funding window, and for the late 2020s. 			
Commercial buildings energy efficiency 6% of 2035 abatement	Y	○	○	○	○
		<ul style="list-style-type: none"> The main delivery mechanism for driving energy efficiency measures in commercial buildings are minimum EPC requirements for private rented buildings and a performance-based rating scheme for large commercial buildings. There is not a developed mechanism for smaller commercial owner occupied buildings which comprise 17% of energy use in commercial and industrial buildings in England and Wales.³⁶ Most energy efficiency measures are assumed to be funded privately. The Government has not published plans for how to ensure SMEs can access financial support for energy efficiency measures. An undeveloped supply chain for energy efficiency measures, a poor history of enforcement of EPC minimum requirements and weaknesses in the accuracy and recommendations of the EPC itself pose risks to effective implementation. Proposed timelines are reasonable, but consultations planned for 2021 and early 2022 have already been delayed. Furthermore, there is very limited information on when the performance-rating scheme will be rolled out and there are optimistic assumptions about how early impacts of plans for a minimum EPC will be seen in building owner energy efficiency decisions. 			
Overall sector assessment	○	○	○	○	○

(c) Recommendations

Our five priority recommendations cover energy market reform, public engagement and energy advice, finalising plans for the heat pump market mechanism, closing the policy gap for energy efficiency and the funding gap for public buildings.

We have made 38 buildings recommendations to Government in this Progress Report, which focus on the key policy gaps set out here and elaborated on further in our assessment of the Heat and Buildings Strategy in March 2022. Progress on energy prices, public engagement, the heat pump market mechanism, energy efficiency in owner-occupied buildings and funding for public sector decarbonisation are considered high priority:

- **Energy prices.** The Government needs to set out its plans to reform electricity and gas pricing to remove current market distortions, which create a significant barrier to the widespread uptake of electrified heat, ahead of next winter. It should also consider increasing funding and accelerating plans for energy efficiency policies particularly in fuel poor homes (see Box 4.3 and the 'Fair funding and affordability' section in Chapter 14).
- **Public engagement and energy advice.** The Government needs to deliver on its commitment to establish a new energy advice service by this summer (see Box 4.4). This service should be linked to other ongoing efforts to help the public understand the causes of high energy prices, and how steps to mitigate these also contribute to the UK's efforts to reduce emissions and combat climate change. It should be accompanied by a widespread publicity campaign, to ensure awareness of the service reaches millions of households across the UK each year. The Committee will extend its advice in this area in future.
- **Energy efficiency.** The Government needs to address the policy gap for energy efficiency in owner-occupied homes and commercial buildings. It should bring forward credible policies which create incentives or enforceable requirements for home and building owners to act. For homes, this could include a policy requiring EPC C from 2028 at the point of sale and/or a mandatory minimum requirement for mortgage lenders. It should also set clear energy efficiency standards for social homes and deliver the legislation for energy efficiency improvements in the private rented sector as proposed.
- **Heat pumps.** The Government needs to publish detailed plans about how its proposed market-based mechanism will work. This should clarify how the obligation on boiler manufacturers will be implemented and enforced, the pathway for increasing requirements, how installations will be verified and accounted for, and what powers will be needed to regulate the market. The Government then needs to start implementing these policies to support early growth of the heat pump market and track how the market is development to step in with further interventions if it is not responding as expected.
- **Public buildings.** The Government needs to increase the multi-year funding committed to public buildings in order to achieve its ambitious decarbonisation targets in both the immediate and medium term. It should ensure mechanisms are in place to support all public buildings, including those not captured in Greening Government Commitments to take steps to develop, implement and report on plans to reduce emissions.

Other recommendations cover continuing progress on heat networks and commercial buildings at pace and making progress on workers and skills and private finance.

The remaining recommendations cover heat networks, commercial buildings and key enablers of progress (workers and skills, finance and data):

- **Heat networks.** The Government needs to deliver on legislation for heat networks outlined in the Queen's Speech 2022.³⁷ This includes empowering Ofgem as the regulator for heat networks and establishing a clear statutory framework for heat network zoning in England (and possibly also Wales).
- **Commercial buildings.** The Government needs to press ahead with plans to phase-out boilers off the gas grid from 2024, and to implement without delay various policy proposals to improve energy efficiency. The Government should publish plans which will ensure that SMEs have sufficient financial support for energy efficiency and low-carbon heat retrofits.
- **Workers and skills.** The Government needs to take action to help the green construction workforce grow. This includes improving its understanding of the current state of employment and training pathways into relevant trades and developing new policies and programmes to support retraining and upskilling of the existing workforce and new entrants (see the 'Workers and skills' section in Chapter 14). Providing clear and stable policies is also crucial to provide confidence to those considering entering the workforce that there will be future employment in the longer term. We will continue to work on this issue and will be providing further analysis and advice in the coming year.
- **Finance.** The Government should outline a comprehensive vision for how it will leverage private financing for the retrofit of UK homes and businesses. Plans should be designed to operate in tandem with the other enablers needed to unlock home retrofit at scale, such as better buildings data and public engagement. Financial levers to consider include green stamp duty, green mortgages, energy as a service, property-linked finance and using the UK Infrastructure Bank to de-risk retail investment into home retrofit.
- **Data and monitoring.** There are several data gaps in the buildings sector that are hindering the Government's ability to effectively develop, target and implement policies, and the Committee's ability to track progress against these policies. The Government should continue to work with ONS to address the more pressing data gaps, and also set up an overarching monitoring and evaluation framework for the Heat and Buildings Strategy, to track the many new policies and programmes it includes.

Policy development needs to be finalised within the next year so that implementation can follow in 2023-2025. Plans should not be diluted at the implementation phase.

Given the short window for scaling up supply chains and ramping up the roll-out of measures, policy development needs to be largely finalised within the next year so implementation can follow quickly in 2023-2025 (Figure 4.17). It will be important for plans to be delivered as proposed and not diluted at the implementation phase.

In last year's report on Progress in Adaptation to Climate Change, we made a series of recommendations setting out how the Government should ensure that buildings across the UK are resilient to future climate risks of overheating and flooding. The majority of these recommendations remain necessary today:

- **New buildings.** A requirement to address overheating has now been included in the Building Regulations (Part O). This is a welcome step forward. The Government must now ensure that local authorities are sufficiently resourced to enforce it. Regarding flooding, additional policy action is needed to ensure that the planning system effectively considers all types of flood risk for new developments.

- **Existing buildings.** The Government should consider how to encourage the take up of passive cooling measures in existing homes at risk of overheating, and to ensure that overheating is considered when homes are undertaking energy efficiency retrofits. Guidance should be developed to provide homeowners with clear and actionable steps to follow if their homes are overheating. For homes in areas of flood risk, the Government should remove barriers to the uptake of property level flood resilience measures.
- **Finance.** The Government should facilitate access to financing needed to install adaptation measures in homes. This could be via grants or enabling access to appropriate funding mechanisms for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.
- **Data and monitoring.** Significant evidence gaps remain regarding the extent of overheating in existing homes. This limits how well targeted policy proposals can be. The Government should undertake research to better understand when overheating occurs in residential and non-residential buildings. The Government should also begin collecting data on the number of buildings which are well-adapted to future climate, including both flood and overheating risks.

All recommendations for the buildings sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department.

Figure 4.17 Policy implementation timeline



Planning and decisions		Implementation				Outcomes
H1 2022	H2 2022	2023	2024	2025	2026	2030
Energy efficiency						
Consult on options to improve energy efficiency in owner-occupied commercial buildings	Plans for supporting SMEs/small commercial owners with retrofit costs	Implementation of policy for owner occupied building energy efficiency				2030: As many homes are at least EPC C as is practical
Call for Evidence on EPC standards for owner-occupied homes	Concrete plans for performance-based rating scheme for large commercial buildings	Roll-out performance-based rating scheme for large commercial buildings				2030: Commercial energy efficiency renovations are completed.
EPC standards for private rented homes	Owner-occupied buildings energy efficiency policy			First compliance window for EPC in private rented non-domestic buildings		
Publish decision on EPC standards for private rented non-domestic buildings	EPC standards for social homes					2032: Public buildings emissions reduced by 50% of 2017 levels.
Review Decent Homes Standard. Consult on EPC minimum for social homes						
Low-carbon heat: General						
Interim standards for Future Homes and Buildings come into force	Confirm plans to rebalance gas and electricity prices	Consultation on Future Buildings Standard & Future Homes Standard	Phase out new fossil fuel heating in large non-domestic buildings off the gas grid	Future Homes Standard and Future Buildings Standard come into force		From 2024-26: All retired boilers off the gas grid are replaced with low-carbon heating.
	Consult and publish decision on boiler phase-out off the gas grid		Legislate for Future Homes & Future Buildings Standards which require low-carbon heat sources and high fabric efficiency from 2025			2035: All retired gas boilers are replaced with low-carbon heating.
	Address incentives for low-carbon heat in commercial buildings		Phase out new fossil fuel heating in homes off the gas grid			2050 virtually all heat in buildings is decarbonised.
	Address Public Sector funding gap					
	Consult and publish decision on boiler phase-out off the gas grid					
Low-carbon heat: Heat pumps						
	Decision on heat pump market mechanism including manufacturer obligation, & if legislation will be needed	Boiler manufacturer obligation regulations (if needed)	Heat Pump Market Obligation in place (until 2028)			2030 4-4.3 million heat pumps installed domestically (cumulative)
Low-carbon heat: Heat networks						
Combined Heat and Power Quality Assurance Scheme	Heat network zoning pilots	Legislation for Heat Networks in England		Heat network zoning in place		2030 22 TWh of heat delivered through low-carbon heat networks
Heat network zoning, including governance and low-carbon requirements	Assess delivery route for Heat Networks Skills Programme					
Low-carbon heat: Hydrogen						
Hydrogen-ready boilers (non-industrial)	Hydrogen-ready boilers (industrial and non-industrial)	Neighbourhood trials of hydrogen		All new boilers are hydrogen-ready	Strategic decision on the role of hydrogen	2050 virtually all heat in buildings is decarbonised.
				Hydrogen village trial		

Enablers. Actions to enable the transition to energy efficiency and low-carbon heat must happen alongside these policies. These include:

- Clear plans to grow and upskill the **workforce**, starting with better data on employment and training in relevant trades
- An energy advice service accompanied by a **widespread public engagement** campaign
- A range of **accessible financing options** for building retrofit, such as green mortgages, green stamp duty and affordable loans
- Better access to buildings information through EPC reform, in-use performance data and green buildings passports
- Strong **enforcement** of building standards and new regulations, with sufficient powers and resource assigned to enforcers
- Clarity on **roles and responsibilities** across central and local bodies for energy, heat and insulation, accompanied by appropriate resourcing
- An **overarching monitoring framework**, supported by effective cross-government data sharing and coordination to address data gaps
- Integration of adaptation priorities into standards and plans, including overheating and flooding risk
- Strong signals that **multi-year funding** will go beyond spending review cycles, to provide certainty and clarity to markets and consumers

Key

Planning Research, consultations, pilot schemes	Decisions Consultation responses, concrete policy plans	Legislation Legislation, updating regulations	Implementation Legislation into force, funding starts, deployment starts	Heat and Building Strategy Outcomes
Necessary milestone that is not included in the Heat and Buildings Strategy		Necessary milestone that is included in the Heat and Buildings Strategy but in this timeline we suggest either an earlier date, or a specific date where HABS had no date.		

Box 4.3

Securing a long-term climate advantage in response to the consumer energy price crisis

Consumer energy prices are at an all-time high during a period of high inflation across the economy. The Government has recognised that these costs are driven by the UK's dependence on natural gas for heating and electricity and signalled its intent to move away from oil and gas for home heating more quickly.

Taking steps to achieve this can also support efforts to decarbonise the buildings sector. There is an opportunity to solve two problems at once, locking in an advantage that will benefit individual households, businesses and the country in the years to come.

Households

There are a series of actions the Government can take in the near-, medium- and long-term towards this aim:

- **Quick and simple steps to help homeowners reduce energy demand.** The energy price cap is expected to increase significantly again in October 2022, just before winter. There is a short window over the summer to help households prepare for this:
 - There are behavioural changes which can materially reduce energy demand without the need for any physical home interventions – for example in our Sixth Carbon Budget analysis turning off lights when not in use could result in annual electricity savings of 0.4 TWh by 2035. These include adjusting the flow temperatures in condensing boilers, lowering the ambient temperature in rooms, and turning off lights and appliances when they are not being used. However, any advice provided by Government on this needs to recognise that many households, particularly those in fuel poverty, are already restricting their energy use beyond the levels it might recommend (with associated risks to health).
 - Measures such as draught proofing, low-flow shower heads, thermostatic radiator controls, and smart thermostats can all help reduce energy demand. While the individual impact is small (e.g. a 3-6% reduction in heat demand can be achieved through more informed and smarter management of heating in existing homes; and widespread use of low flow shower heads results in a 5% reduction in hot water demand in our Sixth Carbon Budget analysis) these measures are relatively cheap and can often be installed by homeowners without any specific technical help.
 - Many homes have never had an EPC assessment, and many of those that have do not have a recent certificate.³⁸ This means that many homeowners lack even the most basic information about the efficiency of their homes. The Government could offer support to households wanting to get an EPC assessment or other energy performance assessments. This could help guide people into and through the process of retrofit, which is a situation that many find unfamiliar or confusing.
- **Targeted support for energy efficiency improvements.** The wholesale price of natural gas is expected to remain high throughout the year and into 2023.³⁹ Improving home energy efficiency can help bring down energy costs for households and could be targeted at those in most need:
 - It will take time to grow supply chains for efficiency retrofits. The Government should prioritise support for fuel poor households and investments in public buildings while it develops a strong policy framework for energy efficiency in owner-occupied homes.
 - The value for money case of energy efficiency has never been stronger. Government support for measures across the entire building stock will help to offset rising costs while also crucially delivering progress towards the Net Zero ambition. This might take the form of a voucher scheme for owner-occupiers, or other forms of Government-backed finance. Any short-term scheme should clearly fit with the Government's long-term plans to grow the sector.
 - Recognising the impacts of the cost-of-living increases, finance may be a greater barrier at present. Government support for loans or finance can help reduce costs and crucially increase confidence at this time.

- **Rebalancing gas and electricity prices to remove market distortions.** Most of the options for low-carbon heat depend on electricity. However the current allocation of policy costs makes electricity (an increasingly low-carbon power source) more expensive on a like-for-like basis than natural gas. While we can expect heat pump efficiency improvements to go some way in reducing their cost relative to gas boilers, it will still be important to remove market distortions (Figure B4.3):
 - Even under current record high gas prices, our estimates suggest that the average heating bill for a heat pump is around 10% higher than for a gas boiler.* Removing energy levies from electricity will directly lower running costs for heat pumps, making them more financially viable. In the medium term, heat pump efficiency improvements should also help bring their running costs closer in line with gas boilers.
 - A plausible combination of further reform to energy pricing could involve shifting electricity levies to the Exchequer now, cutting bills for households and businesses and, over time ramping up the Green Gas Levy, or alternative carbon pricing mechanism, so that Exchequer impacts are evened out but costs are only added to bills as energy prices (and bills) start to fall again.
- **Supporting public understanding of the causes of the energy crisis** and the steps that can be taken to reduce their bills and support climate action (see Box 4.4 below).

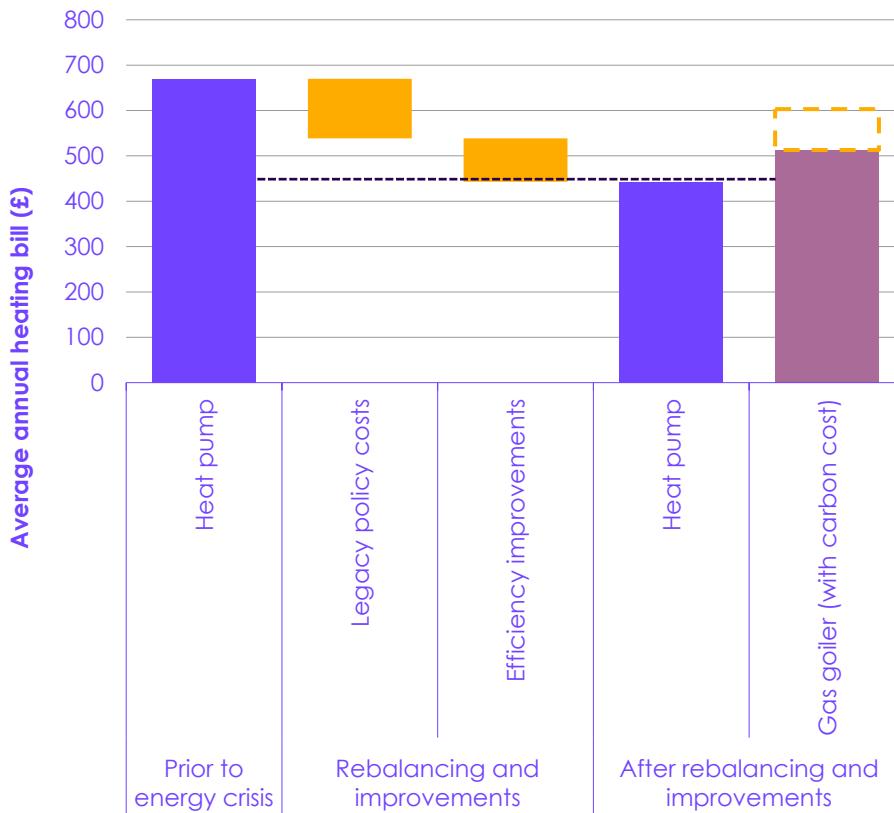
Non-residential buildings

Similar actions could be taken in the non-residential sector, supporting wider efforts to reduce energy demand and lower costs to businesses and the public sector.

- Evidence shows there is strong potential for energy savings from energy efficiency measures in non-residential buildings:
 - The BEIS Building Energy Efficiency Survey (BEES) found that there was the potential for energy efficiency measures to reduce up to 39% of energy usage in surveyed non-residential buildings.
 - The measures with the largest potential savings were carbon and energy management, lighting replacement and building control measures.
 - Over a third of abatement potential came from measures with a payback period of three years or less, generating bill savings of £1.3 billion per year.
 - The data for this comes from 2014-2015, so some measures may have been completed, but limited signs of progress suggest much of the potential remains. Higher energy bills as of 2022 will mean the savings would now be greater than £1.3 billion per year.
- The energy price crisis will have raised energy savings up the agenda for businesses, making it an opportune moment for enhanced advice and financial support from the Government:
 - The BEES finds that common barriers to adopting energy efficiency measures include organisational drivers (such as complex internal decision-making chains) and behavioural factors (such as internal stakeholders having other priorities). It is possible some of these barriers will have shifted due to rising priority of energy price crisis.
 - Common enablers that may need further support were listed in the BEES as awareness of energy management systems knowledge and funding. Energy management systems were less likely to be in place for the private sector and SMEs.
 - Support provided by Government to non-residential building users, in particular to the private sector and SMEs, could look to use this moment to provide information on energy management systems and affordable finance.

* CCC analysis based on the level of the energy price cap in May 2022 (resulting in a gas price of 7 p/kWh and an electricity price of 27 p/kWh) and assumptions from our Sixth Carbon Budget on energy consumption (3.6 MWh/year), heat pump and gas boiler efficiencies (3.0 and 0.87 respectively).

Figure B4.3 The changing economics of heat pumps



Source: BEIS (2022) Average annual domestic gas bills for GB regions (QEP 2.3.3); Ofgem (2022) Default tariff cap level: 1 April 2022 to 30 September 2022, Annex 2 - Wholesale cost allowance methodology; CCC analysis. Notes: Analysis based on 2021 electricity and gas prices, as current record highs are not expected to be permanent. Electricity prices are based on both Ofgem's wholesale costs used to estimate the energy price cap from April-Sept 2021 and CCC analysis. Gas prices are taken from BEIS 2021 average domestic unit gas price (which includes standing charges). Efficiency savings reflect an improvement in heat pump coefficient of performance from 3.0 to 3.5, which is assumed to be achieved by 2030 in our Sixth Carbon Budget analysis, but may happen sooner. Carbon costs added to gas boiler heating bills are based on a carbon price of £39/tCO₂e (using BEIS estimates of carbon prices that align to EU allowances in the EU ETS plus £18/tCO₂e carbon price floor) and an emission factor of 0.19.

Box 4.4

Trusted and independent advice for the public on how to reduce energy bills and emissions

The Government announced its intention in the Energy Security Strategy to launch a comprehensive energy advice service by summer 2022, to help consumers to improve the energy performance of their homes. It also set out plans to launch additional telephone support and specific local area advice to homeowners.

This is a welcome decision, but to be successful the advice service needs to be part of an integrated approach to increase public awareness and support homeowners to access trusted independent advice and services.

Homeowners face three core challenges with retrofit:

1. Knowing what the causes of high energy bills are, and how energy efficiency can help mitigate both the costs of energy, and the emissions from homes
2. Knowing the general steps that they can take to improve the efficiency of their homes and reduce emissions.

3. Knowing what exact measures are suitable and affordable for them and finding trusted and skilled individuals who can assess their needs, coordinate and deliver improvement work.

The Government's proposed advice service can meet all three of these challenges if set up with the right resources and remit. We have recommended that the Government should do this as a priority, so that the service can get up and running by summer 2022 as planned, helping people before the effects of high fuel prices start to hit next winter. Actions within this include:

- **Provide clear guidance through an online platform on steps to reduce energy demand.** As noted above (Box 4.3) there are many simple steps that people can take to reduce their homes' energy demand and emissions. The service should have clear and well-developed guidance that it can share with people across the whole of the UK.
- **Direct people towards obtaining better information about their properties.** Homeowners often lack basic information about their properties. The Government can provide a link to local providers of energy performance assessments through this service. Helping people access this type of information will enable deeper retrofits of properties in time and can identify easier changes for the short term. Government could consider providing funding, for example through a voucher scheme, to encourage energy efficiency assessments.
- **Offer more bespoke support for complex retrofits.** Many homes need to have more extensive improvements to their energy efficiency to meet Net Zero targets, as well as replacing gas and oil boilers with low-carbon heat sources. Doing this will also have a material and lasting positive effect on their energy bills. The advice service should, through its online portal and contact centres:
 - Help guide homeowners through the complexities of building works and link them up with trusted local providers that could help them.
 - Direct people to Government programmes which can help offset the costs of retrofits (e.g. the Boiler Upgrade Scheme, or the Home Upgrade Grant).
- **Deliver specific support that is tailored to local markets.** The programmes on offer will differ across the UK, in particular between the devolved administrations. Some of these are planning (or already have) their own advice service. The service should be UK-wide and help channel people to those where appropriate, to ensure they can access the most relevant advice and programmes. The Government should also consider how it can link-up with Local Authorities to deliver some of this work. Local Authorities are best placed to keep track of traders and others in their area, and help homeowners find trustworthy people to do work for them.
- **Embed the advice service within a larger campaign.** People will only use this service if they are aware that it exists. The Government should promote the service once it is up and running and explicitly link its offer to the challenges people are facing around energy bills.

4. Major risks

Table 4.3

Major risks and required mitigating actions for buildings

Risk category	Description	Mitigating actions	
		Details	In place?
Lack of detail and pace on core policies	Government has a short space of time to finalise and clarify a wide range of policy proposals. If consultations/decisions continue to stall this will not provide certainty to relevant actors and changes that are needed will not be incentivised.	Act fast on consultations. Provide strategic detail ahead of major decisions (to provide clarity even while policy is being developed). Get policies going and adjust as and when necessary.	Partly – some strategic detail provided, but more clarity is needed.
Public awareness and consumer choices	Public understanding and consent for the transition process, and what it will entail for their homes and businesses, is a pre-requisite for the buildings transition. If people are not aware of the changes they need to make and options for making these changes, and the required pace of change, the buildings transition will continue to stall.	Launch an energy advice service to provide trusted information and access to qualified traders and providers in local areas. Accompany the service with a widespread public engagement campaign to reach all households. Continuously monitor and improve the service for reach and effectiveness.	No – Government has committed to launch an energy advice service, but it is not yet in place.
Reliance on market-based mechanisms	Government is proposing a market-based mechanism for heat pumps (via an obligation on boiler manufacturers to sell a rising number of heat pumps) and relies on the market to drive delivery in other areas, such as heat networks. This is an untested approach, and if market participants don't respond to incentives as expected low-carbon heat roll-out will not take off, with significant impact on planned emissions reductions.	Monitor key indicators of market build-up, and intervene with additional measures (e.g. public funding, more regulation) if this is not going to plan. Ensure that newbuild homes incentivise early market growth by strengthening interim (pre-2025) standards.	Partly – Government has committed to develop a progress monitoring framework, but it is not yet in place
Energy prices	Record-high wholesale gas prices have significantly increased energy bills for both households and businesses. While high prices make energy efficiency and low-carbon heat cheaper than fossil fuels, disposable income has come down. This could lead the transition to stall, and is already resulting in some policy decisions (e.g. cutting fuel duty) that could disincentivise decarbonisation. Rebalancing levies between gas and electricity is still needed but needs to be done carefully so as not to impact vulnerable groups even more.	Push ahead with move away from fossil fuels in heating (and other sectors). Strengthen energy efficiency policies. Review balance of levies between gas and electricity. Target public funding to fuel poor households better and increase funding.	Partly – Energy Security Strategy ramps up action on low-carbon supply, but not demand.

Skilled worker shortages	<p>The rapid roll-out of heat pumps, heat networks and energy efficiency retrofits will require thousands of skilled workers in construction and other related trades.</p> <p>Given the required pace of scale-up across these markets throughout the 2020s, additional skilled workers will be needed quickly. Lead times for entering into relevant occupations (either for new entrants or reskilled workers in related professions) means that in many cases training needs to start now for workers to be in place on time. A lack of skilled workers is already often reported as a constraint in home retrofits and not adequately addressing these issues will result in bottlenecks for the transition.</p>	<p>Better data and monitoring of current workforce in relevant occupations.</p> <p>Develop a strategic framework to deliver a fair transition for workers.</p> <p>Develop credible policies that signal to businesses and workers that markets will be profitable and employable in the longer-term.</p> <p>Set out how plans to grow and upskill the workforce will deliver ambitions for low-carbon heat and energy efficiency and fill skills gap identified.</p>	Partly – Some new skills policies delivered, but the UK Skills Action Plan has not yet been published, and action to date may not meet the scale and pace required.
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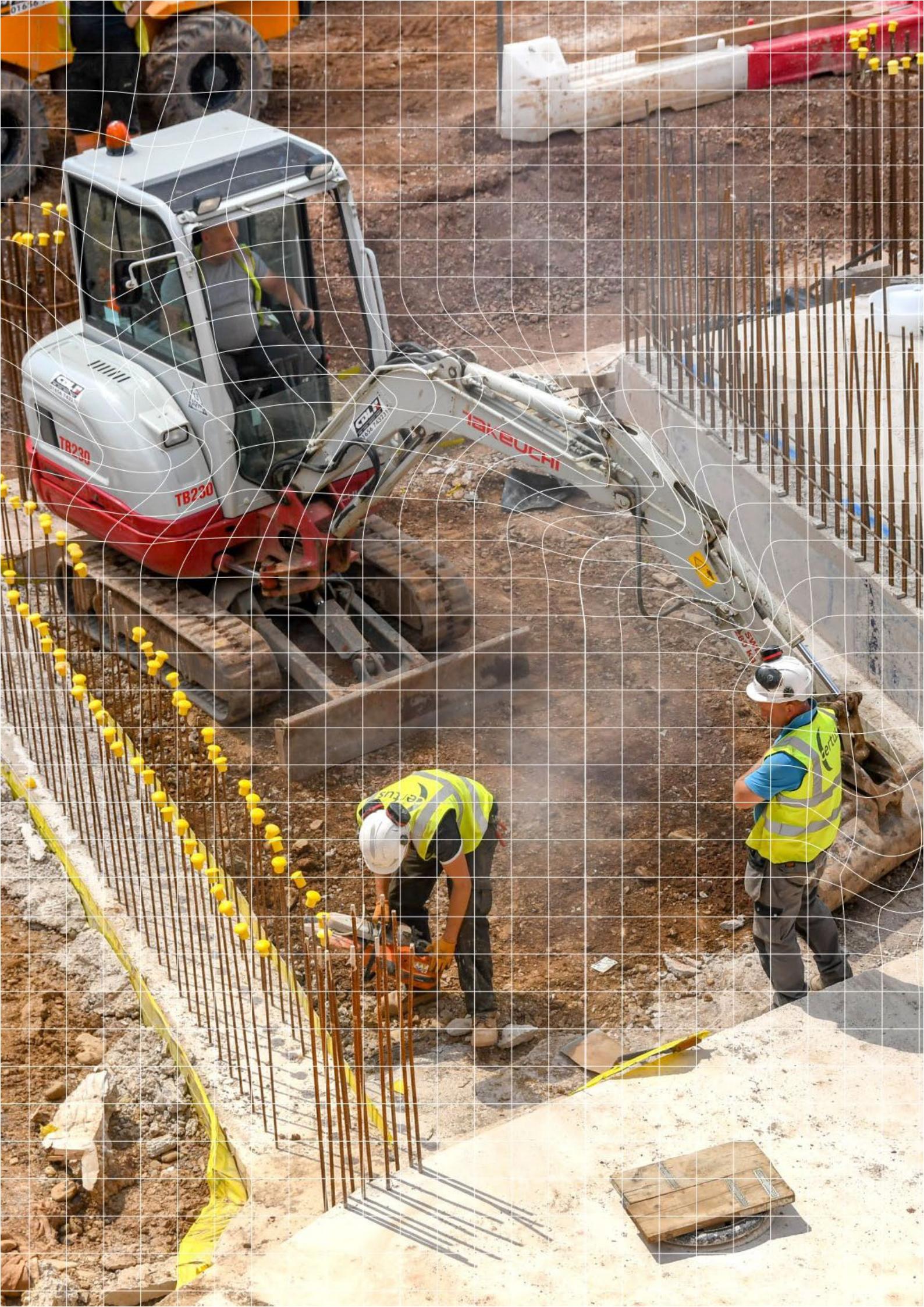
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Chapter 5: Manufacturing and construction

62 MtCO₂e, 14% of UK emissions, in 2020

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Introduction and key messages

Manufacturing and construction sites contributed 14% of UK emissions in 2020. The Government's medium-term decarbonisation ambition in this area has increased substantially over the past two years, supported by several clear policy plans. However, these policy plans are unlikely to deliver the Government's ambition in full and there are initial signs that delivery timelines are starting to slip.

Our key messages are:

- **Emissions.** The Government's Net Zero Strategy committed to an emissions reduction of 63-76% relative to 2019 levels. Since 2019, emissions dropped 5% in 2020, during the COVID-19 pandemic, before rebounding overall to 2019 levels in 2021. Accompanying GVA from the sector in 2021 remained 3% below 2019 levels. Emissions in 2021 are 3% above the Government's pathway for this sector.
- **Government's approach.** The Government's approach to decarbonising manufacturing and construction should provide a boost to industrial clusters but leaves some risk of the UK taking a more expensive decarbonisation route with lower energy security. These facets are driven by the focus on using hydrogen and the application of carbon capture, (use), and storage (CCS or CCUS), lesser focus on electrification, and later focus on improvements in energy and resource efficiency. Government plans for a lesser reduction in emissions before 2025, but more after 2025 compared to our Balanced Pathway.
- **Policy developments.** This year has seen several substantial policy developments including a consultation on a UK ETS cap consistent with the Net Zero Strategy, a call for evidence on the Government's plan for product standards, some progress on the development of hydrogen and CCUS business models and the evolution of the Industrial Energy Transformation Fund into a scheme to complement operational support schemes. These policies will likely provide a substantial proportion of the emissions reductions required from the sector.
- **Policy gaps.** The Government should fill the four main gaps in policy on: electrification, improvements in resource efficiency, low-carbon off-road mobile machinery, and incentives for fuel switching for small facilities not within scope of the UK ETS (which represent approximately 40% of sector emissions). These gaps risk under-delivery against the Government's ambitions for emissions reduction and delaying the development of decarbonisation options. In combination, filling these gaps is likely to help decarbonisation of dispersed sites, which have received less policy focus to-date.
- **Policy design issues.** Existing and planned policies have several issues that need to be resolved:
 - The CCUS business model is showing initial signs of delay and progress on developing CCS in manufacturing is now a year behind the Government's deployment pathway. The Government should finalise the CCUS business model, as well as the hydrogen business model.
 - It is not clear whether energy efficiency policy is strong enough. The Government should clarify its ambition on energy efficiency and how it will deliver these savings.

- Climate Change Agreements are disincentivising electrification. The Government should resolve this by amending their implementation.
- **Carbon Border Adjustments and Products Standards.** The Government should consult on plans to implement by 2030 or earlier, Carbon Border Adjustment Mechanisms (CBAMs) and mandatory minimum climate-related standards on imports of selected manufactured goods.
- **Data.** Availability of relevant data across this sector is particularly poor, and critically limits monitoring and evaluation and policy implementation. As such, the Government should review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting.

In this chapter we review progress in reducing emissions from the UK manufacturing and construction sector and outline the next steps required to ensure we build on this progress and meet future carbon budgets.

The chapter is laid out as follows:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

Direct emissions in the manufacturing and construction sector were 62 MtCO₂e in 2020, and 65 Mt in 2021.

Direct territorial emissions from manufacturing and construction in 2020 were 62 MtCO₂e and accounted for 14% of total UK greenhouse gas (GHG) emissions (Figure 5.1). A further 15 MtCO₂e of indirect emissions occurred due to the consumption of electricity by the sector (Figure 5.1). The sector's emissions come from a diverse range of subsectors and different combustion and non-combustion processes (Figure 5.2).

Emissions in 2020 fell by 5% on 2019 levels, largely due to the COVID-19 pandemic, accompanied by a 12% drop in GVA (Figures 5.4, 5.5). Provisional data suggest that in 2021 sector emissions rebounded to 2019 levels. However, GVA remains 3% down and the split of emissions between sectors has changed since 2019.

- In 2020, off-road mobile machinery was the most affected sub-sector, with emissions down 15%, driven by a 36% fall in output in the construction sector from Q1 to Q2. Other sub-sectors seeing significant emissions reductions were glass & minerals (-13%) and cement & lime (-11%).
- Provisional 2021 emissions data suggest that these three sub-sectors have seen modest rebounds, but are still around 10% below 2019 levels. Whether this is due to long-term economic impacts from the pandemic, or because of progress on decarbonisation, is unclear. Increases in emissions from the iron & steel, chemicals and 'other' sectors have offset these, meaning overall manufacturing and construction emissions are back to 2019 levels (Figure 5.3).

Emissions fell by 19% from 2009 to 2019. After a 5% reduction in 2020, they are now back to 2019 levels.

The longer-term trend in emissions from manufacturing and construction has been downwards with a 19% reduction from 2009 to 2019. Our decomposition analysis suggests that can be attributed to improvements in energy intensity (accounting for 55% of the change), changes in fuel mix (25%) and a structural movement towards a less carbon-intensive mix of industrial output (20%).*

Looking forward to the current year, 2022 emissions and output may well fall again due to current high energy prices and other supply-side disruptions, which are putting significant pressure on the manufacturing sector. Though demand for manufactured goods remains high, margins are being squeezed due to rising input prices, rising energy costs and taxes, and expensive logistics. Research by Make UK suggests that in the first quarter of 2022, 17% of manufacturers have had to temporarily halt production of energy intensive products due to the costs of production.¹

Consumption emissions from the sector continue to be substantially more than territorial emissions.

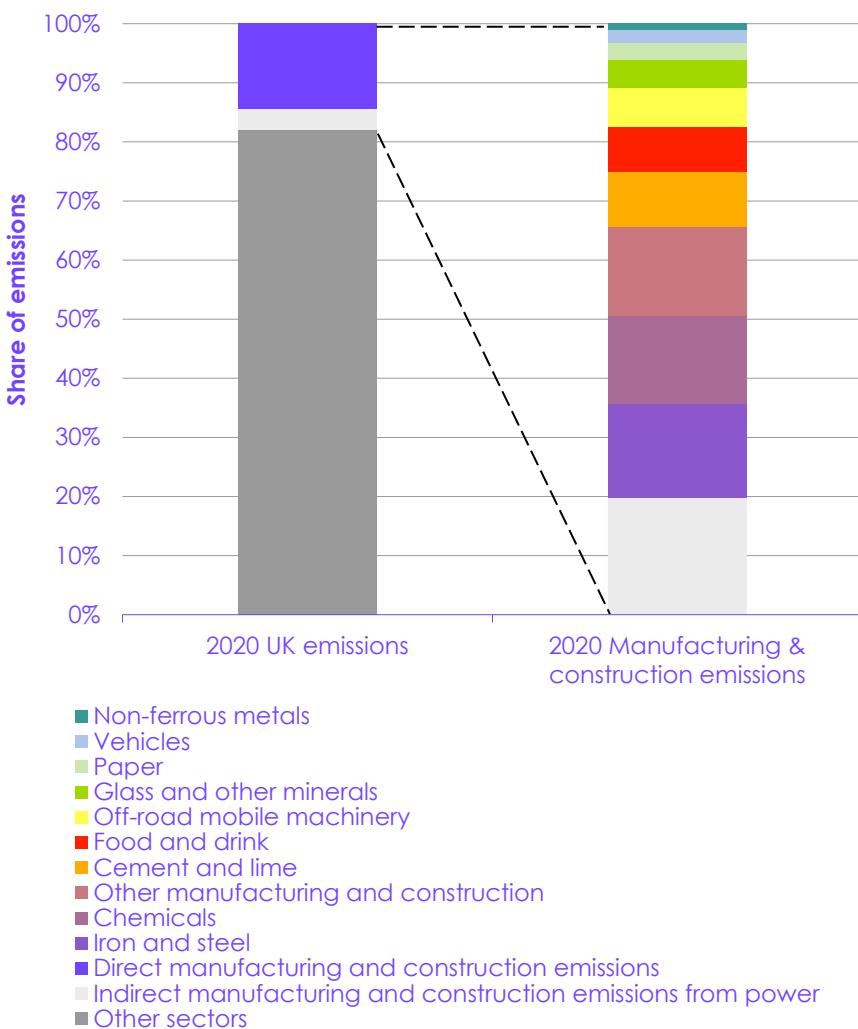
Consumption emissions associated with manufacturing and construction (i.e. emissions from the supply chains of UK consumption regardless of where they occur) continued to be substantially more than territorial emissions for this sector in 2018 (the most recent year for which data are available). There are two scopes associated with manufacturing and construction:

* Ricardo Energy and Environment analysis. The model uses a different scope for emissions based on ONS data collated on a production basis than we use for our emissions analysis. However, the model results give an indication of the changing components of the emissions reductions observed over time.

- Emissions from the supply chains of UK consumption of manufactured and construction products were 146 MtCO₂e in 2018. This includes emissions in the supply chain from other sectors, such as power.
- On the other scope, the emissions from manufacturing and construction sites in the UK or internationally that resulted from UK consumption of all goods and services (not just manufactured and construction products), was 109 MtCO₂e in 2018. Figure 2.11 in Chapter 2 shows a fall of 24% since 1997.

Direct manufacturing and construction emissions accounted for 14% of 2020 UK emissions. The largest sub-sectors were iron and steel and chemicals.

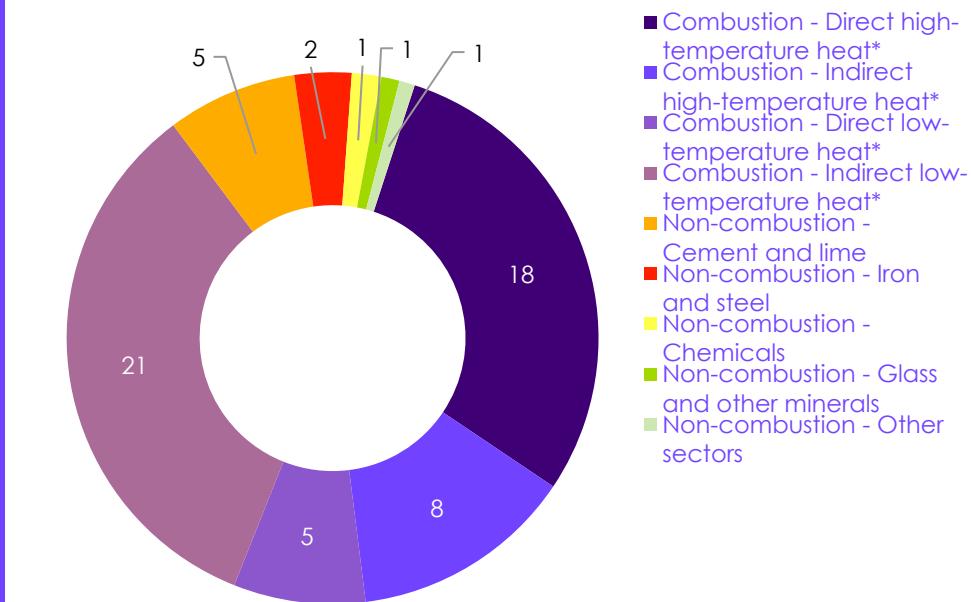
Figure 5.1 Manufacturing and construction emissions by sub-sector as a share of UK total



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; CCC analysis.
Notes: Global warming potentials from AR5 without feedback are used.

85% of manufacturing and construction emissions are from combustion. Within this, an estimated 60% are from low-temperature processes.

Figure 5.2 2020 manufacturing and construction emissions by process (MtCO₂e)

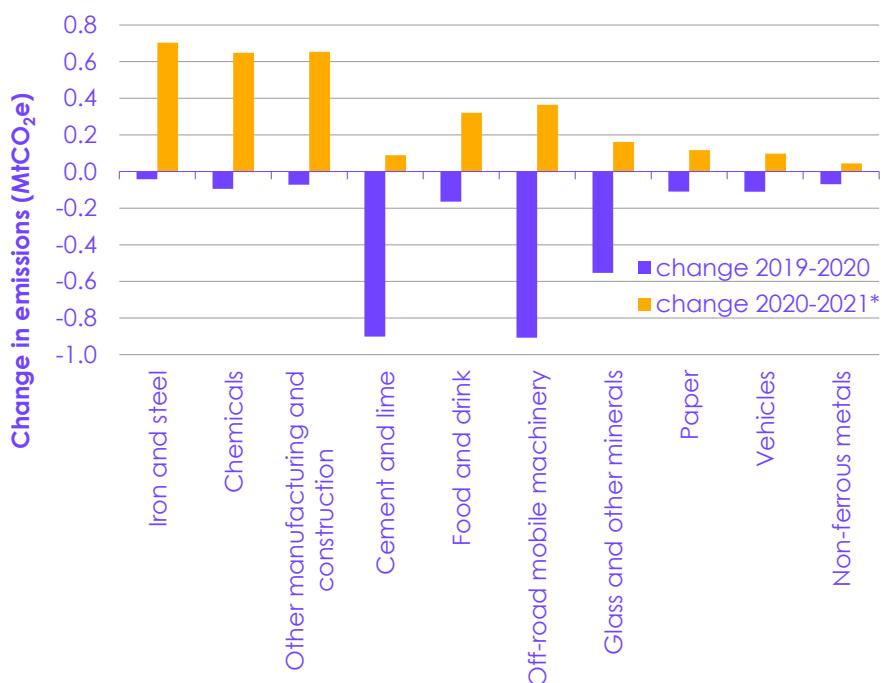


Source: BEIS (2020) Final UK greenhouse gas national statistics: 1990 to 2020; CCC analysis.

Notes: Global warming potentials from AR5 without feedback are used. Combustion emissions arise from burning fuel to produce heat, electricity, or motion. Non-combustion emissions arise from chemical reactions (e.g., calcination of limestone in the production of cement). Direct heating refers to where a material being heated comes into contact with combustion gases. *The breakdown of combustion emissions from low- and high-temperature heat is not published with annual emissions statistics, therefore values are estimates based on internal modelling from 2018.

All sub-sectors saw reductions in emissions in 2020. Provisional 2021 data suggest that overall manufacturing & construction emissions are back to 2019 levels, driven largely by iron & steel, chemicals, and other manufacturing & construction.

Figure 5.3 Change in manufacturing and construction emissions 2019-2021, by sub-sector

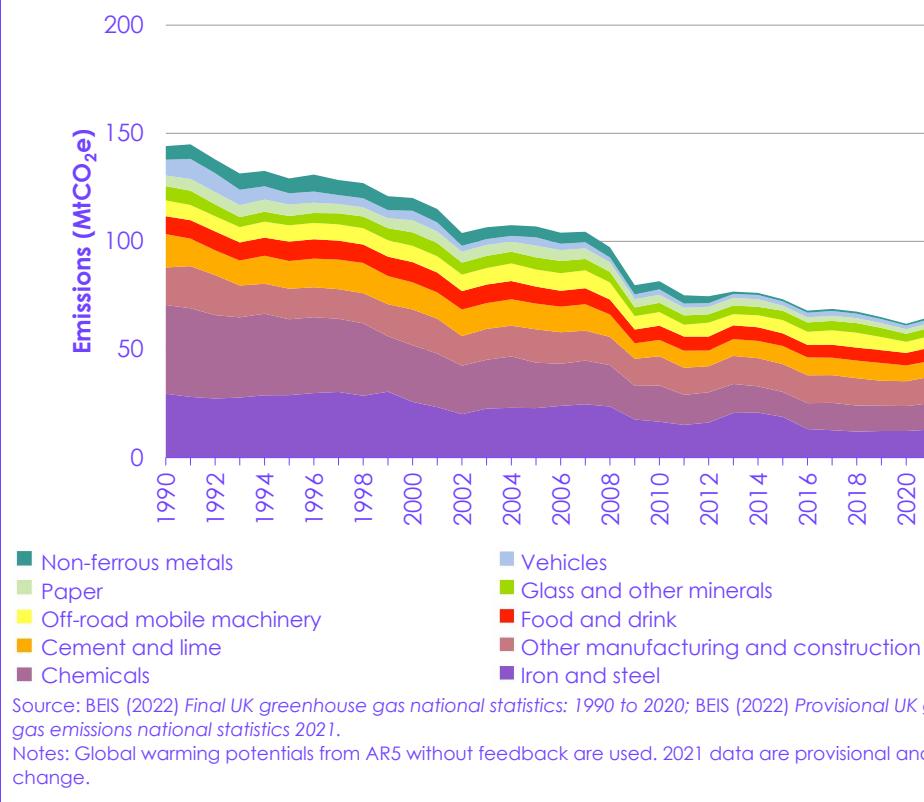


Source: BEIS (2022) Final UK greenhouse gas national statistics: 1990 to 2020; BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021.

Notes: Global warming potentials from AR5 without feedback are used. *2021 data are provisional and subject to change.

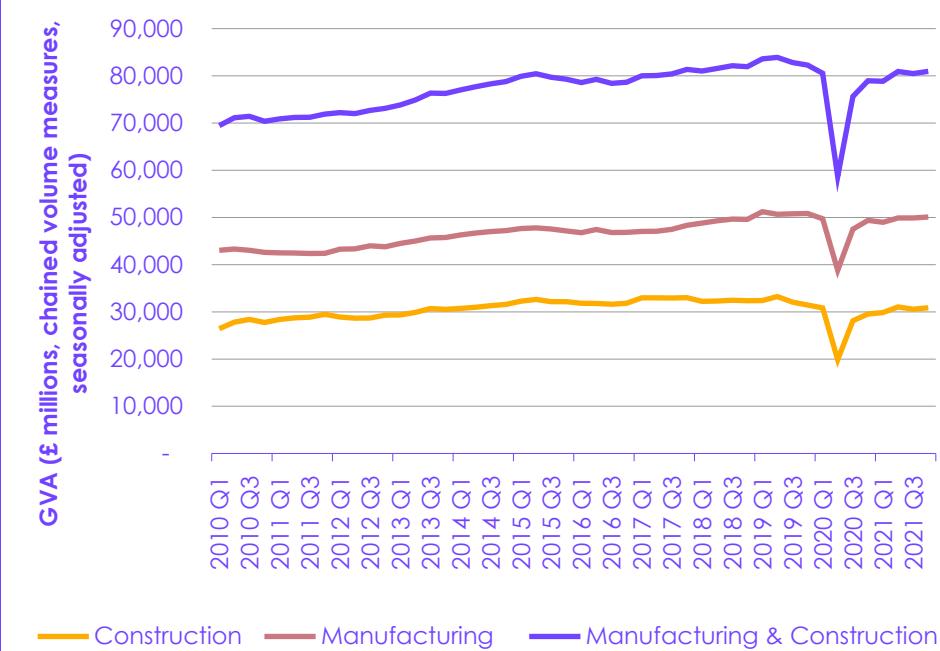
UK territorial emissions from manufacturing and construction have fallen by an average of 3% per year since 1990. Emissions in 2020 fell 5% on the previous year, however provisional data suggest they increased again by 5% in 2021.

Figure 5.4 Manufacturing and construction emissions 1990-2021, by sub-sector



Manufacturing and construction GVA has increased steadily over the past 10 years. Following a sharp drop in 2020 due to the pandemic, levels have begun to rebound, though 2021 GVA remains 3% below 2019 levels.

Figure 5.5 Manufacturing and construction quarterly GVA, 2010-2021



2. Indicators of progress

This section sets out key indicators of progress in manufacturing and construction. It covers indicators of progress towards pre-2025 emissions reductions, such as on energy efficiency and resource efficiency, and indicators of progress towards post-2025 emissions reduction, particularly on fuel switching and CCS. Finally, it outlines progress on wider enablers of decarbonisation in this sector.

Availability of data to measure progress in this sector is particularly poor, and critically limits monitoring and evaluation. We recommend that the Government reviews, invests in, and reforms its industrial decarbonisation data.

Availability of data to measure progress in this sector is particularly poor, and critically limits monitoring and evaluation. We have focused on indicators where data are available, providing a partial picture of progress. We recommend that the Government reviews, invests in, and reforms its industrial decarbonisation data collection and annual reporting to enable better monitoring. We intend to expand the indicators of progress when data become available, as detailed in the data gaps section of the Monitoring Framework for manufacturing and construction.

Progress on the key indicators is illustrated in Table 5.1 and Figures 5.7 – 5.9. A wider set of indicators is outlined in the supporting data to this report, which are explained in the Monitoring Framework. Our monitoring map shows how these fit together (Figure 5.6).

The key indicators show a mixed and incomplete picture.

The key indicators show a mixed and incomplete picture in a sector where tracking quantitative progress is still particularly challenging because of the paucity of good data available and the diversity of the sector.

Figure 5.6 Monitoring map for manufacturing and construction

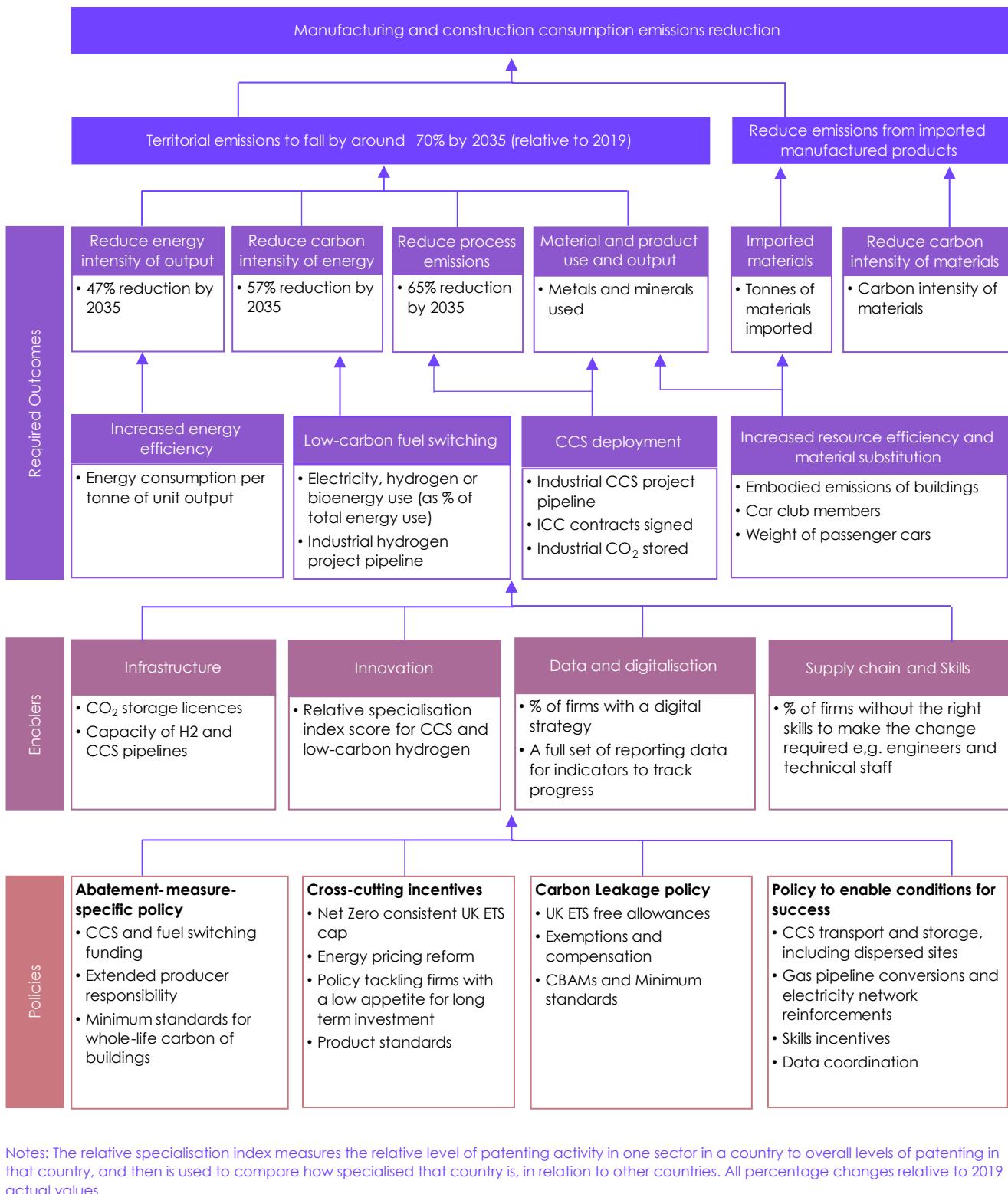
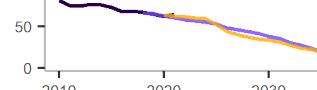
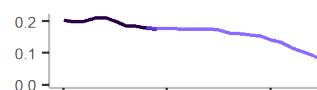
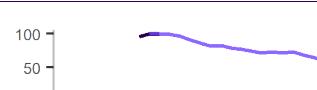
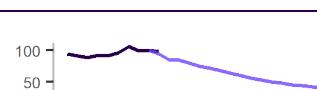


Table 5.1

Manufacturing and construction indicators

Manufacturing & construction indicators		Most recent value & benchmark		Trend	
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov - Pipeline
Territorial emissions	Territorial emissions from manufacturing and construction	2021	65.1 MtCO ₂ e; CCC benchmark: 60.7; Gov benchmark: 63.0	+5% from 2020	
Consumption emissions	Emissions from consumption of manufactured and construction products	2018	146 MtCO ₂ e	+1% from 2017	
Carbon-intensity of energy	Carbon-intensity of energy consumed in manufacturing and construction	2019	0.175 TWh/MtCO ₂ e; CCC benchmark: 0.178	-2% from 2018	
Material and product use	Material and product use	2018	312 Mt	-5% from 2017	
Energy efficiency	Energy consumption per tonne of crude steel	2019	99.3 GWh/tonne, indexed 2018=100; CCC benchmark: 100.4	-1% from 2018	
	Energy consumption per tonne of paper	2019	98.7 GWh/tonne, indexed 2018=100; CCC benchmark: 94.8	-1% from 2018	
Low-carbon fuel switching	Electricity, hydrogen, and bioenergy use (as % of total energy use)	2019	36.4%; CCC benchmark: 36.5%	+1.1pp from 2018	
	Industrial hydrogen project pipeline	NA			
CCS	Industrial CCS project pipeline*	NA			
Resource efficiency	Average embodied carbon of buildings	NA			

Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.

Notes: All values are rounded to 3 significant figures; solid lines represent pathways; dotted lines show the linear rate of change required to meet in-year benchmarks; global warming potentials from AR5 without feedback are used; 'Industrial CCS project pipeline' refers to the pipeline of 'ready and known' planned projects by industrial clusters, as collected by the CCSA; a dashed black line is used to reflect that this is an estimate of future production, rather than historical data, a current value is not presented for this reason.

Progress reducing emissions before 2025

Territorial emissions in the sector in 2021 were 3% higher than the Government's pathway (Figure 5.7).^{*} However, this may reflect continued disruption due to the pandemic, for example increased output as firms catch up on reduced production in the previous year, rather than a genuine lack of progress with emissions reduction actions.

To assess whether genuine actions to reduce emissions before 2025 have been delivered we assess progress against the 'required outcomes' in Figure 5.6. There are two key limitations to this year's assessment.

- Due to data limitations, 2019 is the latest year for which we have both full pathways and data for several of our indicators.
- We seek to track against indicators based on the Government's pathway where available. However, the analysis mostly relies on tracking against underlying aspects of our Balanced Pathway, due to a lack of published data on the underlying aspects of the Government pathway. This pathway has somewhat higher ambition than the Government's ambition overall pre-2025 (Figure 5.7), and differing ambition levels on specific technologies (see our accompanying Monitoring Framework).

Progress on fuel switching in 2019 appears to be on track; indicators of progress on energy efficiency show a mixed and incomplete picture; we cannot assess progress on resource efficiency.

When tracking against our Balanced Pathway, progress on fuel switching in 2019 appears to be on track, although this is not a strong indicator of medium-term progress; indicators of progress on energy efficiency show a mixed and incomplete picture; given available data, we cannot assess progress on resource efficiency (Box 4.1 in the Monitoring Framework).

Energy efficiency

Indicators on energy efficiency show a mixed picture of progress. It is difficult to conclude whether underlying progress is in line with our pathway.

Our indicators of energy efficiency progress in 2019 relative to 2018 (the base year of our Balanced Pathway) show a mixed picture. Since the indicators only provide a partial understanding on progress, it is difficult to conclude whether underlying progress is in line with our pathway.

- Overall energy-intensity of output in 2019 has improved at a faster rate than our pathway. While this measure can indicate reductions in the amount of energy used to produce the same products, changes can also reflect changes in the composition of UK manufacturing. As such it is informative to look at the energy consumption per unit of production for particular areas, where data are available.
- The energy consumed per unit of steel and paper, respectively, gives a mixed picture on energy efficiency in 2019, relative to 2018, with steel energy efficiency appearing ahead of pathway and paper energy efficiency appearing behind its pathway.

* The Government has only published a pathway for its industry sector, rather than our narrower manufacturing and construction sector. The difference is the inclusion of oil refineries, which we assign to the fuel supply sector. We have estimated a pathway for manufacturing and construction based on their pathway for industry, and our estimate of Government's pathway for refining. We will use this pathway, which we refer to as the 'Government pathway' to monitor progress on decarbonising the manufacturing and construction sector.

- Our pathways indicate that across key sectors, such as paper and in food and drink, the adoption of energy management systems should be ramping up to above 65% by 2028. However, evidence from the Energy Savings Opportunities Scheme (ESOS) phase 2 data in 2021 suggests that the adoption of ISO 50001 energy management systems across sectors is between 5 and 10%, which is similar to the level in ESOS phase 1 subset data reported in 2017.²

Fuel Switching

Near-term progress on fuel switching is broadly on track, although this is not a strong indicator of medium-term progress, with most of the change coming through uptake of bioenergy.

The carbon-intensity of energy used and uptake of low-carbon energy sources in 2019 was broadly in line with our pathway, although this is not a strong indicator of medium-term progress, with most of the change coming through uptake of bioenergy.

- The carbon-intensity of energy improved by 2% in 2019 on the previous year, which is in line with our pathway.
- Bioenergy use in the sector was up 1% in 2019 on 2018 levels. While this helps with short-term emissions reduction, we only see a limited role for additional bioenergy in manufacturing and construction.
- The fraction of total energy use from electricity stayed constant at 25%. However, there are no substantial increases in electrification (or hydrogen) in our pathway until around 2025.
- Data to track progress on decarbonisation of off-road mobile machinery are severely limited at present. However, there is qualitative evidence of incremental progress on the changing composition of the fleet. Qualitative evidence from industry suggests that the transition to a lower-emitting fleet via electric or hydrogen machinery is in its very earliest stages with only a handful of manufacturers across Europe selling these products and sales in the UK well under 1% of the market share.*

Resource efficiency and material substitution

Limited data makes it difficult to assess progress on resource efficiency and material substitution. Proxy indicators suggest mixed progress but provide a very partial account.

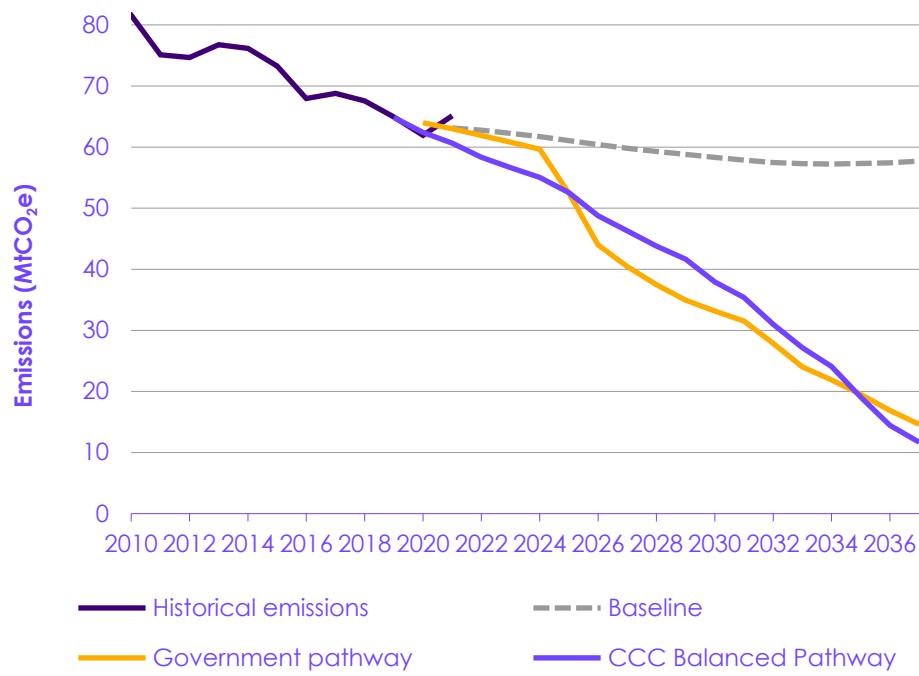
It is difficult to assess progress on resource efficiency and material substitution without better data to measure real progress across the diverse range of products. We suggest the need for improved data collection in Box 4.1 of the Monitoring Framework. Furthermore, we do not have a clear Government ambition in the near term. The indicators covered here provide a very partial picture and suggest mixed progress on resource efficiency.

- Proxy indicators on the resource-efficient production and use of cars indicate cars are getting heavier rather than lighter (Figure 5.8), and are heavier than our benchmark. More effort is needed to encourage shared forms of mobility to reduce the size of the car fleet (Figure 5.9).
- The use of metals and minerals in manufactured and construction products consumed by UK residents fell nearly 20% from a 2015 peak to 2018, the last year of available data. This appears to suggest increased resource efficiency, although we do not have sufficient data to understand what measures are driving these changes.

* Early findings from Construction Equipment Association survey.

The estimated Government pathway for manufacturing and construction sees lesser emissions reductions than the CCC pathway before 2025, followed by rapid decarbonisation.

Figure 5.7 Emissions and ambition in the manufacturing and construction sector

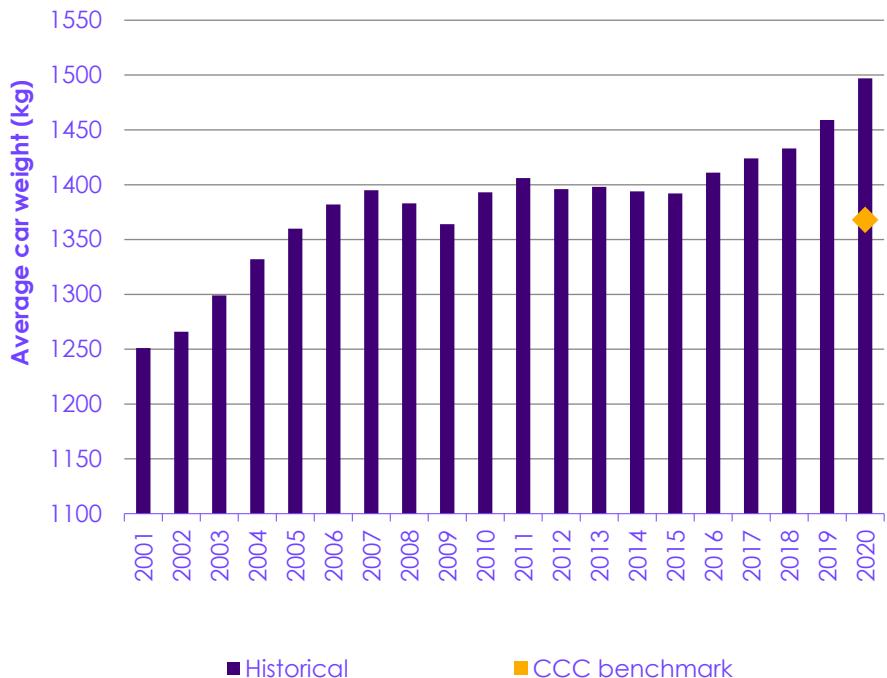


Source: BEIS (2022) Final UK greenhouse gas national statistics: 1990 to 2020; BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2021) Net Zero Strategy: Build Back Greener; CCC analysis.

Notes: Global warming potentials from AR5 without feedback are used. The Government pathway for the manufacturing and construction sector is estimated, as Government uses the sector 'Industry', which also includes refining.

The average car sold in the UK is 20% heavier than 20 years ago. Although electric vehicles are heavier than their petrol equivalent, there has been a consistent shift towards larger vehicles.³

Figure 5.8 Average weight of passenger cars sold in the UK



Source: ICCT (2022) European Vehicle Market Statistics: Pocketbook 2021/22⁴; CCC analysis.

The number of car club members remains less than 2% of the number of car owners, but trends are on an upward trajectory. Although too early to tell, the data suggest the size of the car fleet compared to the number of members is getting more efficient.

Figure 5.9 Car club members and size of the car club fleet



Source: CoMoUK (2020) Car Club Annual Report Great Britain 2020⁵; CCC analysis.

Notes: The size of the car club fleet indicates the efficiency of car clubs (the ratio of members to vehicle numbers).

Progress in preparing for emissions reductions in 2025 and beyond

Much of the Government's ambition for the sector is for 2025 and beyond. There is limited data to assess current progress on hydrogen, and some evidence that CCS deployment is a year behind schedule.

The Government's Net Zero pathway plans for a substantial increase in manufacturing and construction emissions reductions from 2025 (Figure 5.7), with a large part of this from fuel switching and CCS. We estimate that progress in preparing the CCS aspect of this large increase is now a year behind schedule. There is insufficient data on expected industrial hydrogen projects to assess whether this is on track.

- The Government's Net Zero Strategy set out ambition to have 2 MtCO₂/year of industrial CCS by 2025 and 6 MtCO₂/year by 2030.
- The Carbon Capture and Storage Association has published a Delivery Plan to 2035,⁶ which includes data on the pipeline of ready and known carbon capture projects in industry. These data suggest that, although there is a significant pipeline of projects for the early 2030s (provided the necessary policy environment is in place to support them), there will be less industrial CCS before 2027 than in the Government's pathway.
- Industrial carbon capture (ICC) business model contracts have also not yet been awarded, with the latest expectation that they will be awarded from mid-2023, a year later than envisaged last year. Assuming a three-year lead-time between contracts signed and carbon captured also suggests that deployment is a year off-track.

Enablers of success

67% of manufacturers and 71% of construction firms need more engineering and technical staff to reach the skills and knowledge needed to lower their environmental impact.

We have not set pathways for the wider enablers of decarbonisation in manufacturing and construction: infrastructure, innovation, data and digitalisation, and skills. However, we note a few key statistics:

- **Infrastructure readiness.** The North Sea Transition Authority has awarded six CO₂ storage licenses on the UK Continental Shelf, which could see up to 23 MtCO₂ stored annually by 2038 (see Chapter 14, Infrastructure section).
- **Innovation.** We can see from analysis by the Intellectual Property Office (IPO) using their Relative Specialisation Index (RSI), that the UK's patenting activity is highly specialised relative to the rest of the world for both CCS and low-carbon hydrogen.^{7,8}
- **Data and digitalisation.** Research by the Enterprise Research Centre in 2020 found that less than 60% of manufacturing and construction SMEs had a digital strategy in place.⁹
- **Skills:** A 2020 survey by the Institute of Engineering and Technology found that 67% of manufacturers and 71% of construction firms need more engineering and technical staff to reach the skills and knowledge needed to lower their environmental impact.¹⁰

3. Policy progress, assessment and next steps

The Government's decarbonisation ambition has increased over the past two years, but policy plans are unlikely to deliver the Government's ambition in full.

The Government's medium-term decarbonisation ambition for manufacturing and construction has increased substantially over the past two years, supported by several clear policy plans.

However, these policy plans are unlikely to deliver the Government's ambition in full and there are initial signs that delivery timelines are starting to slip.

To fulfil its ambition, the Government will need to strengthen existing policy and fill gaps in policy.

This section sets out details of these three aspects in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

This year has seen several substantial policy developments. The Net Zero Strategy set out increased ambition on industrial decarbonisation to 2035, but minimal ambition before 2025. To support this, Government has progressed several policies including a mix of cross-cutting incentives that can support a variety of emissions reductions, several policies targeted at supporting particular types of emissions reductions measures, policy to manage carbon leakage and (iv) policies to support the enablers of decarbonisation in these areas. We set out progress in these four areas in the subsections below.

Cross-cutting incentives

There have been several developments on cross-cutting incentives, most notably on the UK Emissions Trading Scheme (UK ETS), capital funding schemes and demand-side policies.

The UK and Devolved Governments have consulted on a new emissions cap for the UK ETS.

UK Emissions Trading Scheme. The UK and Devolved Governments have consulted on a new cap for the UK ETS, running from January 2024 to 2030 to align with the Government's Net Zero trajectory (see Chapter 2). With manufacturing emissions currently accounting for a large portion of the scheme's coverage, the tightened cap will help to drive manufacturing decarbonisation. However, a one-year delay in proposed implementation of the cap has meant a further year in which there is a substantial number of surplus emissions allowances. These surplus allowances will be carried over into future years and loosen the effective cap somewhat.

Cross-abatement-measure capital funding. Over the past year, the Government has awarded funds from long-announced capital funding schemes (Table 5.2) to demonstrate future technologies and develop feasibility or engineering studies. However, there has been no activity on the Clean Steel Fund, which has now been dormant for three years.

- Some progress was made in delivering the £315 million Industrial Energy Transformation Fund (IETF). In January 2022 the first round of phase 2 was launched with a £60 million pot for feasibility and engineering studies, and deployment projects to start by May 2023. The next two funding periods will be May 2022 and October 2022, with £100 million split between them.
- The £66 million Transforming Foundation Industries fund ran a funding competition totalling £1.5 million across the two strands in the summer of 2021 for small scale R&D projects.¹¹
- There has been no activity on the £250 million Clean Steel Fund, which was launched in 2019, since a response to a Call for Evidence in December 2020. While the response said funds could be released from 2023 onwards, there has been no news on its deployment or any associated strategy.¹²

The Government is investigating product standards, labelling and procurement and expects these policies to drive change towards low-carbon consumption within this decade.

Demand-side policies. The Government is investigating product standards, labelling and procurement and expects these policies to drive change towards low-carbon consumption within this decade.

- BEIS has completed a Call for Evidence to inform proposals for industrial product standards, which Government plans to consult on in autumn 2022.¹³ The Government's stated aim is for voluntary product standards and labelling to be implemented by 2025, and potentially mandatory minimum standards in the mid to late 2020s.
- The Government co-established the Industrial Deep Decarbonisation Initiative to drive public and private procurement of green steel and cement.¹⁴ Through this initiative it committed to disclose embodied emissions in major public works from 2025 and this year set a 2030 target for embodied emissions. This will provide a useful contribution towards international decarbonisation. However, complementary supply side policy will be necessary to drive production of low-carbon steel or cement in the UK to avoid this policy offshoring steel and cement production.

Policies targeted at specific abatement measures

There are several policies targeted specifically on either CCS, fuel switching, energy efficiency, resource efficiency or material substitution, set out below. In these areas there are several schemes providing funding, which we summarise in Table 5.2.

Within the past year, the first industrial clusters have been selected, there have been updates on the CCS business models, and there has been continued innovation funding for industry.

Industrial Carbon Capture and Storage. Government has continued to develop a policy package on CCS to achieve its ambition to deploy CCS in at least two industrial clusters by the mid-2020s and to deliver 6 MtCO₂/year of industrial CCS by 2030 and 9 MtCO₂/year by 2035.¹⁵ This has included deciding the location of the first clusters, initiating the process of deciding which capture projects receive support, continuing the development of the business model and funding model for industrial CCS, and innovation funding.

- The Government has provisionally decided that the first two CO₂ transport and storage clusters to be constructed will be the HyNet and East Coast clusters. The process for deciding further clustered or dispersed transport and storage infrastructure is yet to begin (see Chapter 14 Infrastructure section for further detail).

- In November 2021, Government launched the process for individual projects, including manufacturing projects, to apply for support to connect to the first transport and storage networks. The Government is expecting to make final decisions on allocating support under this phase from Q2 2023 - later than previously indicated.¹⁶
- The mechanism for supporting manufacturing CCS projects – the Industrial Carbon Capture (ICC) business model – is nearly finalised, although slightly behind the Government's initial timelines.¹⁷ The exact timetable for negotiations is to be confirmed, with the first projects expected to be awarded contracts from mid-2023.
- Progress has been made on developing the Industrial Decarbonisation and Hydrogen Revenue Support Scheme (IDHRS) and the CCUS Infrastructure Fund (CIF). IDHRS, announced in the Government's Net Zero Strategy, is a complementary mechanism to provide revenue funding for both CCS and hydrogen projects, via the business models. IDHRS is expected to fund projects from 2023 and will provide up to £140 million to fund the new hydrogen and ICC business models. The £1 billion CIF will support capital expenditure on industrial CCS projects and transport and storage infrastructure. The split of funding is not specified, but it is likely that a greater proportion will go to transport and storage infrastructure.¹⁸
- There is new and ongoing funding for CCUS innovation and demonstration, under the Net Zero Innovation Portfolio. The CCUS Innovation 2 competition opened in July 2021, comprising £19.5 million in grant funding for projects to develop novel CCUS technology and reduce the cost of deployment.¹⁹ The Scottish Government launched the £5 million CO₂ Utilisation Challenge Fund in April 2022, to support research and development into CO₂ utilisation technologies.²⁰

While some updates have been made to the hydrogen business model, there has been a lack of policy developments relating to industrial electrification in the past year.

Fuel Switching. The Government has consulted on its hydrogen business model, which should incentivise production of hydrogen and, in turn, encourage the use of hydrogen in manufacturing and construction, though additional supporting policies may be needed to ensure this. Aside from hydrogen, there has been a lack of policy developments to support electrification (and bioenergy) in industry in the past year, other than funding under the IETF and Net Zero Innovation Portfolio.²¹

- The Government has consulted on the design of the business model for low-carbon hydrogen. The business model aims to lower the costs of producing hydrogen so that it is competitive compared to alternative high-carbon fuels. Although the focus is on producing hydrogen, rather than supplying manufacturing and construction firms, the Government has indicated its intention for this sector to be a substantial target for the policy. Their consultation response stated their intention to finalise the hydrogen business model in 2022, and to allocate the first support contracts for hydrogen production projects reaching final investment decisions from 2023.²²
- In the past year, the Government has continued to develop the Net Zero Hydrogen Fund (NZHF) and IDHRS to provide capital and revenue support for hydrogen production. The first and second strands of the £240 million NZHF opened to applicants in April 2022. Again, although this doesn't provide direct support to end-users of hydrogen, it is hoped that developing hydrogen as a competitive fuel will incentivise its use, including in manufacturing.

- New and ongoing innovation and demonstration funding has been announced for fuel switching, under the Net Zero Innovation Portfolio and Phase 2 of the IETF.
 - The Industrial Hydrogen Accelerator Programme was announced in early 2022, as part of the Net Zero Innovation Portfolio.²³ The £26 million fund opened to applications in April 2022 and will support innovation projects generating evidence on end-to-end industrial fuel switching to hydrogen.
 - The £55 million Industrial Fuel Switching 2 competition launched in October 2021 as part of the Net Zero Innovation Portfolio, to support innovation in the development of pre-commercial fuel switching and fuel switch enabling technology for the industrial sector.²⁴ Three separate lots will focus on hydrogen, electrification, and biomass/wastes respectively.
 - Also part of the Net Zero Innovation Portfolio, the £40 million Red diesel replacement competition opened to applications in September 2021.²⁵ The competition aims to fund the development of technologies that enable Off-Road Mobile Machinery to switch from red diesel to hydrogen or other low carbon fuels.

Proposals for updating future scope and functioning of key energy efficiency schemes have been brought forward.

Energy Efficiency. The Government has brought forward proposals for updating the Climate Change Agreement (CCA) scheme and the Energy Savings Opportunities Scheme, but no decisions have yet been made on their future. Innovation funding has been announced to support the demonstration and development of new industrial efficiency technologies.

- BEIS has brought forward new proposals on the future of CCAs including an option for the new scheme length, a mid-scheme review, changes in eligibility, mandatory adoption of energy management systems for participants in future, annual reporting and considering how to tackle the synergies of data collection across similar schemes.
- Additionally, a consultation was launched in July 2021 on strengthening ESOS. BEIS sought views on improving the quality of audits through increased standardisation of reporting requirements, the inclusion of a Net Zero element to audits and requiring public disclosure of high-level energy efficiency recommendations by participants.
- In August 2021, the scope of Phase 3 of the Industrial Energy Efficiency Accelerator (IEEA) programme was announced which outlined how £8 million grant funding would be competitively awarded between 2021 and 2025 to support the development and demonstration of innovative industrial efficiency technologies.

Resource efficiency and circular economy plans, targets and policies have faced delays. There has been some progress in areas of packaging waste and construction.

Resource Efficiency and Material Substitution. Resource efficiency policies, including reforms to and the expansion of Extended Producer Responsibility schemes, have largely been delayed, with progress made on mapping out what needs to happen across the construction sector.

- The Environment Act 2021 provided the legal framework to set targets and policies on resource efficiency (alongside waste). A consultation on the proposed environmental targets opened in March 2022.²⁶ The setting of a resource productivity target has been delayed but not ruled out.

- Actions regarding the existing and proposed new Extended Producer Responsibility (EPR) schemes have been delayed. Amendments to, and consultations on, improving the effectiveness of the existing EPR schemes (which apply to waste from packaging, electrical and electronic equipment, batteries and vehicles) that were expected by the middle of 2021 have largely been delayed.²⁷ The commitment given in the Resources and Waste Strategy to begin consulting on at least two new EPR schemes, likely to apply to textiles and one other product group, by the end of current parliament in 2022 has also been delayed.
- Funded by BEIS and in collaboration with Defra, The Green Construction Board published a Routemap to Zero Avoidable Waste in construction in July 2021 to identify the actions to be taken right across the construction process and by Government to reduce this waste stream to zero.²⁸
- Development of a policy roadmap to increase the use of timber in construction in England, committed to in the Net Zero Strategy, has started.²⁹
- The Timber in Construction (TiC) Innovation Fund was released early 2022 which will provide up to £1.5 million by March 2025 to support the development of innovative timber products, supply chains and ways of working with wood.³⁰
- The Circular Economy Bill in Scotland was postponed in 2020 but the consultation on a new Circular Economy Bill was published on 30th May 2022 alongside a consultation on a Route Map to 2025 to set out how Scotland will achieve its waste and recycling targets.^{31,32}

Table 5.2

Capital funding announced to support decarbonisation of manufacturing and construction

Measure supported	Scheme name	Total amount available*	Spending timeline
CCS, fuel switching	Industrial Decarbonisation Challenge fund	£170m	2019-2024
Energy efficiency, fuel switching, CCS	Industrial Energy Transformation Fund (IETF)	£315m	2020-2024
Energy efficiency, resource efficiency	Transforming Foundation Industries	£66m	2020-2025
Energy efficiency	Industrial Energy Efficiency Accelerator - Phase 3 [Net Zero Innovation Portfolio]	£8m	2021-2022
Material substitution	Timber in Construction Innovation Fund	£1.5m	2022-2025
Fuel switching	Industrial Hydrogen Accelerator [Net Zero Innovation Portfolio]	£26m	From 2022
Fuel switching	Industrial Fuel Switching 2 competition [Net Zero Innovation Portfolio]	£55m	From 2021
Fuel switching	Red diesel replacement competition [Net Zero Innovation Portfolio]	£40m	From 2021
CCS	CCUS Innovation 2.0 Competition [Net Zero Innovation Portfolio]	£19.5m	From 2021
CCS	CO ₂ Utilisation Challenge Fund [Scottish Government]	£5m	From 2022
CCS	CCUS Infrastructure Fund (CIF)	£1bn**	2021-2030
Steel sector measures only	Clean Steel Fund	£250m	From 2023

Source: BEIS (2021) *Industrial Decarbonisation Strategy*, Annex 2: Current government decarbonisation policy; GOV.UK Net Zero Innovation Portfolio
Notes: * Over the lifetime of the scheme; includes funding that has already been awarded, in several cases. ** Not all of the CCUS Infrastructure Fund is for industrial CCS, the funding will also support development of T&S networks.

Carbon leakage policy

Government has made some small steps developing its medium to long-term approach to managing carbon leakage risk.

Government has made some small steps towards developing its medium- to long-term approach to managing carbon leakage risk, while taking steps to ensure it maintains its short-term approach. Details are set out in the Carbon Leakage Policy subsection of Chapter 14.

Policy to support enablers

Funding for future innovation has been announced and awarded, largely through the Net Zero Innovation Portfolio, as outlined above and in Table 5.2.

Wider policy has included infrastructure development through the cluster sequencing process, and skills support through the Green Jobs Taskforce.

Some policy progress has occurred on CCS infrastructure, as outlined above and in Chapter 14 – Infrastructure. The cluster sequencing process has been launched, and further developments have been made on the CCUS Infrastructure Fund (CIF) and the Transport & Storage Regulatory Investment (TRI) business model. Policy on hydrogen infrastructure is further behind, with the UK hydrogen strategy lacking any definitive plans but committing to further work on this.

The Government published the Green Jobs Taskforce report in July 2021, which set out recommendations on how to meet the Government ambition of two million green jobs by 2030. Subsequently the Net Zero Strategy committed to legislating that new local skills plans should consider the skills needed for climate action and wider environmental goals.

(b) Assessment of policies and plans

The Government's strategy should provide a boost to industrial clusters but leaves some risk of the UK taking a more expensive decarbonisation route with lower energy security.

Policy is not on track to deliver the emissions reductions targeted in the Government's Net Zero Strategy.

The Government's strategic approach to decarbonising manufacturing and construction should provide a boost to industrial clusters but leaves some risk of the UK taking a more expensive decarbonisation route with lower energy security. These facets are driven by more focus on the use of hydrogen and the application of CCS, less on electrification in the sector and later focus on improvements in energy and resource efficiency.

To deliver the Government's strategy there is a set of several strong policy plans emerging. However, we assess that policy is not on track to deliver the emissions reductions targeted in the Government's Net Zero Strategy, and there are several areas of substantial shortfall on policy.

- Our assessment in Figure 5.10 suggests that planned policies will not deliver enough emissions reductions to meet the Government's intended emissions pathway for manufacturing and construction. Of the emissions reductions for which there is policy, most of this has either some or significant risk of failing to deliver. Part of this is inherent in the fact that policies to support central actions in Government's plans, such as hydrogen and CCS, are not yet in place.
- Of the 15 departmental recommendations in the 2021 Progress Report allocated primarily to the manufacturing and construction sector, none have been fully achieved, eight have been partly achieved or are underway, and four have not been achieved. Of those departmental recommendations that were not due to be completed, we assess that there has been sufficient progress on one and some but insufficient progress on two.
- The Policy scorecard for manufacturing and construction (Table 5.3) sets out our assessment of policies by different areas. We have greater confidence of delivery of emissions reductions covered by the UK emissions trading scheme.

There is an emerging set of policy levers that will seek to cap emissions, upgrade the least-efficient operations, and support innovation and early deployment.

Policy gaps exist on resource efficiency, electrification, off-road mobile machinery, and the decarbonisation of smaller sites outside the scope of the UK ETS.

For sites within the UK ETS that participate in the Climate Change Agreement Scheme, there is a distortive disincentive against electrification.

There is an emerging set of policy levers for decarbonising manufacturing and construction that will seek to cap emissions, upgrade the least-efficient operations, and support innovation and early deployment. These will likely help to provide a substantial proportion of the emissions reductions required from the sector. The UK ETS now plans to have a credible cap on emissions, which is supported by subsidy via the hydrogen and CCUS business models and IETF, and very initial plans to introduce minimum standards. However, there are several gaps in policy including on resource efficiency, electrification, low-carbon off-road mobile machinery and decarbonisation of the 40% of emissions from smaller operations not within the scope of the UK ETS. It is not clear whether energy efficiency policy is strong enough. These gaps risk under-delivery against the Government's decarbonisation ambition and delaying the development of decarbonisation options:

- Firmer policies are needed to deliver sufficient resource efficiency. While more established policies including Extended Producer Responsibility schemes have improved waste collection, recovery, and recycling, it is less clear how reforms will incentivise a reduction in material and product use.
- There is very little targeted support for electrification, which risks the technology options and supply chain being underdeveloped. It also misses an opportunity to increase energy security by gradually reducing reliance on gas.
- Policy has focused on decarbonising clusters, because of a focus on hydrogen and CCS, which has likely accentuated the lack of support for electrification, which may be well suited to dispersed sites.
- There is an absence of policy progress on industrial off-road mobile machinery, with no clear strategy to reduce emissions from this source.
- There is no clear strategy for decarbonising small facilities not covered by the UK ETS, which together represent around 40% of sectoral emissions. Some policies, such as product standards and the hydrogen business model, could help, but these could just end up supporting facilities within the UK ETS (such as larger sites in the basic materials sectors), without a clear strategy.
- It is not clear whether energy efficiency policies will deliver sufficient emissions reductions, given a lack of clarity over both ambition and estimated emissions reductions. Decisions on the future of energy efficiency schemes, such as CCAs and ESOS, and on product standards, may provide an opportunity for clarity.

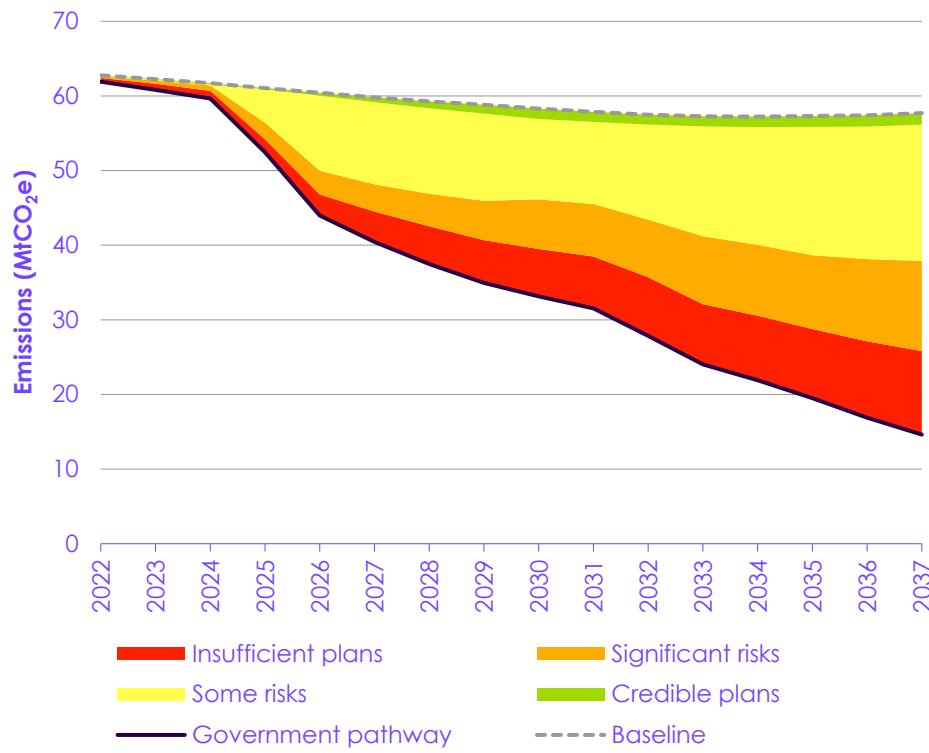
There are also some issues with existing and planned policies, including delays and unintended consequences in design.

- There are delays emerging with delivering the Government's 2025 CCS ambition. The ICC business model has been delayed and the pipeline of projects suggests it could now be impossible to deliver by 2025.
- For sites within the UK ETS that participate in the Climate Change Agreement Scheme, there is a distortive disincentive against electrification. This is because, for these sites, their energy efficiency targets are set solely based on electricity consumption. Consequently electrifying makes them more likely to miss their 'energy efficiency' targets, even if their overall energy efficiency improves. When redesigning the CCA scheme, the Government should remove this distortion.

Finally, the availability of relevant data across this sector is very poor, and critically limits monitoring and evaluation and policy implementation.

Most policies within the manufacturing and construction sector are classed as either some or significant risks, reflecting that more needs to be done to be confident that policy savings will be delivered.

Figure 5.10 Assessment of policies and plans for manufacturing and construction



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: Global warming potentials from AR5 without feedback are used. Baseline, pathway and emissions savings are estimated based on data published by BEIS with the Net Zero Strategy. Where a detailed emissions breakdown by measure was lacking, we have applied the proportions of emissions savings from specific technologies from our own modelling and scenarios. This also applies for splitting out the share of emissions reductions that occurs under the UK ETS.

Table 5.3

Policy scorecard for manufacturing and construction

Sub-sector		Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
CCS	22% of 2035 emissions reductions	Y	Y	Y	Y	Y
		<ul style="list-style-type: none"> CCS abatement is set to be supported by a combination of the various funding and business models and the UK ETS (we assess that minimal abatement from CCS will occur outside the traded sector). Risks remain because these aren't yet proven or finalised and there is no specific policy framework for dispersed sites. Innovation and demonstration funded through the Industrial Energy Transformation Fund (IETF) and Net Zero Innovation Portfolio. Capital funding available through the CCS Infrastructure Fund (CIF) and ongoing revenue support from Industrial Decarbonisation and Hydrogen Revenue Support scheme (IDHRS). The transport and storage business model will support infrastructure, though again no specific plan for dispersed sites. Timeline proposed under the cluster sequencing process, though there is uncertainty on exact timings for clusters that haven't already been given provisional support. 				
Fuel switching	Hydrogen*	Y	Y	O	Y	Y
	19% of 2035 emissions reductions	<ul style="list-style-type: none"> Combination of the UK ETS and hydrogen business model provide incentives, although this is less developed than the CCS business models and is not focused on end-use in industry. We assess that most of the Government's envisaged hydrogen use is at sites covered by the UK ETS (apart from off-road mobile machinery, which is split out here) – and that these sites will benefit from both incentives. Net Zero Hydrogen Fund and IDHRS provide capital and ongoing revenue support for hydrogen production. IETF and Net Zero Innovation portfolio (e.g., the Industrial Hydrogen Accelerator) provide funding for feasibility and demonstration. Clusters will provide infrastructure for sites in clusters, but there is no clear plan for hydrogen infrastructure, especially for dispersed sites. Government intends to finalise the hydrogen business model in 2022, and to allocate the first support contracts for production projects reaching final investment decisions from 2023, but further detail lacking – especially for industry specifically. 				
	Electrification and bioenergy – within UK ETS*	O	O	O	R	O
	12% of 2035 emissions reductions	<ul style="list-style-type: none"> The UK ETS is the main policy to drive uptake of electrification and bioenergy for these sites. Small amounts of capital funding are accessible via the IETF and industrial fuel switching competition for innovation. Barriers include development of the technology and supply chain. We have not assessed whether electricity grid reinforcement near industrial sites is currently providing a further challenge beyond cost. The Net Zero Strategy said Government will set out initial steps to support the uptake of electrification by the end of 2021, but this has not been forthcoming. There is no further strategy, timeline, or specific delivery mechanism in place. 				
	Electrification and bioenergy – outside UK ETS*	R	O	O	R	R
	9% of 2035 emissions reductions	<ul style="list-style-type: none"> For sites outside of the UK ETS there is no delivery mechanism for electrification or bioenergy, nor a strategy or timeline. Funding is still accessible via the IETF and industrial fuel switching competition. The same barriers apply, plus there is also misaligned incentives from Climate Change Agreements (CCA). 				

Sub-sector		Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Fuel switching (cont.)	Off-road mobile machinery (ORMM)	R	O	O	R	R
	10% of 2035 emissions reductions	<ul style="list-style-type: none"> No strategy, policy, or timeline. Not covered by the UK ETS and largely falls outside of the clusters so unlikely to benefit substantially from work to develop industrial clusters. Funding is available for firms that can develop low-carbon alternatives to red diesel through the £40 million Red diesel replacement competition. 				
Energy efficiency	At facilities within UK ETS 8% of 2035 emissions reductions	G	Y	Y	O	G
		<ul style="list-style-type: none"> The UK ETS provides the main incentive, it is very likely to deliver some emissions reductions (hence a share of the overall assessment is rated green), but the existing flexibility within the ETS means there is uncertainty over whether it will deliver all the emissions reductions required. Industrial Energy Efficiency Accelerator (IEEA), IETF, and Industrial Heat Recovery (IHR) provide funding support. The IETF could help to tackle one of the main barriers for firms which is the availability of capital to invest in longer payback period investment. There is policy in place to tackle information failures, such as the Energy Savings Opportunity Scheme (ESOS) where firms report their energy use and receive information about potential energy savings. There are plans to make changes ESOS. 				
	At facilities outside the UK ETS 2% of 2035 emissions reductions	O	O	Y	O	O
Resource efficiency	Designing more resource efficient products (light-weighting, recycling, material substitution) 12% of 2035 emissions reductions	O	R	O	O	O
		<ul style="list-style-type: none"> More action in addition to EPR schemes and a Plastics Packaging Tax is needed to incentivise resource efficient design and demand for resource-efficient products. Government is considering approaches that could create this demand following a Call for Evidence on a market for low emissions industrial products. Investment to progress the National Materials Datahub, which is intended to improve data, particularly the availability and quality of secondary materials for recycling and reuse, has not been secured. The Routemap to Zero Avoidable Waste in construction provides a detailed timeline for action in construction. Indicative timelines are given in Government strategies for increasing the scope of EPRs and implementing product standards, all to be consulted on or implemented before 2025. Some currently face delays. 				

Sub-sector		Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Resource efficiency (cont.)	Using products more efficiently (product longevity, reuse & sharing)	O	R	R	R	R
	5% of 2035 emissions reductions	<ul style="list-style-type: none"> While Government documents have positively highlighted approaches to using products more efficiently, including using EPR schemes to make it easier to reuse and repair products and a ban on some single-use plastic items, existing policies are limited and narrow. Voluntary standards such as Ecolabels also exist, but uptake is low. It is unclear what funding will deliver policies for efficient consumption. Increased data transparency is seen as vital to enabling more sustainable consumption. Proposals to improve data and reporting for industrial products are promised this year. However, initial indications do not suggest these will be designed to encourage alternative modes of consumption (for example reuse, repair, and leasing). 				
Overall sector assessment		O	O	O	O	O

Notes: The 'traded sector' refers to the parts of the manufacturing and construction sector that are within the scope of the UK Emissions Trading Scheme (UK ETS); The share of emissions reduction in 2035 is estimated based on BEIS Net Zero Strategy and internal modelling where a detailed breakdown is not provided. *Hydrogen, electrification, and bioenergy exclude use of those energy sources for off-road mobile machinery.

(c) Recommendations

Our full set of departmental recommendations in this sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department. Here we provide a summary. We present the departmental recommendations based on the structure of our assessment of policies which identified areas (a) where it is important that the Government keep up progress, (b) with issues in the existing policy, (c) where there are gaps in policy and (d) with poor data availability.

The Government should finalise CCS and hydrogen business models.

To ensure that the Government stays on course in areas where policy is stronger, we have set out departmental recommendations on the development of CCS and hydrogen.

- Hydrogen.** The Government must finalise the design of the hydrogen business model and Industrial Decarbonisation and Hydrogen Revenue Scheme in 2022, ensuring the policy does not create a unlevel playing field for industrial electrification in the medium term.
- CCS.** The Government should finalise the Industrial Carbon Capture and Transport & Storage business models, to enable final investment decisions on the first ICC projects in H1 2023 (see also Chapter 14 - Infrastructure).

The Government should set out its ambition on both energy efficiency and resource efficiency and how it is going to deliver these savings.

Energy efficiency. On energy efficiency, where it is not clear what ambition existing plans aim to deliver, the Government should set out both its ambition and how it is going to deliver these savings. It should consult on the design of product standards. It should also resolve the distortive disincentive against electrification caused by the design of the Climate Change Agreements scheme for sites covered by the UK ETS.

The Government should fill gaps in policy on electrification, low-carbon off-road mobile machinery, and incentivising fuel switching in small manufacturing facilities.

To fill the gaps in policy we recommend policy development on resource efficiency, electrification, low-carbon off-road mobile machinery, incentivising fuel switching in those small manufacturing facilities not currently covered by the UK ETS, and action on carbon leakage. In combination these are likely to help decarbonisation of dispersed sites, which have received less policy focus.

- **Resource efficiency.** The Government should set out a policy package for resource efficiency to deliver its ambition up until at least 2027, including a plan to mandate assessment of building whole life carbon by 2025, supported by a target enabled by new Environment Act powers.
- **Electrification.** The Government must consult on a funding mechanism to support the additional costs of electrification in manufacturing. This should be supported by reforms to electricity pricing. In combination, or alone if practical, these should incentivise early deployment of new electrification.
- **Off-road mobile machinery.** The Government should set out a strategy for decarbonisation of off-road mobile machinery, including policy proposals.
- **Small manufacturing and construction facilities.** The Government should create a clear incentive for manufacturing facilities not currently covered by the UK ETS to switch to low-carbon energy sources by reforming the suite of energy and carbon policies.
- **Carbon leakage.** The Government should consult on plans to implement by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products (see Chapter 14 – Carbon Leakage for detail).

To enable effective policy the Government should review, invest in and initiate reform of industrial decarbonisation data collection and annual reporting.

Data. To enable effective policy the Government should review, invest in and initiate reform of industrial decarbonisation data collection and annual reporting. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry.

4. Major risks

Table 5.4

Major risks and required mitigating actions for manufacturing and construction

Risk category	Description	Mitigating actions	
		Details	In place?
Carbon Leakage	The situation that may occur if, for reasons of costs related to climate policies, businesses were to transfer production to other countries with laxer emissions constraints.	Options to ensure a level playing field for costs include use of free allowances, exemptions and compensation or the application of equivalent policies to imports as on UK production (namely via product standards or carbon border adjustments).	The UK currently has free allowances, exemptions, and compensation in place, and will consult on product standards and carbon border adjustments later this year.
Offshoring from demand-side policies	Policies such as low-carbon public procurement could drive the UK to import its low-carbon products from countries with stronger supply-side policies, rather than drive UK producers to decarbonise. This could damage public support for policy.	The Government should have a clear strategy for coordinating supply-side and demand-side interventions. This is particularly important for sectors where sites produce products for a very wide range of customers and a limited-scope policy, such as public procurement wouldn't provide sufficient demand alone, to make deep decarbonisation viable.	The Industrial Decarbonisation Strategy considers both supply and demand side policy. However, it is not clear how it strategically considers their interaction.
Effect on cost of living	Additional cost of goods does not receive public support.	The Government should think carefully about how the costs fall across households and which levers can be used to create a fair distribution.	It is not clear whether the Government has assessed how the cost of industrial decarbonisation would be distributed under different policy approaches.
Technology development fails	Some technologies or infrastructure fail or are developed too slowly, and emissions targets are missed (despite ETS emissions cap, which could be breached with companies paying high costs to breach)	Innovation and demonstration are key to bringing down the costs and increasing the rate of commercialisation of new technologies. Innovation funding at an international level or innovation taking place around the world should be supported to share learning and ensure the technologies develop at the pace we need them.	There are several innovation and infrastructure support policies in place. Although, some areas are weaker, including on electrification.
Capital availability	Very high internal cost of capital in manufacturing companies results in less investment.	The Government could look to remove barriers to the use of lower cost private finance. It could also offer loans to spread the cost over time or targeted grants where appropriate. More generally, it could reduce investment risks associated with low-carbon technologies.	Partly – there are a variety of competition funding schemes for demonstration and feasibility projects.

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Chapter 6: Electricity supply

48 MtCO₂e, 11% of UK emissions, in 2021

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Introduction and key messages

Reducing emissions from electricity generation and then using low-carbon electricity to power the economy is a central part of reaching Net Zero. Sector emissions have fallen rapidly over the last decade, and the Government has made a strong commitment to fully decarbonise the sector by 2035. The key challenge is now to ensure that these ambitions are delivered on, and that available low-carbon electricity can be fully utilised and is sufficiently reliable and resilient.

Our key messages are:

- **Emissions.** Largely due to a combination of nuclear outages and exceptionally low windspeeds, emissions from electricity generation rose by 10% in 2021 compared to 2020 levels. With coal now all but removed, this highlights the need to continue the rapid expansion of zero-carbon generation and develop flexible low-carbon alternatives to gas.
- **Policy progress.** In the past year the Government has committed to electricity generation being 95% low-carbon by 2030 and fully decarbonised by 2035. It has also made stretching commitments to increase low-carbon capacity from renewables and nuclear, although these have some delivery risks. Overall, credible plans are in place for over half the emissions reduction required in 2035.
- **Recommendations and next steps.** The overriding challenge is now to ensure that the Government's ambitions are delivered.
 - A key gap in comparison to other sectors (e.g. heat and buildings, transport) is the absence of an overarching delivery plan or strategy. This would improve visibility and confidence for private sector investors and should be developed as a priority. It should set out the Government's approach and the requirements for a fully decarbonised, resilient electricity system by 2035.
 - Key enablers will also need to be tackled, including ensuring electricity market arrangements are fit for a low-carbon system, that both onshore and offshore network capacity and access is in place to support increasing electrification of the economy, and that potential supply-chain bottlenecks are addressed to avoid delaying investment.
 - The Committee will publish a report later in 2022 setting out how a decarbonised and resilient electricity system could be delivered.

The evidence underpinning these key messages is set out in four sections as follows:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

Electricity supply represents 11% of UK emissions. Sector emissions increased by 10% in 2021, but have fallen by over 75% since 1990.

In 2021 greenhouse gas (GHG) emissions from electricity generation represented 11% of total UK GHG emissions. The vast majority of these emissions were from gas-fired power stations (Figure 6.1).

Emissions increased by 10% in 2021 compared to 2020, to 48.3 MtCO₂e (Figure 6.1).

- This means emissions are tracking substantially (15 MtCO₂e, 44%) above the Government's Net Zero Strategy pathway for 2021 (Figure 6.2).
- Emissions remain 8% below pre-pandemic (2019) levels, 69% below 2010 levels, and 76% below 1990 levels, reflecting the almost complete removal of coal generation from the electricity system during the 2010s.

The increase in 2021 emissions reflects both rising demand in response to the easing of restrictions due to the COVID-19 pandemic, and an increase in the carbon-intensity of generation:

Electricity demand rose 2% in 2021 compared to 2020, largely driven by rebounding industrial demand following COVID-19 restrictions.

- **Electricity demand.** Demand rose by 2% to 285 TWh in 2021, but was still 4% lower than pre-pandemic levels. This rebound was primarily driven by higher industrial demand (Figure 6.3).

- Industrial electricity demand increased by 4%, while commercial and residential demand both increased by 1% relative to 2020 levels.
- Overall electricity demand remained below pre-pandemic levels, reflecting the continuation of restrictions during 2021. Residential demand was 5% higher and commercial and industrial demand 10% and 6% lower than in 2019, respectively, reflecting the higher prevalence of working from home during the pandemic.
- In the third and fourth quarters of 2021, residential electricity demand was 4% and 7% respectively lower than in the equivalent periods in 2020. This may be a consequence of increased electricity prices resulting from higher gas prices, combined with milder weather and some relaxation of lockdown restrictions during parts of that period.

Emissions intensity rose by 12% in 2021 compared to 2020.

- **Emissions intensity.** Emissions intensity rose by 12% in 2021 to 200 gCO₂/kWh. Low-carbon generation was 9% lower than in 2020 due to low windspeeds and outages at nuclear plants. Consequently, gas generation and imports rose to compensate for this, increasing emissions.

- **Low-carbon generation** reduced by 9% in 2021.

- The lowest average windspeeds in a decade led to a 14% reduction in wind generation in 2021, despite a 5% increase in capacity. Consequently, the average offshore wind load factor fell to 37% compared to 46% in 2020, and the average onshore wind load factor fell to 23% compared to 28% in 2020. There is no clear evidence this is part of a longer-term trend (Figure 6.4), but we will continue to monitor this as part of our annual progress tracking.

Gas generation and imports both rose in 2021 compared to 2020.

- There was also less sunshine in 2021 compared to 2020, causing a 6% reduction in solar generation. The average solar load factor fell to 10% compared to 11% in 2020.

- Nuclear generation reduced by 9% in 2021, primarily due to plant outages. This is part of a continued decline in nuclear generation due to ageing of the UK reactor fleet.

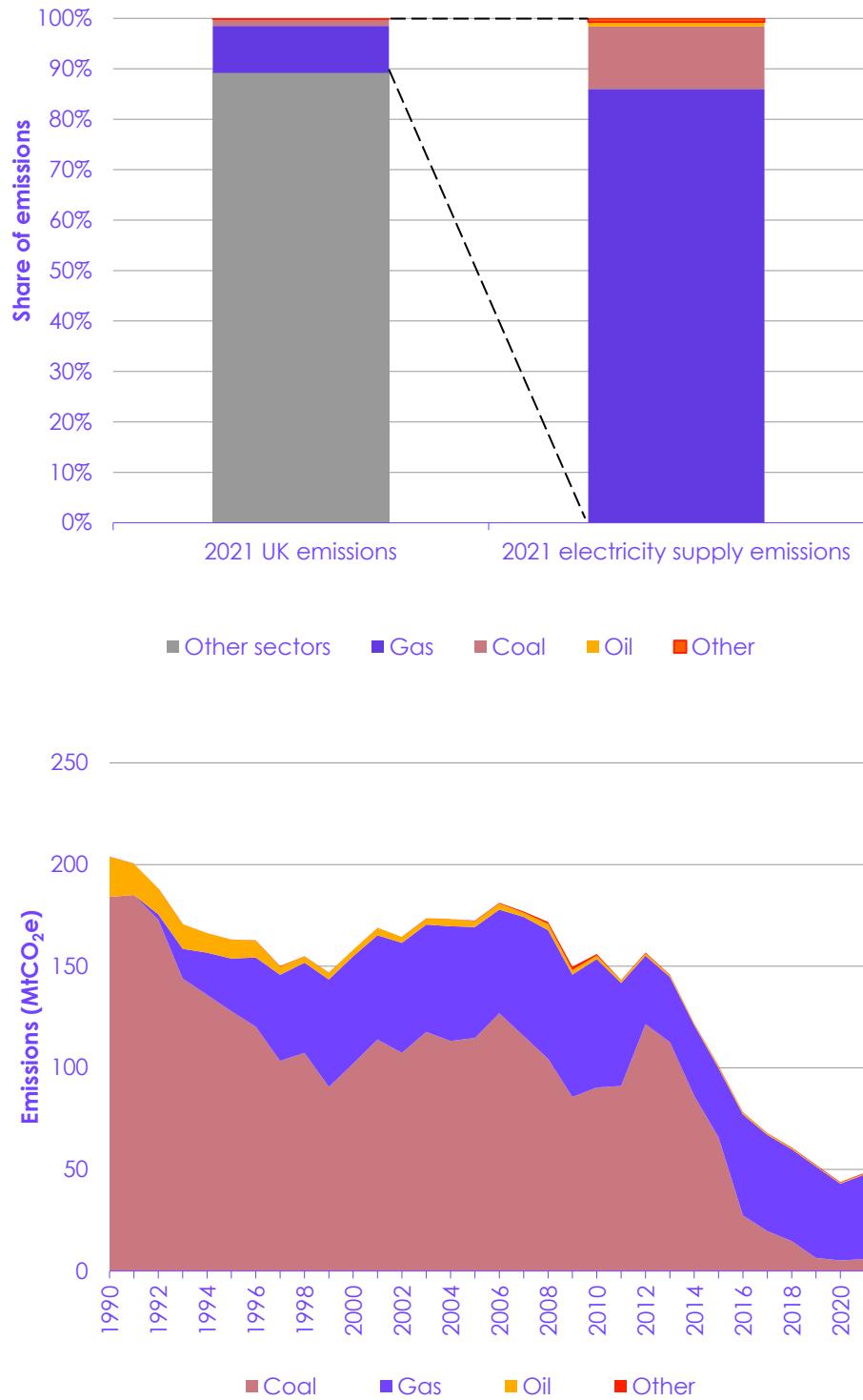
- **Fossil fuel generation and imports.** To compensate for lower renewable and nuclear generation, fossil fuel generation increased by 12% and imports by 37%.

- Gas-fired generation rose by 12% in 2021. Coal generation also increased, by 15%, but remains only 2% of total supply.
- Imports increased by 37%, although they still represent less than 10% of electricity supplied. New interconnectors were opened, including with Norway, increasing capacity from 5.0 GW to 7.4 GW.

Overall, over half of electricity generation in 2021 came from low-carbon sources, with the bulk of the remaining generation met by gas (Figure 6.5).

In 2021 emissions from electricity supply were 11% of total UK GHG emissions, and were around 75% below 1990 levels as coal has been phased out.

Figure 6.1 Electricity supply emissions by sub-sector

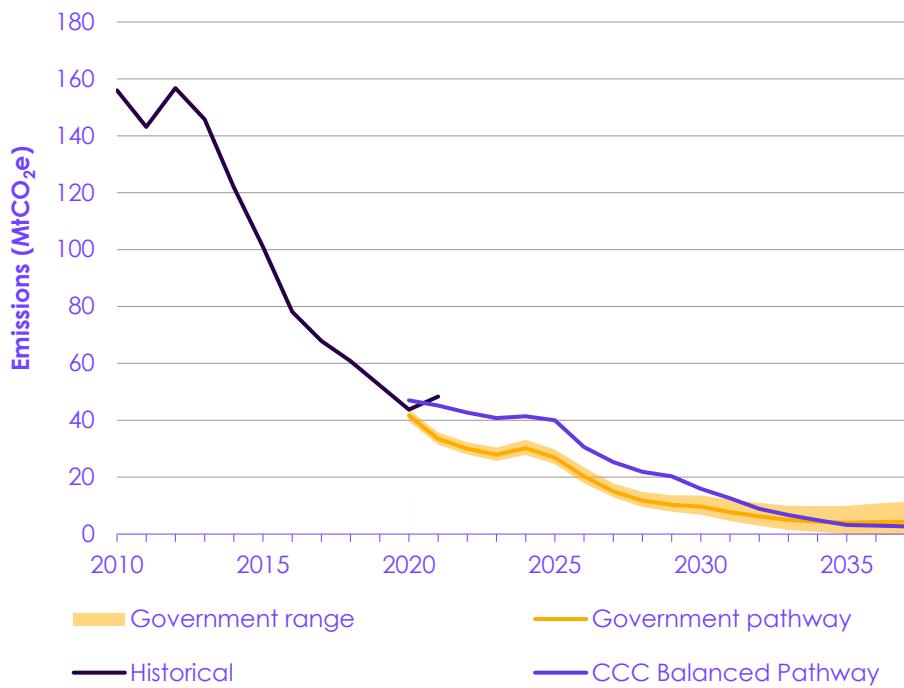


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.

Notes: Global warming potentials from IPCC AR5 without feedback are used.

The increase in emissions in 2021 means there is a large gap to the Government's Net Zero Strategy pathway.

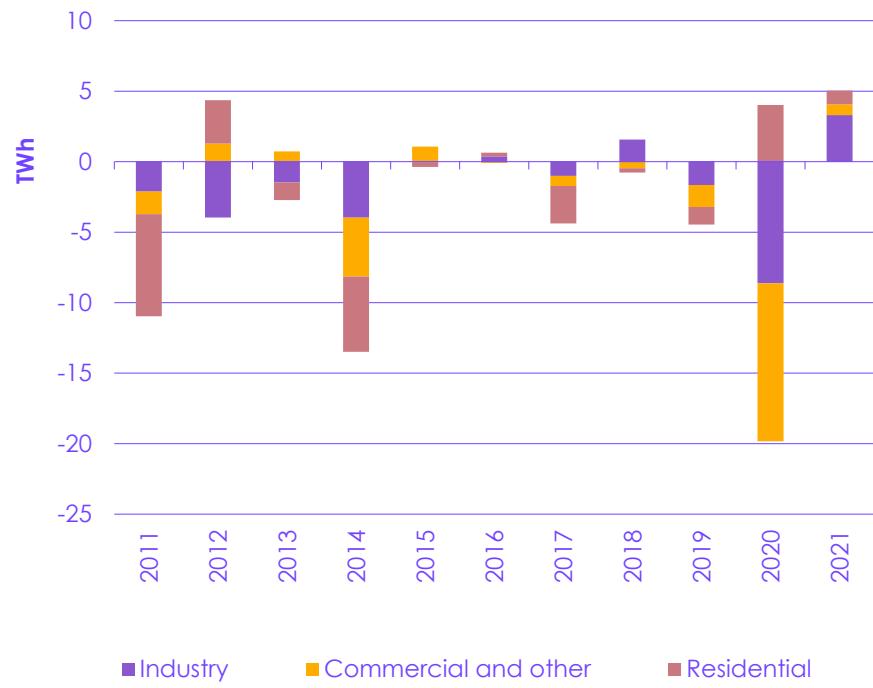
Figure 6.2 Net Zero Strategy and CCC emission pathways (2010-2037)



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; BEIS (2021) Net Zero Strategy; CCC (2020) Sixth Carbon Budget.

Electricity consumption increased relative to 2020, largely due to increased industrial demand.

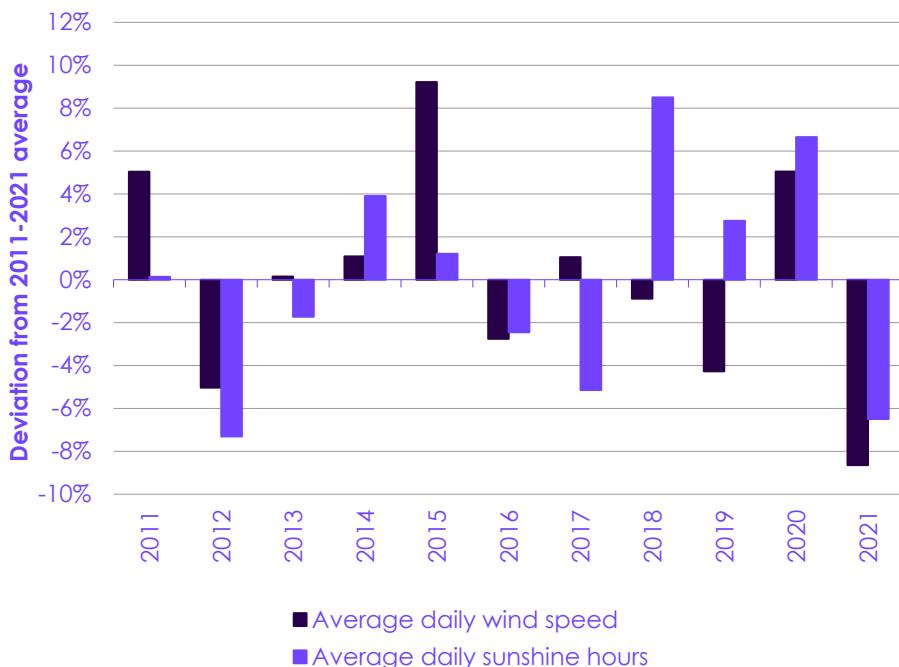
Figure 6.3 Annual change in electricity consumption by sector (2011-2021)



Source: BEIS (2022) Energy Trends.

2021 saw the lowest wind speeds in the last decade.

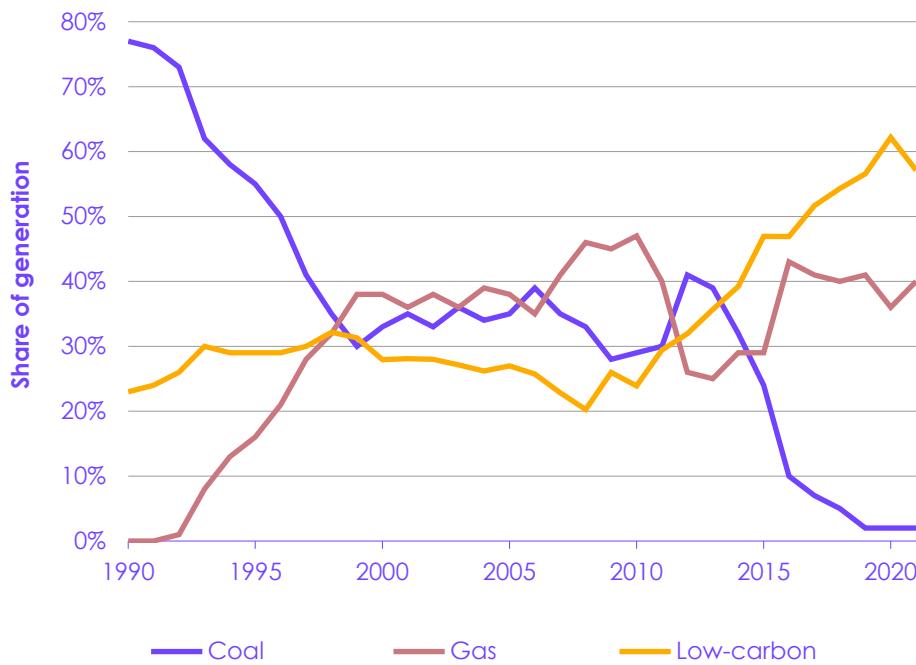
Figure 6.4 Weather variability (2011-2021)



Source: BEIS (2022) Energy Trends.

Over half of 2021 electricity generation came from low-carbon sources.

Figure 6.5 Share of electricity generation by source (1990-2021)



Source: BEIS (2022) Energy Trends; CCC analysis.

2. Indicators of progress

This section focuses on indicators for renewables. We will publish a wider set of indicators in a separate report later in 2022.

This section sets out the key indicators for monitoring progress in reducing emissions from electricity supply, towards full decarbonisation by 2035.

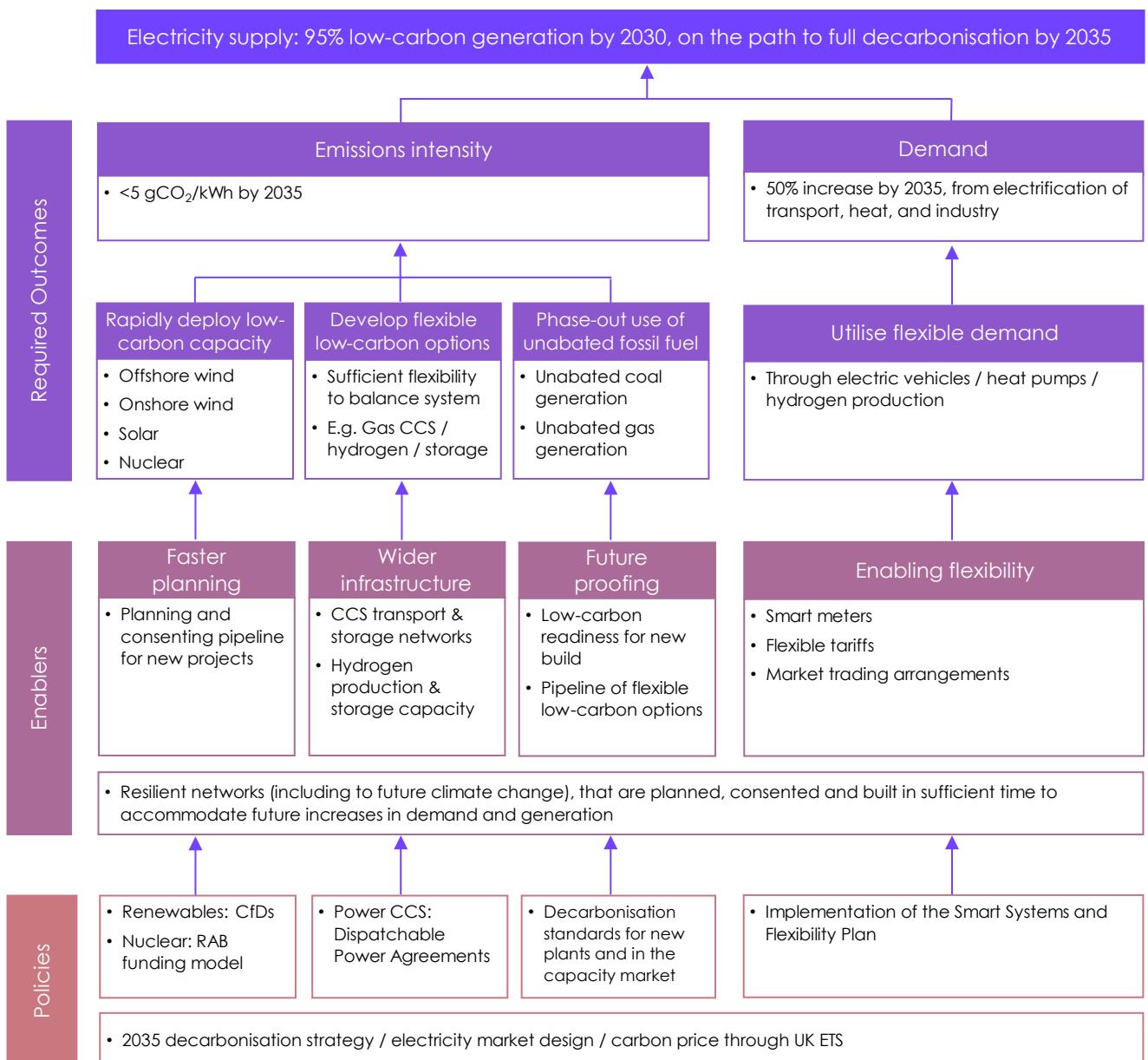
Figure 6.6 summarises the key outcomes and conditions required to deliver the decarbonisation of electricity supply. A description of how these components combine to deliver the sector's decarbonisation pathway can be found in our accompanying Monitoring Framework.

A subset of these indicators, focusing on renewables, are included in this report, with key indicators set out in Table 6.1 and Figures 6.7-6.9:

- **Operational capacity.** The indicator pathways reflect the Government's objectives as set out in the Energy Security Strategy (ESS) for offshore wind and solar (see Section 3a), and is in line with our Balanced Pathway for onshore wind.
- **Construction pipeline.** This reflects the annual flow of projects required to enter construction, taking into account average timings. For offshore wind and solar, the annual amounts entering construction will need to ramp up significantly over the 2020s to be on track for the Government's objectives for installed capacity.
- **Consenting pipeline.** This reflects the annual flow of projects required to enter the consenting process. These are relatively front-loaded, given average timings and completion rates.

We will publish a wider set of indicators, covering the full scope of the monitoring map, in a separate report to be published later in 2022.

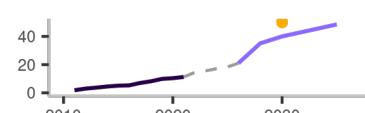
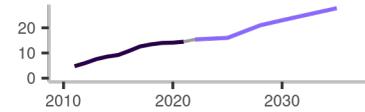
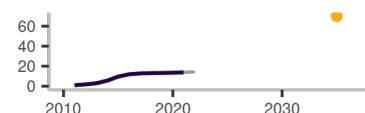
Figure 6.6 Monitoring map for electricity supply



Source: CCC analysis.

Table 6.1

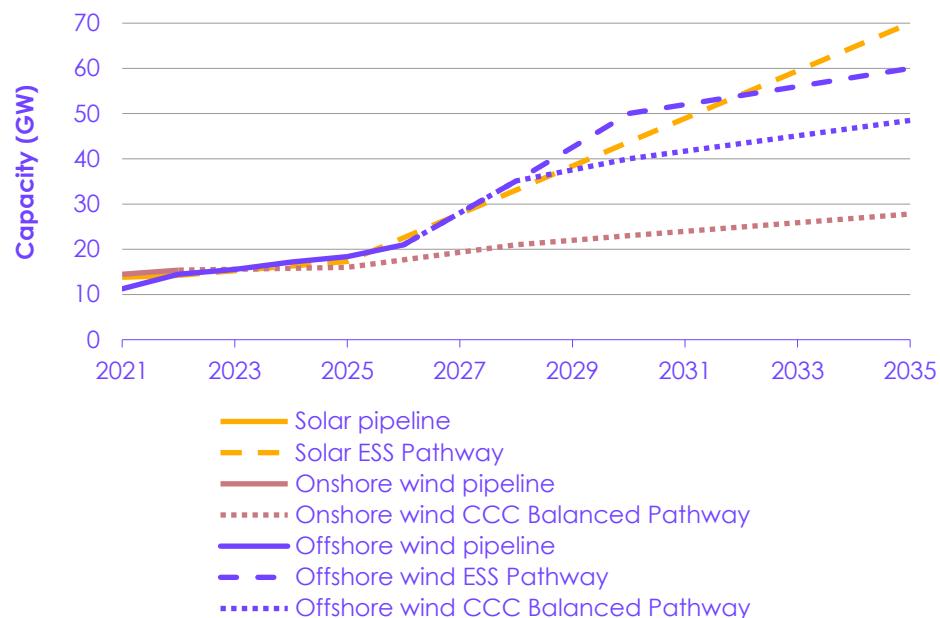
Electricity supply renewables indicators

Electricity supply indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov - Pipeline
Low-carbon capacity - Renewables	Offshore wind - operational capacity	2021	11 GW	+8% from 2020	
	Onshore wind - operational capacity	2021	14 GW	+3% from 2020	
	Solar - operational capacity	2021	14 GW	+2% from 2020	

Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.
Notes: All values are rounded to 2 significant figures; solid lines represent pathways; points represent in-year benchmarks; dotted lines show the pipeline.

Renewables capacity

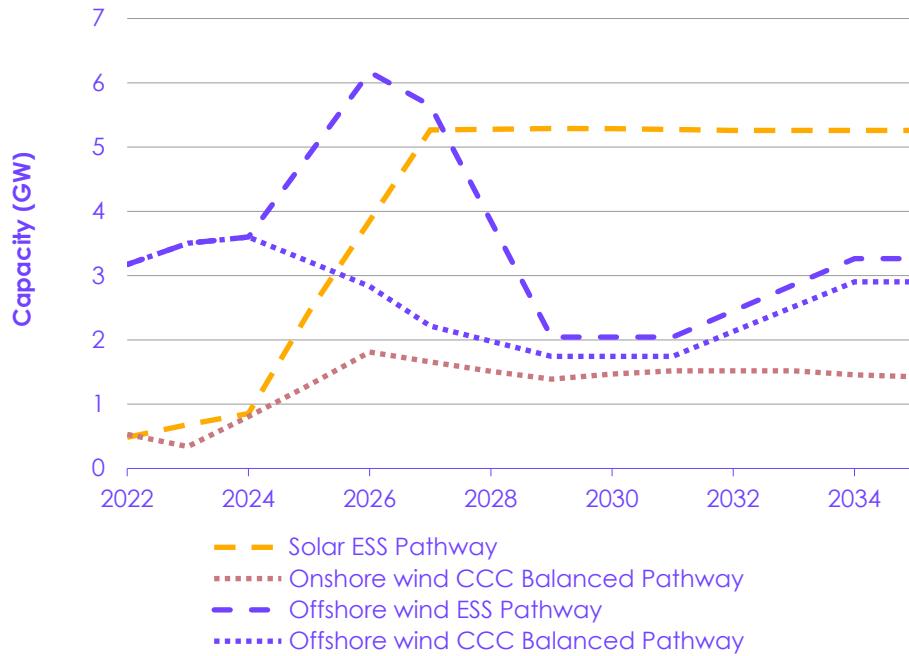
The ESS set out stretching ambitions for growth in capacity of offshore wind and solar, but there was less focus on onshore wind.

Figure 6.7 Operational capacity

Source: BEIS (2022) Energy Trends Table 6.1; BEIS (2022) Renewable Energy Planning Database; CCC analysis.
Notes: Offshore wind range reflects up to 50 GW by 2030 ambition from the ESS and the previous 40 GW ambition. Solar ambition based on the ESS. Onshore wind ambition reflects CCC Balanced Pathway.

The pathways require a ramping up of construction over the 2020s.

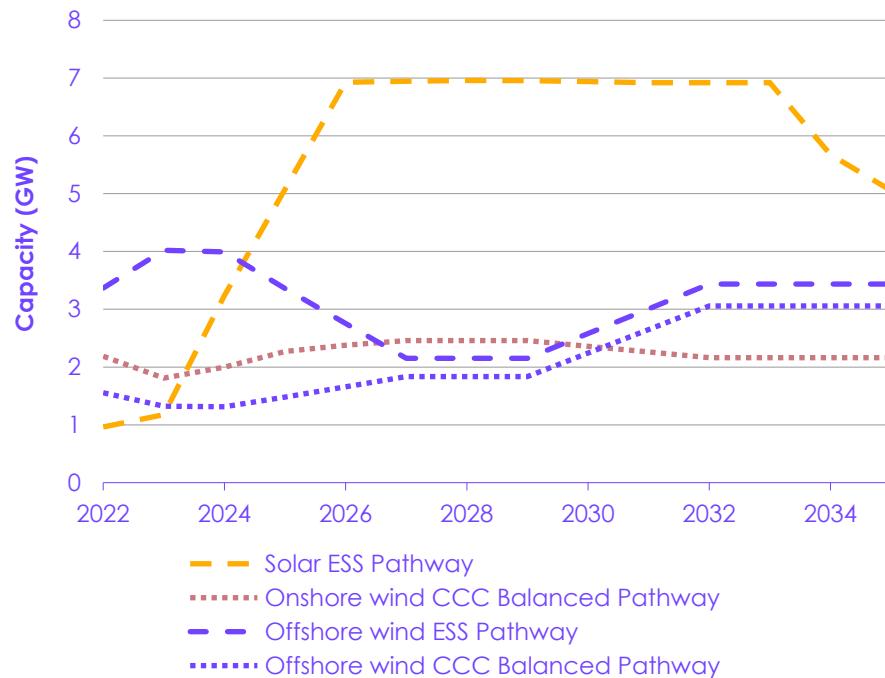
Figure 6.8 Annual capacity entering construction



Source: BEIS (2022) Energy Trends Table 6.1; BEIS (2022) Renewable Energy Planning Database; CCC analysis.
Notes: A project enters construction after obtaining planning permission and reaching final investment decision (FID). For offshore wind, construction includes onshore construction.

Capacity needs to enter the consenting stage significantly in advance of when it is required to be deployed.

Figure 6.9 Annual capacity entering consenting



Source: BEIS (2022) Energy Trends; CCC analysis.
Notes: We define entering consenting as submitting a planning application to the relevant local or national authority. The expected completion rate is included when calculating the required capacity entering consenting. We assume the Government implements policy changes outlined in the ESS by 2025, including a reduction in the time between entering consenting and entering construction from 5 years to 2 years for offshore wind.

3. Policy progress, assessment and next steps

Delivering on the Government's ambitions is now the overriding challenge for policy.

This section sets out progress made on developing policy for reducing emissions from electricity supply in the past year, our assessment of that policy progress, and our recommendations to be taken forward over the coming year.

- There has been a wide range of recent policy developments. As part of the Net Zero Strategy, the Government committed to fully decarbonising electricity generation by 2035. It subsequently increased its ambition further across a range of technologies in the ESS.
- Credible plans are in place for over half the emissions reductions required in 2035 but some risks remain, particularly around renewables deployment over the 2020s and nuclear.
- Our recommendations reflect that the overriding challenge is now to ensure that the Government's ambitions are delivered.
 - A key gap in comparison to other sectors (e.g. heat and buildings, transport) is the absence of an overarching delivery plan or strategy. This should be developed as a priority.
 - Other key enablers will also need to be tackled, including electricity market arrangements, onshore and offshore network capacity and potential supply chain bottlenecks.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

The Energy Security Strategy

The Government has increased ambition across a range of areas in response to the invasion of Ukraine.

In response to the invasion of Ukraine, the Government published its ESS. This was a welcome move which increased ambition across a range of areas with the aim of reducing dependence on imported fossil fuels, in particular through faster deployment of renewables.

Overall, the supply-side ambitions in the ESS were broadly appropriate, but actions on the demand-side were limited and could have gone further:

- **Supply-side ambition.** The ESS significantly increased the Government's aims for deployment of low-carbon technologies, including offshore wind, solar, nuclear, and hydrogen production. Alongside this there were new commitments to speed-up planning processes, scale-up network grid connections and review electricity markets. Overall, despite a lack of focus on the opportunities of onshore wind, this was an ambitious and stretching package of measures.

- **Demand-side ambition.** The ESS was almost entirely supply-focused and much of it will not be delivered until well after the immediate crisis has passed. There remains an urgent need for equivalent action to reduce demand for fossil fuels to reduce emissions and limit energy bills over the longer term. That could include moving the policy costs due to historical subsidies off electricity bills and onto general public spending, and a sustained push for both energy efficiency improvements and electrification, especially in the buildings sector.

Renewables

The ESS increased ambition on renewables.

As part of the ESS, the Government increased ambition for offshore wind and solar, and aims to improve the planning process for onshore wind. This is a welcome move that will help reduce dependence on fossil gas, whether for electricity generation or hydrogen production, while accelerating progress towards the Government's objective to fully decarbonise electricity supply by 2035.

- **Offshore wind.** The Government increased its ambition for 2030 from 40 GW to up to 50 GW, including up to 5 GW of floating offshore wind. That compares to 11 GW installed currently. It has also committed to reducing time taken for consenting new projects, from up to four years down to one year.
- **Solar.** The Government set out an expectation for a five-fold increase on currently installed capacity by 2035, which would equate to a total of 70 GW. It also committed to consult in 2022 on amending planning rules to strengthen policy in favour of development of ground-mounted solar on non-protected land, and to consult on radically simplifying planning processes for rooftop solar.
- **Onshore wind.** While the ESS did not state an ambition for onshore wind capacity, the Government did commit to consulting this year on developing local partnerships for communities in return for benefits, including lower energy bills.

The results of the fourth round of auctions for low-carbon electricity contracts will be known in mid-2022.

2022 also sees the next round of auctions for low-carbon electricity contracts (Contracts for Difference – CfDs), the results of which will be known in mid-2022. Funding has been confirmed, and onshore wind and solar are now eligible to bid in addition to offshore wind.

- **Offshore wind.** £210 million per year has been made available for offshore wind, and a minimum of £24 million per year for floating offshore wind. These projects will be delivering from 2025, and there is no limit on the amount of capacity that can be procured within the budget.
- **Onshore wind and solar.** These technologies are now eligible to bid for CfDs, and £10 million per year is available for Pot 1 technologies (which includes onshore wind and solar). There is a limit of 5 GW capacity that can be procured for Pot 1, with a maximum of 3.5 GW each for onshore wind and solar.
- **Auction timings.** The results of the auction will be known in mid-2022. The Government has confirmed that auctions for CfDs will now be run annually, providing project developers with a more regular pathway for accessing these.

Auctions for low-carbon electricity contracts will now happen annually.

Nuclear

The ESS significantly increased ambition for nuclear deployment, and the Government has announced a new funding model for delivering this.

In the ESS, the Government significantly increased its long-term ambition for nuclear. It also moved forward with a new funding model for new-build plants, including funding next-generation nuclear projects.

- **Long-term ambition.** In the ESS the Government announced an ambition to deploy up to 24 GW of nuclear capacity by 2050, which could represent up to 25% of UK electricity generation. In addition to taking one project to a final investment decision (FID) this Parliament, the plan is now to take a further two projects to FID in the next Parliament.
- **Funding.** The Government has announced a new funding model, and has created several new funds, to support new nuclear projects.
 - The Government has agreed to introduce a Regulated Asset Base (RAB) model for funding new nuclear projects, and introduced legislation for this in October 2021. The RAB model involves a levy on consumer bills, which contributes to construction costs and transfers some of the construction risk to consumers. While this helps reduce the cost of capital for investors and therefore overall financing requirements, it also means consumers are exposed to risks of potential project delays and additional costs.
 - The Government has announced a new £385 million Advanced Nuclear Fund and a £120 million Future Nuclear Enabling Fund.

Low-carbon flexibility

Some progress has been made developing policies for low-carbon flexibility, across hydrogen and CCS power plants, and energy storage.

The Government has announced a range of new policies aimed at bringing forward and facilitating new sources of low-carbon flexibility, including for generation and on the demand side.

- **Low-carbon flexible generation.** This can be delivered by a range of different solutions, including hydrogen, carbon capture and storage (CCS), and energy storage.
 - **Hydrogen power plants.** In summer 2021 the Government published calls for evidence (CfEs) on decarbonisation readiness for new combustion plants and on aligning the capacity market with Net Zero. These aim to take into account potential for future hydrogen plants.
 - **CCS power plants.** The Net Zero Strategy set an objective for at least one operational power CCS plant by the mid-2020s. In April 2022 the Government issued a consultation on developing Dispatchable Power Agreements to support CCS deployment.
 - **Storage.** In September 2021 the Government issued a CfE on facilitating large-scale long-duration electricity storage. It also committed to an aim for at least six long-duration storage demonstrators to be in place by 2025, and has run and awarded funding to 24 projects in a competition to deliver these.
- **Demand-side flexibility.** In 2021 the Government published its Smart Systems and Flexibility Plan and Digitalisation Strategy. These included a commitment to move to half-hourly electricity market settlement by 2025, and new smart meter installation targets for energy suppliers.

Steps are being taken to establish the structures necessary to enable demand-side flexibility.

Both of these are needed to enable smart tariffs for consumers, which will allow them to benefit from increased demand-side flexibility.

Networks

The ESS recognises that electricity networks will need to develop to keep pace with decarbonisation of the system. It includes commitments on a new Future System Operator (FSO), strategies to identify the required network developments for Net Zero, and aims to speed-up delivery of strategic network infrastructure.

The Government has created a new independent system operator which will take a wider strategic approach to gas and electricity networks.

The ESS made a range of commitments to ensure electricity networks are fit for Net Zero.

- **Future System Operator.** In 2022 the Government announced the creation of a new independent system operator. The FSO will take on some of the existing operational roles of the National Grid system operator for the electricity and gas system. It will take a wider strategic approach to coordinating and planning those networks, as well as for new emerging markets like hydrogen and CCS.
- **Network strategies.** In addition to the ongoing Offshore Transmission Networks Review, the ESS committed the Government to:
 - Publishing a strategic framework in 2022 with Ofgem for how networks will deliver Net Zero.
 - Appointing an Electricity Networks Commissioner to advise Government on policies and regulatory changes to accelerate progress on network infrastructure.
 - Setting out a blueprint for the whole network system by the end of 2022 in a Holistic Network Design (HND) for offshore networks and Centralised Strategic Network Plan (CSNP) for onshore transmission. The HND will identify the strategic infrastructure needed to deliver offshore wind by 2030.
- **Delivery timelines.** The ESS aims to speed-up delivery of strategic network infrastructure, including through:
 - An aspiration to halve the time taken to deliver strategic onshore transmission network infrastructure.
 - Publishing a revised Strategy and Policy Statement to ensure Ofgem expedites its approvals process to build networks in anticipation of new sources of generation and demand.

Electricity market design

The Government is reviewing whether electricity market arrangements need to be updated for Net Zero.

Moving to a fully decarbonised electricity system will have a range of implications for how electricity markets will need to be designed and operated. In the ESS the Government launched a Review of Electricity Market Arrangements, with an aim to publish high-level options for market reform in summer 2022. To feed into that process the Committee has set up an expert advisory group on electricity market design (Box 6.1).

The Committee has set up an expert group to advise it on electricity market design and to feed into the Government's review.

Box 6.1

CCC expert advisory group on electricity market design

The Government has committed to decarbonising UK electricity generation by 2035. This is likely to bring challenges which current market arrangements and policy have not been designed for, including:

- **Changing cost structures**, towards a system dominated by capital costs with large amounts of zero marginal cost variable renewable generation. This is increasingly likely to lead to periods where these are the marginal generator and to periods of surplus generation. In a system based on marginal cost pricing this means increasing periods with low or negative electricity prices, compressing periods available for cost recovery for generators without CfDs.
- **The need to reward system flexibility**, which will be critical for integrating high levels of variable renewable generation. That flexibility could come from low-carbon generation (e.g. gas CCS, hydrogen) or from other sources including demand, hydrogen production with surplus generation, storage, and interconnection.
- **Phasing-out unabated gas**, which means developing the market for the alternative sources of flexible low-carbon generation, providing incentives to ensure these are dispatched ahead of unabated gas, and preventing lock-in of unabated gas technology.

These challenges are likely to evolve over time and may require different policy approaches over the 2020s and 2030s, as markets and technologies mature.

As part of the ESS, the Government announced a Review of Electricity Market Arrangements (REMA).

The Committee has established an expert group to advise it on electricity market design. Issues the group are examining include:

- Key questions and challenges any changes to market design should aim to address.
- The range of high-level proposals that have been published for addressing those questions and challenges.
- Principles and recommendations for Government to take forward through REMA.

We will publish the Chair's report summarising the findings and recommendations of the expert group on our website in summer 2022.

(b) Assessment of policies and plans

Good progress has been made on policy but the absence of an overarching delivery plan or strategy is a key gap in comparison to the approach in other sectors.

Credible plans are in place for over half the emissions reduction needed in 2035, but there are some risks around renewables and nuclear delivery.

Figure 6.10 and Table 6.2 set out our assessment of Government progress in the past year. Good progress has been made across most elements. A key gap in comparison to other sectors (e.g. heat and buildings, transport) is the absence of an overarching delivery plan or strategy for full decarbonisation of electricity generation by 2035.

- Credible plans – for both ambition on capacity and policy to deliver that – are in place for over half the abatement required in 2035, but some delivery risks remain, including some unexplained emission reductions.
 - Positive aspects include the importance of renewables in providing low-carbon electricity, and the success of Government auctions for contracts in delivering that to-date.
 - Delivery risks remain, particularly around low-carbon flexibility and nuclear.

- There are some deployment risks around renewables and energy storage, particularly over the 2020s. The Government has set very ambitious deployment goals for renewables, and there are potential barriers from planning, network capacity, and supply chains. In the longer-term there is scope to catch-up on delays provided these barriers are addressed.

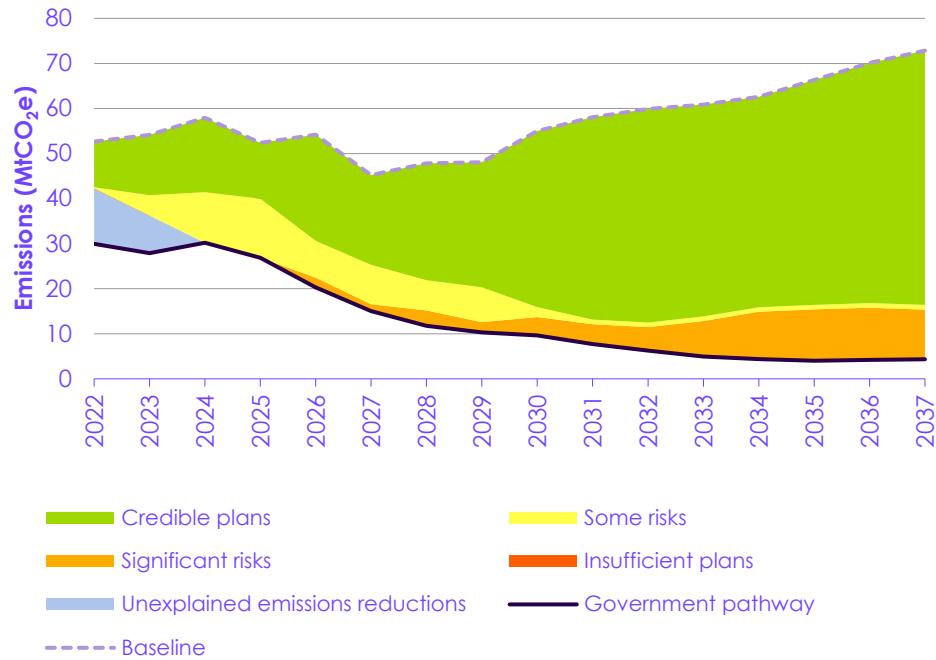
- More significant risks exist around policy to deliver low-carbon flexibility at sufficient scale required to balance a renewables-based system, and around timely delivery of new-build nuclear.
- Actual emissions were significantly (44%) higher than the BEIS pathway in 2021. Some of this is due to weather variability and nuclear outages, but we have assessed this short-term divergence as unexplained given uncertainty over how long it will persist.

Generally, good progress has been made in implementing our 2021 recommendations.

- Our assessment of the eight recommendations to Government in our 2021 Progress Report is that two were achieved, one partly achieved, and one not achieved, with a further two underway and two making sufficient progress.
 - In the Net Zero Strategy the Government accepted our high priority recommendation to fully decarbonise electricity generation by 2035. However, they have yet to develop a delivery plan or strategy for this.
 - Progress is being made with recommendations around electricity market design and networks, albeit slowly. Concrete outputs from these processes will need to be seen over the coming year.

There are credible plans for over half the emissions reduction required in 2035, but delivery risks exist over the 2020s.

Figure 6.10 Assessment of policies and plans for electricity supply



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) Energy and emissions projections: Net Zero Strategy baseline; CCC analysis.

Notes: The published BEIS baseline in the Net Zero Strategy has very low emissions as it incorporates significant deployment of low-carbon generation (particularly renewables). We have assessed progress against the baseline from the Sixth Carbon Budget, in order to show the impact of low-risk emissions reduction. The Sixth Carbon Budget baseline incorporates agreed low-carbon contracts up to the third CfD auction round (AR3). As a result, emissions fall over the mid-2020s, and then rise thereafter as unabated gas is assumed to meet new demands.

Actual emissions were significantly higher than the BEIS pathway in 2021. Some of this is due to weather variability and nuclear outages, but we have assessed this short-term divergence as unexplained given uncertainty over how long it will persist.

Table 6.2

Policy scorecard for electricity supply

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Renewables 80% of 2035 abatement	G	G	Y	G	G
<ul style="list-style-type: none"> Ambition for up to 50 GW of offshore wind by 2030 and 70 GW of solar by 2035 in the ESS. Annual auctions for low-carbon electricity contracts, including onshore wind and solar. Key delivery risks around planning and consenting new projects. ESS commits to reduce the consenting time for offshore wind. 					
Nuclear 10% of 2035 abatement	O	O	O	O	O
<ul style="list-style-type: none"> Aim for 24 GW capacity by 2050, with one project FID this Parliament and two in the next. A RAB funding model for new projects and funding pots for next-generation nuclear have both been announced. Negotiations around a new plant at Sizewell have started. Timely delivery - for financial close and construction - remains a key risk. 					
Flexible low-carbon generation & storage 10% of 2035 abatement	Y	Y	O	O	Y
<ul style="list-style-type: none"> Aim for at least one power CCS plant by the mid-2020s, incentivised through Dispatchable Power Agreements. This policy is still being finalised. The Hydrogen Strategy lacks a clear objective for the role of hydrogen in electricity supply. Progress has been made on low-carbon readiness standards for new power plants. Commitment to at least six long-duration storage demonstrators by 2025, with innovation funding awarded in 2022. 					
Flexible demand	G	G	Y	Y	G
<ul style="list-style-type: none"> Smart Systems and Flexibility Plan, and Energy Digitalisation Strategy both published. Ofgem implementing half-hourly settlement by 2025, to enable smart tariffs. Smart meter installation targets for energy suppliers. 					
Networks	N/A	N/A	N/A	N/A	Y
<ul style="list-style-type: none"> New independent system operator (the FSO), with a remit for a more strategic perspective. Commitment to publish a strategic framework in 2022 with Ofgem on Net Zero networks. Key risks around network capacity developing in time to support increasing generation and demand. Government aims to halve time for delivering onshore transmission infrastructure. 					
Electricity market design	N/A	N/A	N/A	N/A	G
<ul style="list-style-type: none"> Reviewing Electricity Market Arrangements, publishing high-level options in summer 2022. 					
Overall sector assessment	G	G	Y	Y	G

(c) Recommendations

The recommendations for the electricity supply sector are available in the accompanying tables in the Annex (grouped by department) and on our website, where they are filterable by sector and department.

The Government has made strong commitments to fully decarbonise the sector by 2035 and increase the amount of low-carbon electricity generation capacity. The key challenge is now to ensure that these ambitions are delivered on, and that available low-carbon electricity can be fully utilised and is sufficiently reliable and resilient.

Our recommendations are therefore focused on ensuring there is a clear delivery plan in place and that key enabling factors are addressed:

Our priority recommendation is to develop an overarching delivery plan or strategy for meeting the Government's objective of fully decarbonising electricity supply by 2035.

Other enablers will need to be addressed to ensure delivery of 2035 decarbonisation, including market design, networks, and supply chains.

- **Our overarching priority recommendation.** The Government should publish an overarching delivery plan or strategy, setting out how their objective of a fully decarbonised electricity system by 2035 will be delivered.
 - This is needed to identify the contributions required from each element, assess whether policies in place are sufficient to deliver that, and to put in place contingencies for major risks.
 - A clear delivery plan will improve visibility and confidence for private sector investors, helping reduce costs and build-up supply chains.
 - This is a key gap in comparison to other sectors (e.g. heat and buildings, transport).
- **Our other priority recommendations.** These cover the enabling factors necessary to support an increasingly flexible low-carbon electricity system.
 - **Electricity market design.** Decarbonising the electricity system by 2035 will bring challenges which current market arrangements were not designed for (Box 6.1). These need to be reviewed and updated where relevant, in sufficient time to support the investment required over the coming decade and ensure a smoothly running system.
 - **Networks.** Well-functioning and resilient onshore and offshore electricity networks are needed to deliver electricity from generators to consumers. As the economy increasingly electrifies it is important that investments in resilient infrastructure are identified, planned, consented and built, in sufficient time, to accommodate the new demands and generation.

In addition, given the scale of deployment required across the sector, in new sources of generation, storage, and networks, identifying and addressing potential key supply chain bottlenecks will be critical to avoid delaying investment.

We will publish a separate standalone report on decarbonising electricity supply later in 2022, as part of which we will review the scope of our recommendations.

The Committee will publish a report on decarbonising electricity supply later in 2022.

4. Major risks

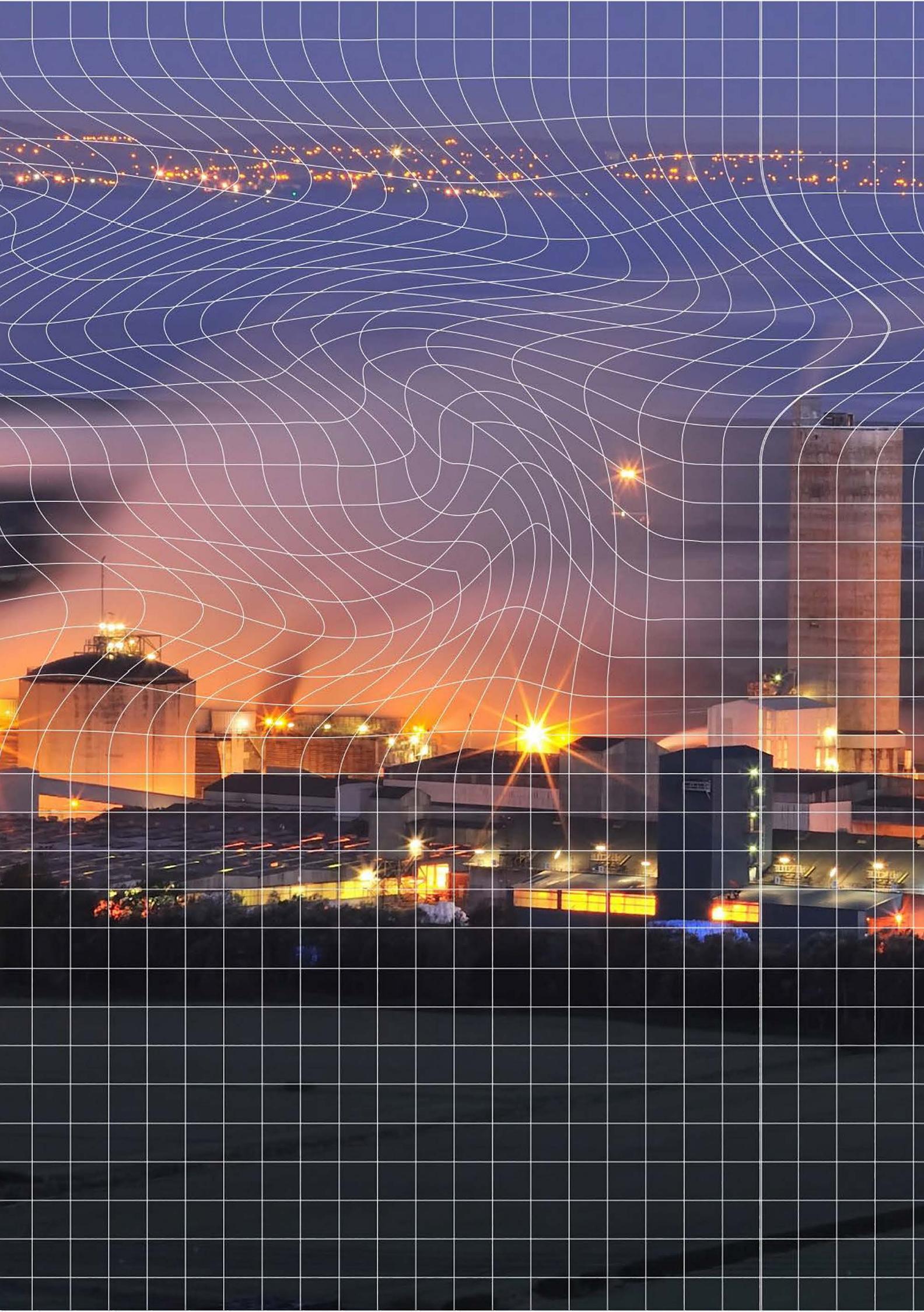
Table 6.4

Major risks and required mitigating actions in the electricity supply sector

Risk category	Description	Mitigating actions Details	Mitigating actions In place?
2035 decarbonisation strategy	Lack of progress developing a clear strategy or delivery plan for meeting the Government's commitment to fully decarbonise by 2035, risking important elements being insufficiently developed to the required scale (e.g. low-carbon flexibility, contingencies for key risks)	<ul style="list-style-type: none"> • Publish a strategy/delivery plan • Develop plans sufficiently for all required individual elements • Ensure wider energy policies aligned to 2035 objective 	Partly
Demand	Lack of progress in electrifying end-use demand, including for the manufacture of hydrogen, or energy storage, risking excessive curtailment of low-carbon generation at times of high availability	<ul style="list-style-type: none"> • Deploy electrolyzers • Develop hydrogen demand • Develop energy storage options 	Partly
Low-carbon flexibility	Not bringing forward sufficient flexibility (on both supply and demand sides) risks not being able to properly balance a system based on renewables, with implications for security of supply	<ul style="list-style-type: none"> • Publish a strategy/delivery plan for 2035 decarbonisation to identify flexibility requirements • Develop and deploy a range of options for flexibility and storage • Monitor the investment pipeline • Review market arrangements to ensure they are fit for purpose 	Partly
Nuclear delivery	Risk of overruns/delays, leading to additional costs	<ul style="list-style-type: none"> • Accelerate development and deployment of alternative forms of schedulable low-carbon generation • Identify key decision points required to preserve optionality 	No
Electricity networks	Risk electricity networks are not resilient and/or planned, consented and built, in sufficient time, to accommodate future increases in demand and generation	<ul style="list-style-type: none"> • Identify requirements for Net Zero • Address barriers (e.g. planning/consenting) • Ensure network operators' incentives align to requirements • Plan for future climate risks to ensure resilience 	Partly
CCS delivery	Failure to demonstrate power station operability, or economic factors making deployment unviable (e.g. sustained high gas prices)	<ul style="list-style-type: none"> • Develop contingency strategy for alternatives • Identify key decision points required to preserve optionality 	No

Endnotes

There are no endnotes for this section.



Chapter 7: Fuel supply

34 MtCO₂e, 8% of UK emissions in 2020

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Introduction and key messages

The fuel supply sector contributed to 8% of total UK emissions in 2020. Greenhouse gas emissions in the fuel supply sector came predominantly from fossil fuel supply, with small contributions from hydrogen production,* and bioenergy supply.†

While emissions from fossil fuel supply have decreased by 3% per year on average since 1990, these reductions stem from the decline of activity in fossil fuel extraction rather than active efforts to decarbonise the sector. We find there are considerable risks to delivery in the policies put forward in the Net Zero Strategy, particularly for reducing the emissions footprint of oil and gas production.

In this chapter, we assess progress in reducing emissions in fuel supply and set out the action needed to decarbonise the sector.

Our key messages are:

- **Current high fossil fuel prices.** Given the sharp increase in fossil fuel prices exacerbated by the invasion of Ukraine, and the Energy Security Strategy (ESS)¹ published in response to it, the role and demand for UK fossil fuel production and hydrogen production have changed considerably since the publication of the Net Zero Strategy in 2021.
- **Increase in hydrogen production capacity.** The ESS increased the Government's commitment on hydrogen production capacity by 2030, from 5 GW to 10 GW, of which at least half will be electrolyzers (i.e. green hydrogen). However, the future mix of hydrogen supply remains uncertain.
 - Prospects for hydrogen produced from fossil gas with carbon capture and storage (CCS) – known as blue hydrogen – depend on a relatively quick return to more moderate international gas prices.
 - The Government has indicated its willingness to increase supply from green hydrogen. However, despite the increased ambition for low-carbon electricity generation in the ESS, there remain questions over whether green hydrogen could fill the gap sufficiently by 2030 should blue hydrogen not be delivered at scale.
- **New licensing round for oil and gas production.** The ESS signalled an increase in North Sea oil and gas production to contribute to displacing the substantial portion of global fossil fuel supply that comes from Russia. As an immediate measure to provide incentives for the sector, on 26th May Government announced the Energy Profits Levy which notably introduced a 90% tax relief for firms that invest in oil and gas extraction.² Increased oil and gas production in the UK would have implications for emissions if new oil and gas installations lead to additional unabated energy use.
 - As we set out in our letter to BEIS on 24th February,³ the Government and industry must ensure that North Sea production has a very low emissions footprint, in parallel to the UK reducing fossil fuel consumption as quickly as possible.

* This chapter accounts for emissions that might stem from low-carbon hydrogen production. Emissions from current UK high-carbon hydrogen and ammonia (e.g. used in industry and agriculture) are included in Chapter 5.

† Bioenergy emissions are currently accounted for in other sectors. Chapter 8 covers emissions associated with the cultivation of energy crops and UK forestry. Chapters 3, 9, and 10 include emissions from transporting fuels and biomass by land, air, and sea.

- The North Sea Transition Deal Update recently reaffirmed a 50% emissions reductions target by 2030, short of the 68% we estimated to be achievable in our Balanced Pathway. The potential increased production in the North Sea makes it even more important to ensure that the footprint of UK oil and gas production is as low as possible.
- **Biomass Strategy.** The Biomass Policy Statement provided a framework to consider biomass priority use across sectors alongside the deployment of BECCS, outlining the scope of the forthcoming Biomass Strategy.
 - This Strategy needs to be part of a comprehensive land use strategy, including setting out how land for UK biomass and forestry will be freed up (e.g. through reduced livestock farming as a result of diet changes). It should address the findings of the Intergovernmental Panel on Climate Change Working Group III (IPCC WG III) Report on risks of biomass demand to biodiversity and land carbon stocks.⁴
 - It should also set out mechanisms to support expansion of domestic biomass supply, ensuring that the UK has sufficient biomass available to meet expected removals requirements using CCS by 2050.
 - The use of bioenergy with CCS (BECCS) should be deployed at scale rapidly. However, BECCS needs to meet the highest sustainability standards with strong monitoring, reporting and verification (MRV) frameworks, as addressed in the IPCC WGIII. Assess contingency options for greater emissions reductions will be required if BECCS can't be delivered sustainably at scale.
 - Bioenergy without CCS should be phased out rapidly across power generation and biofuels production plants, where CCS will need to be retrofitted to facilities already in operation and newbuild BECCS plants should start to ramp-up at good pace.

The rest of this chapter is laid out as follows:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

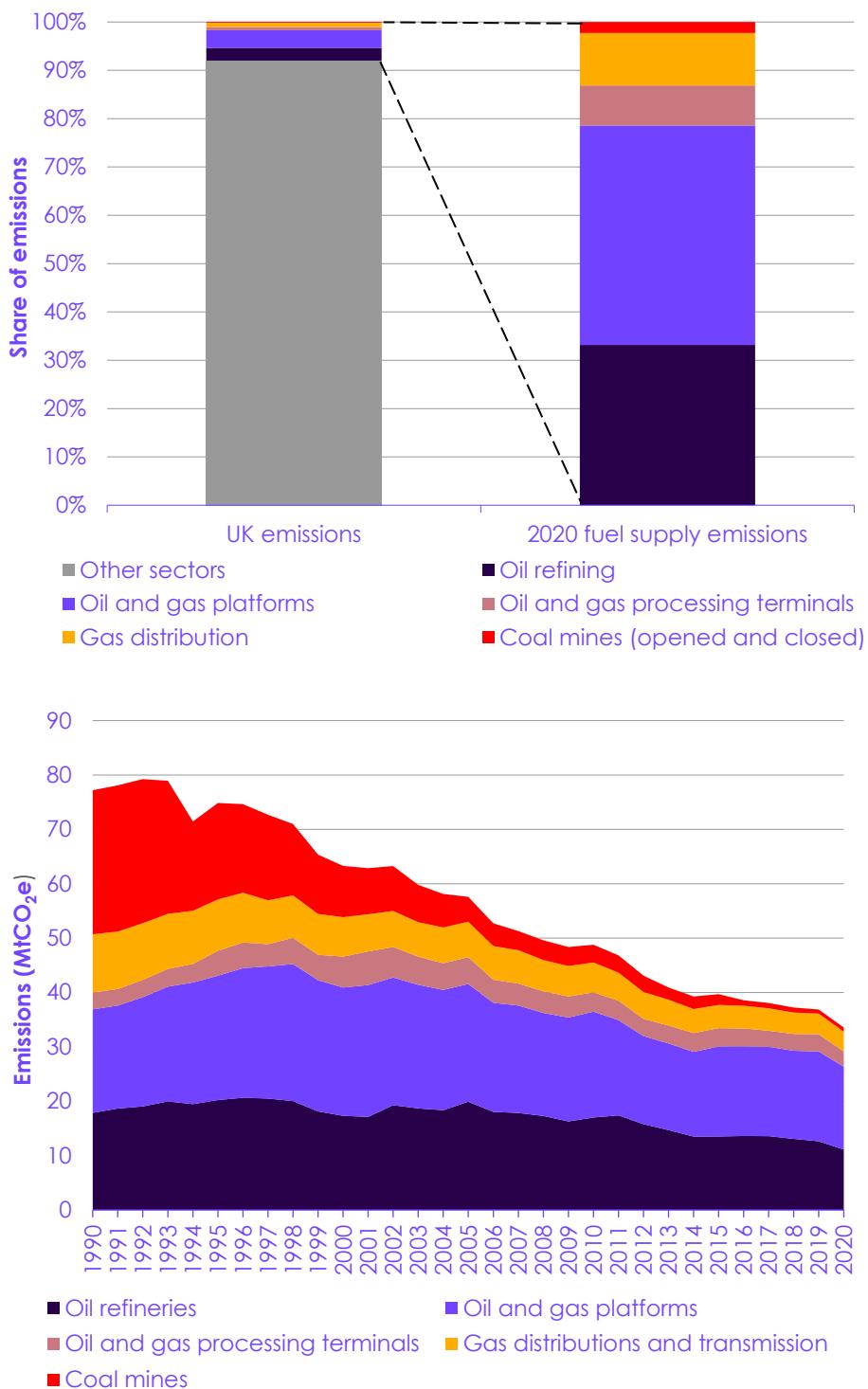
Emissions from the fossil fuel supply sector were 34 MtCO₂e in 2020, which represented 8% of the UK total. Around 87% of the emissions came from oil and gas production, processing and refining (Figure 7.1). Carbon dioxide (CO₂) comprised 83% and methane (CH₄) emissions 16% of the sector's total emissions.

Emissions fell by 10% in 2020 due to the decline in oil and gas production and refining during the Covid-19 lockdowns

Decreasing coal demand contributed to reducing 59% of all emissions in the fuel supply sector since 1990

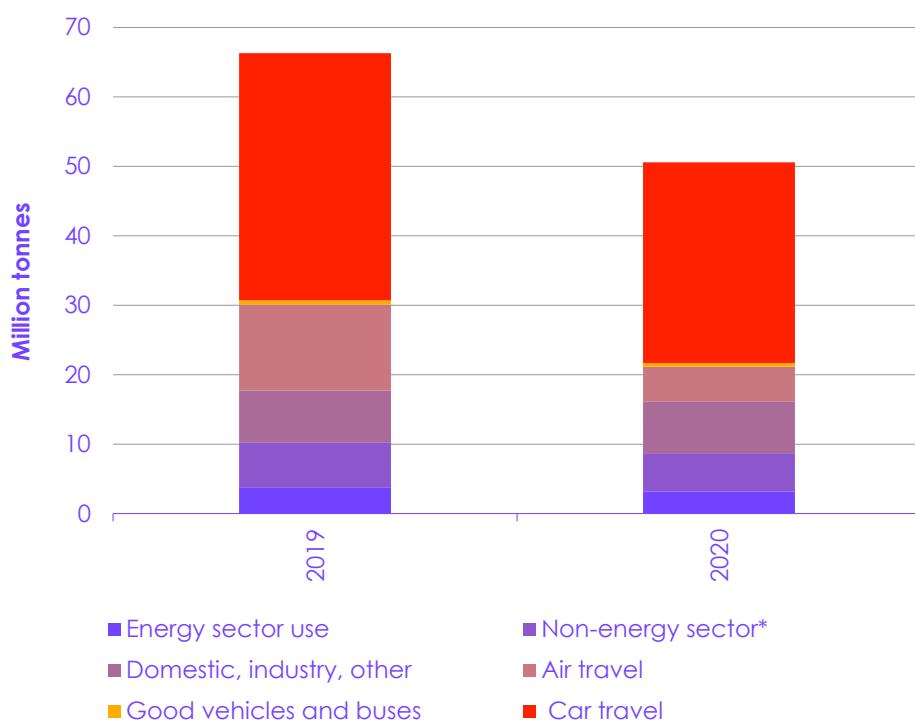
- Emissions in 2020 were 10% below 2019 levels. This was driven partly by the marked decrease in fossil fuel consumption (Figure 7.2) due to travel restrictions during the lockdown, which led to a reduction in refining output and oil and gas production.⁵ Indeed, in each of these sectors, emissions in 2020 fell by 1.5 MtCO₂ and 1.7 MtCO₂, respectively, compared to 2019 levels.
- Emissions from the fossil fuel supply sector have substantially decreased over the last few decades, with 57% emissions reduction since 1990 (Figure 7.1). Most of the reduction has been the result of a decline in fossil fuel production, as seen in the move away from coal mining and falling oil and gas reserves, rather than from decarbonisation policy.
 - Indeed, coal demand in the UK has continued to fall, especially in the electricity sector, which contributed to 59% of emissions reductions in the fuel supply sector since 1990. Over half of the remaining emissions from the coal mining sub-sector are due to methane leakage from closed coal mines, rather than ongoing coal mining. As mines continue to close in the UK, there is less and less scope for emissions reductions in this area.
 - Declining oil and gas reserves have led to reduced production, and therefore emissions reductions. Remaining recoverable oil reserves have decreased by 44% since 1995, and gas reserves by 75% in the same period.⁶ This trend is set to continue as oil and gas production is expected to decline by 6% on average per year to 2030.⁷
 - Emissions from methane leakage in the gas transmission and distribution networks reduced notably thanks to the Iron Mains Risk Reduction Programme (IMRRP),⁸ with gas network emissions reduced by 46% since 2002 when the programme was introduced. Emissions in this area should continue to decline as the IMRRP is set to run until 2032.

Figure 7.1 Fuel supply emissions by sub-sector as a share of UK total



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.

Figure 7.2 Oil consumption in the UK, 2019 to 2020



Source: CCC analysis; Digest of UK Energy Statistics (DUKES); petroleum. *Non-energy sector refers to petroleum products manufacturing (Crude oil and oil products: data sources and methodology (publishing.service.gov.uk)).

2. Indicators of progress

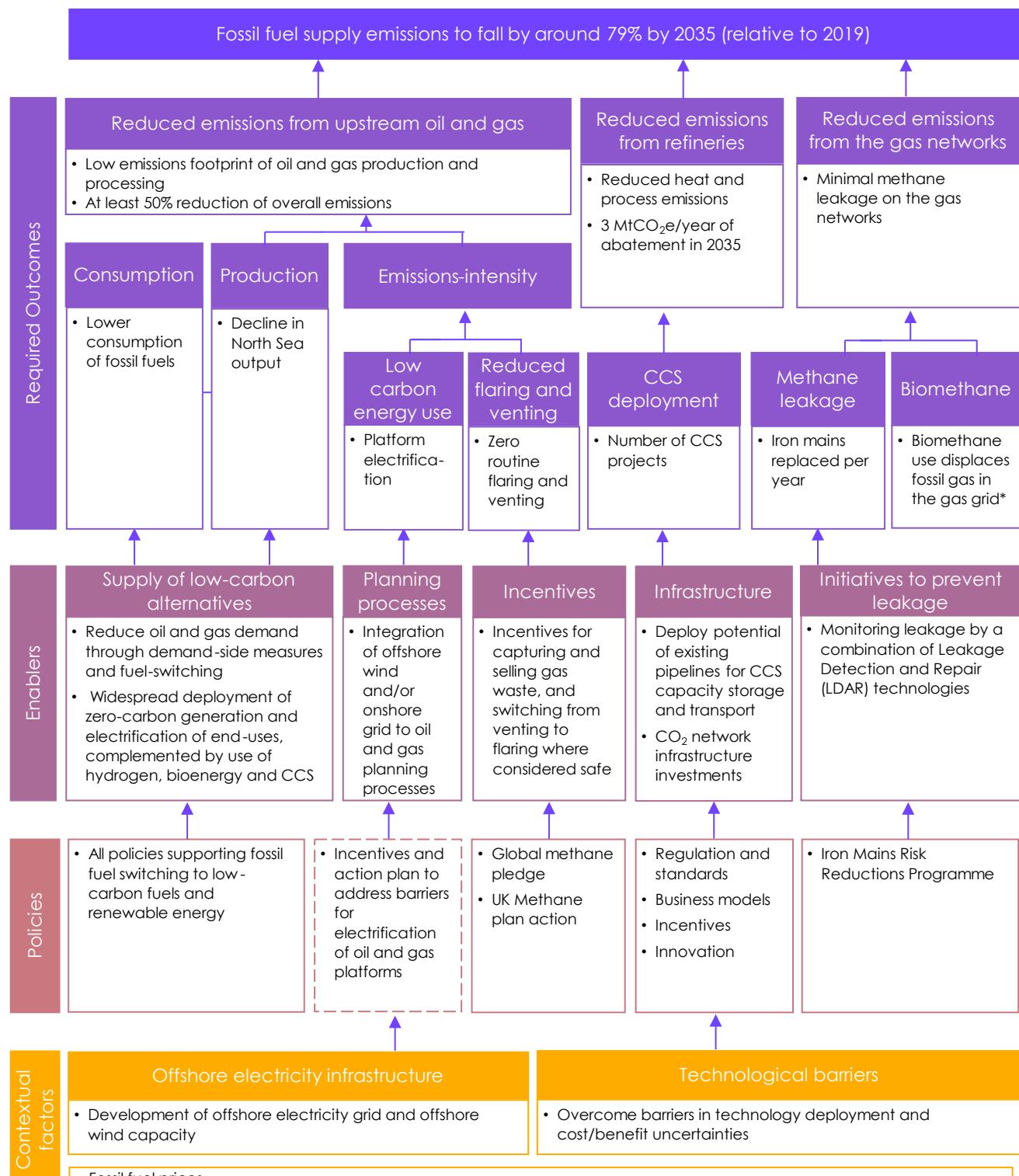
The CCC will develop hydrogen and bioenergy supply indicators that consider the Energy Security Strategy and the upcoming Biomass Strategy.

This section sets out the key indicators of progress for the fossil fuel supply sector. For hydrogen and bioenergy supply, the Committee intends to develop a set of indicators for next year's Progress Report considering, respectively, the recent Energy Security Strategy ambitions and the publication of Government's Biomass Strategy later in 2022.

A detailed approach on the indicators developed to represent progress in fuel supply sector is shown in our accompanying Monitoring Framework.

- The indicators on refineries emissions and on oil and gas production emissions (Table 7.1) highlight progress against the largest outcomes in the sector, since these sub-sectors represent the majority (87%) of sector emissions. Although emissions have decreased over recent decades, there has been minimal progress from active efforts to decarbonise the sector. Figure 7.3 highlights the key actions to reduce emissions from refineries, oil and gas production, and gas distribution and transmission.
- In tracking progress on reducing emissions from oil and gas production, we use indicators for both total emissions (Figure 7.4) and the emissions-intensity of production (Figure 7.5) as there is considerable uncertainty over future North Sea oil and gas production levels. Both total emissions and emissions-intensity have been broadly flat for the last decade, but significant reductions should be achieved over coming years as production levels decline and as progress is made on methane venting, flaring and electrification of platforms.
- The refineries emissions indicator allows us to track progress against savings due to implementation of CCS and greater energy efficiency, as well as how fossil fuel demand decreases as a consequence of switching away from petroleum. Fall in emissions from refineries are currently associated with the downward trend in refinery output (partly due to switching away from fossil fuel use) rather than decarbonisation of refineries (Figure 7.6).

Figure 7.3 Monitoring map for fossil fuel supply



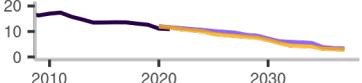
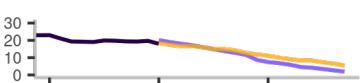
*Emissions reductions from displacing fossil gas use by biomethane will account for in end user sectors.

Source: CCC analysis.

Notes: Policy boxes with a dashed line indicate areas not yet addressed by the Government's plans.

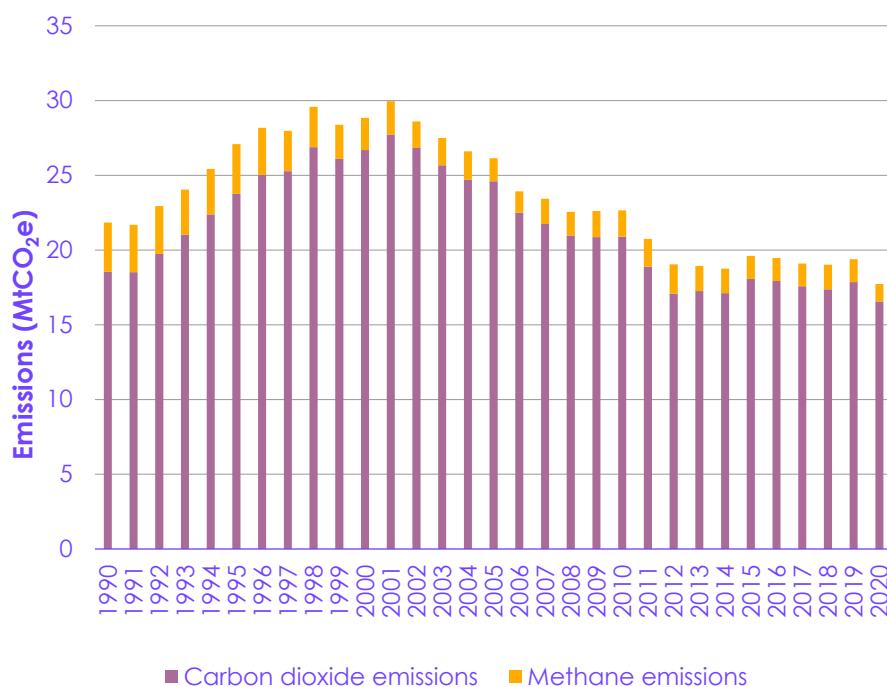
Table 7.1

Key indicators for fuel supply

Fuel supply indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Fossil fuel supply emissions	Refineries emissions	2021	11 MtCO ₂ e; CCC benchmark: 12; Gov benchmark: 12	-2% from 2020	
	Oil and gas production emissions	2020	18 MtCO ₂ e; CCC benchmark: 20; Gov benchmark: 19	-8% from 2019	
	Emissions intensity of oil and gas production	2020	28 kgCO ₂ e/boe; CCC benchmark: 31; Gov benchmark: 29	-5% from 2019	

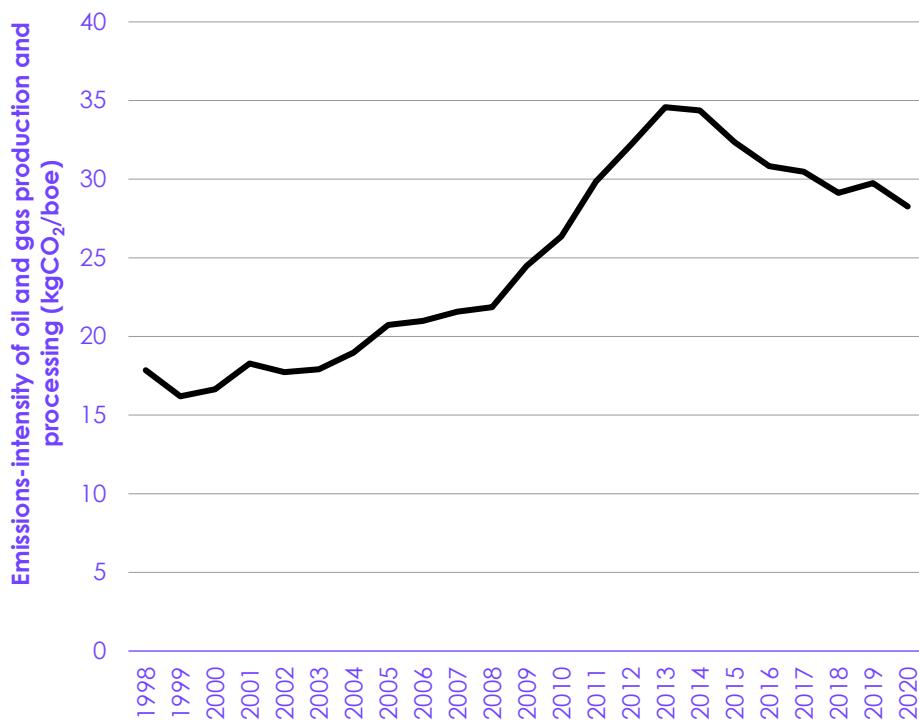
Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.

Notes: All values are rounded to 2 significant figures; solid lines represent pathways. The emissions intensity indicator includes an estimate of the Government trajectory based on oil and gas production projections produced by the North Sea Transition Authority. We assume that no abatement of LNG terminals and compressor stations under the Government pathway.

Figure 7.4 Trends in emissions from oil and gas production and processing

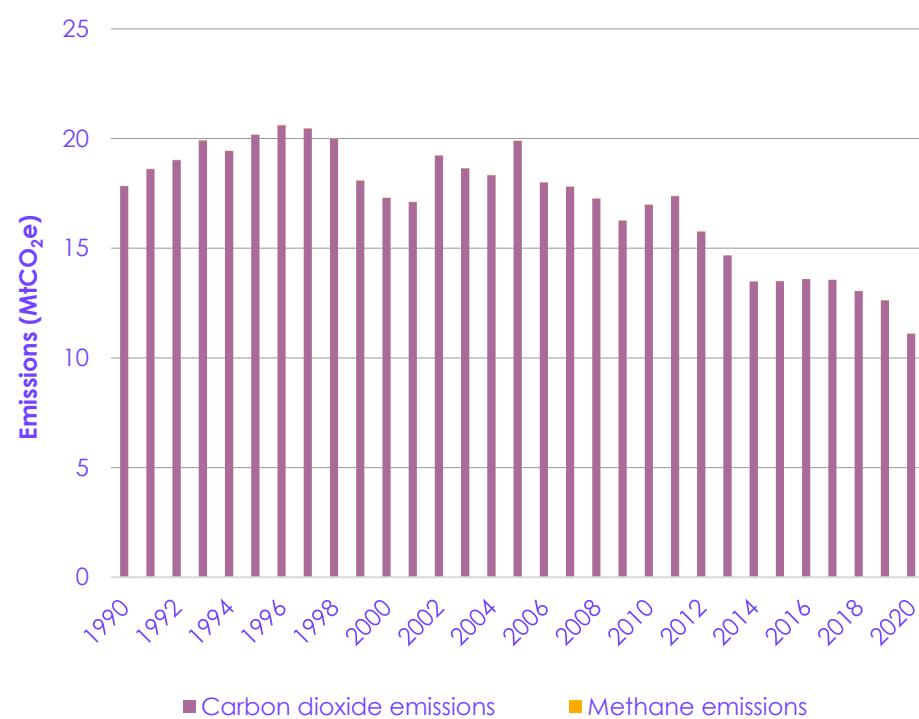
Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; CCC analysis.

Figure 7.5 Emissions-intensity of oil and gas production and processing



Source: North Sea Transition Authority (NSTA); Production and expenditure projections - Data downloads and publications - Data centre (ogauthority.co.uk); CCC analysis.

Figure 7.6 Trends in emissions from refineries



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; CCC analysis.

3. Policy progress, assessment and next steps

The current energy crisis and the associated high fossil fuel prices are shifting the economics of decarbonisation. Government's evolving strategy to reach Net Zero in the context of Russia's invasion of Ukraine will have implications for UK territorial and global emissions. We take this into account in our assessment of policy.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

Fossil Fuel Supply

The 50% target of the North Sea Transition Deal is not ambitious enough, particularly in the context of a push for new oil and gas extraction

The Government recently published an update to the North Sea Transition Deal⁹ that reaffirms Government and industry commitments to reduce emissions in the sector by 50% below 2018 levels by 2030, aligned with the Net Zero Strategy. The North Sea Transition Authority* (NSTA) has embedded the 50% target in its Strategy and Stewardship Expectation to guide and monitor the industry.

This target is less ambitious than the 68% reduction we estimated could be achieved in the sector. Given the potential increase in North Sea oil and gas production presented in the ESS and incentivised as part of the recent Energy Profits Levy,¹⁰ the Government's commitment to reduce emissions by 50% is insufficient. Industry should be redoubling efforts to cut emissions at source, required and incentivised by Government policy and NSTA regulation.

- The Government announced in the ESS a licensing round for oil and gas exploration in the Autumn, which will be subject to the new Climate Compatibility Checkpoint. We wrote to the Government in response to the recent consultation on the Checkpoint,³ which advised the Government to set stringent climate tests for licensing of exploration as well as to later development stages (e.g. consenting of production).
- Some initial actions are ongoing to support the electrification of offshore platforms. Crown Estate Scotland has developed the project Innovation and Targeted Oil and Gas (INTOG) leasing round, specifically, for integration of offshore wind projects into oil and gas installations.
- The NSTA has published the updated flaring and venting guidance, which sets out measures for all facilities to achieve zero routine flaring and venting by 2030. In parallel, the industry will deliver individual action plans by 2022, reinforcing requirements to prevent gas waste emissions for reasons other than safety.

Action is needed to reduce emissions from flaring and venting in line with the Global Methane Pledge

* Previously known as the Oil and Gas Authority.

- Actions on reducing methane emissions from the upstream oil and gas sector, including onshore terminals, are required as part of the UK's contributions under the Global Methane Pledge, an international initiative to reduce global methane emissions by 30% by 2030, relative to 2020. The oil and gas sector set out its methane emissions pledge and the target to reduce halve its methane emissions by 2030.¹¹

Hydrogen production

In August 2021, the Government published its Hydrogen Strategy, which set out supporting policies required for the development of hydrogen production and use (e.g. Net Zero Hydrogen Fund, Hydrogen Business Model, and the Low-carbon Hydrogen Standard), and the key actions and milestones to develop hydrogen supply and demand to 2030.

This document did not set out the respective roles of different types of hydrogen production. More recently, Government published a range of documents including the Hydrogen Investor Roadmap with a new timeline for deployment.

The Energy Security Strategy doubled the UK target for hydrogen production to 10 GW.

The Hydrogen Production Strategy is due to be published shortly. The UK Government's Energy Security Strategy in April 2022 set out an increased ambition for hydrogen production capacity, doubling the target for 2030 to 10 GW, from the 5 GW set out in the Ten Point Plan in 2020.¹²

- This new target includes at least 5 GW of electrolytic ('green') production capacity. This is partly in response to current very high gas prices that will potentially affect hydrogen production from fossil gas with CCS (i.e. blue hydrogen) should they endure long-term. The increased ambition for zero-carbon electricity generation (i.e. renewables, nuclear) does potentially enable increased green hydrogen production relative to previous plans.
 - The UK's ambition for 5 GW of green hydrogen capacity is now similar to Germany's Hydrogen Strategy which has set out intentions to deploy electrolyser capacity of 5 GW installed by 2030.
 - Increasing demand for electrolyzers in the UK will require acceleration of electrolyser supply-chain development. Given the nascent state of the hydrogen sector, this expansion will need to be strongly supported by Government policy, as market signals for investment are likely to be weak while hydrogen demand is gradually established across sectors.
- Prospects for blue hydrogen will depend on a relatively quick return to more moderate international gas prices. Despite the increased ambition for low-carbon electricity generation in the ESS, there remain questions over whether green hydrogen could fill the gap sufficiently by 2030 should blue hydrogen not be delivered at scale.
- Government recently launched the Hydrogen BECCS Innovation Programme,¹³ thus extending the range of options to produce hydrogen, while delivering greenhouse gas removals. The programme aims to support the deployment and commercialisation of hydrogen production from biogenic feedstocks via gasification combined with CCS.

Bioenergy

Policies compatible with the sustainable use of biomass for Net Zero are not yet in place. However, a Biomass Strategy is scheduled for later in 2022.

The upcoming Biomass Strategy should set out mechanisms to support growth in domestic biomass supply alongside wider land use considerations

- The Government published the Biomass Policy Statement in 2021, setting out the scope of the Biomass Strategy and provided an early view of the best use of biomass across some sectors, reinforcing the need for bioenergy to be used in combination with CCS.
- Sustainable biomass production in the UK is important to deliver the greenhouse gas removals required for Net Zero at UK and devolved administration levels (see Chapter 13). As highlighted in the Intergovernmental Panel on Climate Change Working Group III (IPCCWGIII) report, assurance of the sustainability of biomass production depends on robust monitoring reporting and verification.
- The Biomass Strategy needs to be part of a comprehensive land use strategy, including setting out how land for UK biomass and forestry will be freed up (e.g. through reduced livestock farming as a result of diet changes).
- The strategy should set out mechanisms to support growth in domestic biomass supply, alongside the rapid deployment of BECCS in power generation and biofuels production plants, ensuring that the UK will have sufficient biomass available to meet expected removals requirements using CCS by 2050. This should align with the Committee's 2018 Biomass report, 2020 Land Use report, as well as the IPCCWGIII assessment on mitigation of climate change, which covers wider approaches on sustainability-oriented policies and food production security.

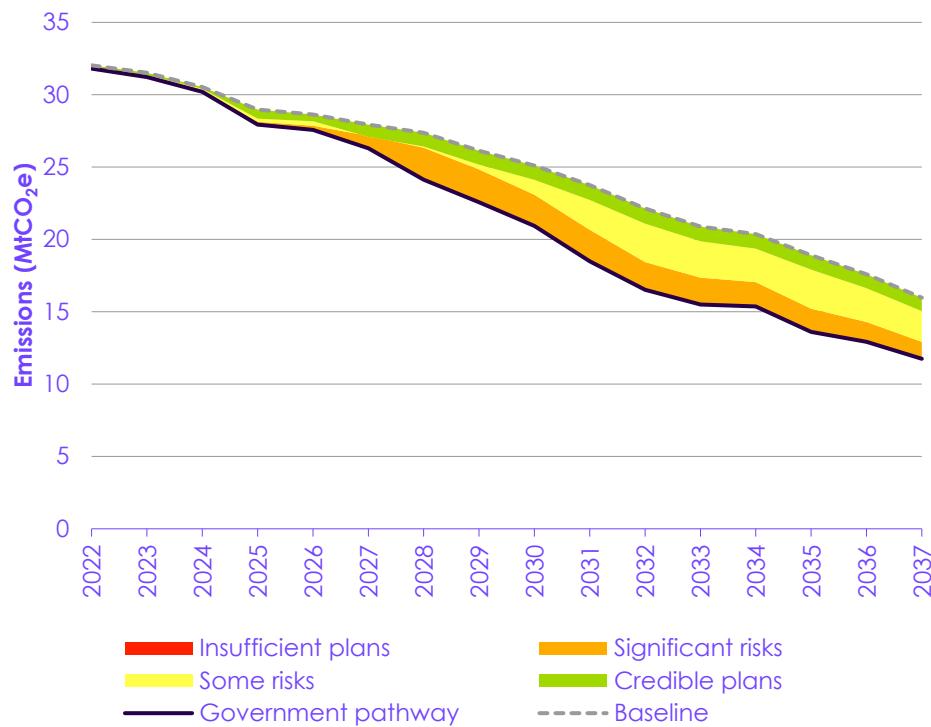
(b) Assessment of policies and plans

In this progress report, we assess Government plans in relation to the delivery of the pathway set out in the Net Zero Strategy.

There are risks to delivering the 50% target of the North Sea Transition Deal

- We have previously highlighted potential to reduce emissions from oil and gas production beyond the 50% commitment in the North Sea Transition Deal, as the target heavily relies on emissions reductions that will be driven by the ongoing decline in oil and gas production rather than decarbonisation efforts. Even against the current, less ambitious target, we have identified risks to delivery (Figure 7.7), particularly from the electrification of oil and gas platforms which will require a rapid and efficient integration of offshore planning and processes.
- The Government has made significant progress through the Hydrogen Strategy to deliver policies that can support the development of a hydrogen economy. Some uncertainties remain, in particular on the future mix of hydrogen production technologies and steps towards their deployment.
- Other policies like the Iron Mains Risk Programme represent a credible source of emissions reductions that have already contributed to emissions reductions in the sector and will continue to do so in the next decade.

Figure 7.7 Assessment of policies and plans for fuel supply



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Table 7.2

Policy scorecard for fuel supply

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Electrification of oil and gas platforms 22% of 2035 abatement	O	O	R	O	O
	<ul style="list-style-type: none"> There is no clear mechanism to provide incentives or action plan to address the barriers to the electrification of oil and gas platforms. 				
Reduced flaring and venting 6% of 2035 abatement	Y	Y	Y	O	Y
	<ul style="list-style-type: none"> Policies and regulation are in place to reduce emissions from flaring and venting (e.g. Updated Flaring and venting guidance and Methane action plan), although targets in the NSTD could be brought earlier. 				
Reduced methane leakage 17% of 2035 abatement	G	G	G	G	G
	<ul style="list-style-type: none"> Iron Mains Risk Reduction Programme is ongoing and delivering emissions reductions that align with CCC recommendations. 				
Low-carbon hydrogen production 0% of 2035 abatement*	Y	Y	O	G	Y
	<ul style="list-style-type: none"> Some uncertainties remain, particularly on the role of different hydrogen production technologies, and whether the incentives for investment will be sufficiently strong and supply chain capacity sufficiently large to deliver hydrogen production at scale and pace. 				
Bioenergy best-use and CCS readiness 7% of 2035 abatement**	O	Y	Y	O	Y
	<ul style="list-style-type: none"> The Biomass Strategy later in 2022 needs to set out how land for UK biomass and forestry will be freed up (e.g. through reduced livestock farming as a result of diet changes), and mechanisms to support growth in domestic biomass supply alongside the rapid deployment of BECCS in power generation and biofuels plants. 				
CCUS in refineries 15% of 2035 abatement	Y	G	Y	Y	Y
	<ul style="list-style-type: none"> Some risks as policies are being developed but not yet in place. 				
Overall sector assessment	Y	Y	O	Y	Y

* Emissions reductions from low-carbon hydrogen production are accounted for in end-use sectors and there is a slight increase in emissions due to blue hydrogen production.

**Emissions reductions from bioenergy will be accounted for in other sectors (e.g. surface transport, agriculture and land & use, aviation and shipping).

(c) Recommendations

The new recommendations in this sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department.

Government should clarify plans and responsibilities are needed to integrate oil and gas platforms to the electricity grid

Government should develop minimum emissions intensity standards for domestic oil and gas production by the next licensing round.

Government should update its sustainability criteria for bioenergy feedstocks

- Given the Government's plans for new oil and gas production, it must ensure that North Sea production has a very low emissions footprint. The Government should clarify plans and responsibilities for electrification of oil and gas infrastructure through integration with the offshore wind planning process and/or onshore grid, so that by 2027 new oil and gas platforms can achieve zero emissions from operational energy use.
- We recommend that minimum emissions-intensity standards are developed for domestic oil and gas production by the next licensing round, seeking to ensure a consistent measurement approach with emerging international measurement standards.
- The Government's ambition to double hydrogen production capacity to reach 10 GW by 2030 (of which at least 5 GW is to be electrolyzers) will require it to set out supporting policies to provide additional funding, ensuring that there will be mechanisms in place to deliver hydrogen production at scale and pace.
- The Biomass Strategy will be published by the end of 2022, which we expect to include updated sustainability criteria for bioenergy feedstocks and mechanisms to monitor the best use of biomass. This Strategy needs to be part of a comprehensive land use strategy, including setting out how land for UK biomass and forestry will be freed up (e.g. through reduced livestock farming as a result of diet changes). (See chapter 8)
- The Strategy should also set out mechanisms to support growth in domestic sustainable biomass supply, alongside the rapid deployment of BECCS, ensuring that UK will have sufficient biomass available to meet expected removals requirements using CCS by 2050. (See chapters 8 and 13). It should also cover assurance of the sustainability of biomass production with robust monitoring, reporting and verification frameworks. Given, the risks that biomass cannot be delivered sustainably at scale, we recommend that contingency plans should be put in place for both energy production and removals elements.
- Bioenergy without CCS should be phased out rapidly in power generation and biofuels production plants where CCS will need to be retrofitted to facilities already in operation and newbuild BECCS plants should start to ramp-up at good pace.

4. Major risks

Table 7.3

Major risks and required mitigating actions for fuel supply

Risk category	Description	Mitigating actions	
		Details	In place?
High gas prices	Current high fossil gas prices make hydrogen from gas with CCS less economically attractive. While there is scope to compensate with some additional electrolytic production, sustained high gas prices may limit the scope for low-carbon hydrogen production, and therefore uptake of hydrogen solutions overall, this decade.	Support the development and commercialisation of various sources of hydrogen production to set in place hydrogen supply chains and storage.	Partly
New oil and gas production	The Energy Security Strategy announced aims to develop more oil and gas production in the North Sea, incentivised as part of the recent Energy Profits Levy. The additional energy use of new assets could increase emissions if it remains unabated.	Require new oil and gas platforms to use electricity for their operations.	No

Endnotes

¹ BEIS (2022) *British Energy Security Strategy*, <https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy>.

² HM Treasury (2022) *Energy Profits Levy Factsheet*, <https://www.gov.uk/government/publications/cost-of-living-support/energy-profits-levy-factsheet-26-may-2022>.

³ CCC (2022) *Letter: Climate Compatibility of New Oil and Gas Fields*, <https://www.theccc.org.uk/publication/letter-climate-compatibility-of-new-oil-and-gas-fields/>.

⁴ IPCC (2022) *Climate Change 2022: Mitigation of Climate change*, <https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/>.

⁵ BEIS (2021) *Digest of UK Energy Statistics*, <https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2021>.

⁶ ONS (2021) *Oil and gas: reserves and resources*, <https://www.ons.gov.uk/economy/environmentalaccounts/datasets/ukenvironmentalaccountsoilandgas/current>

⁷ North Sea Transition Authority (2022) *Production and expenditure projections*, <https://nstauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>.

⁸ HSE/Ofgem (2011) *10 year review of the Iron Mains Replacement Programme*, <https://www.hse.gov.uk/research/rrhtm/rr888.htm>.

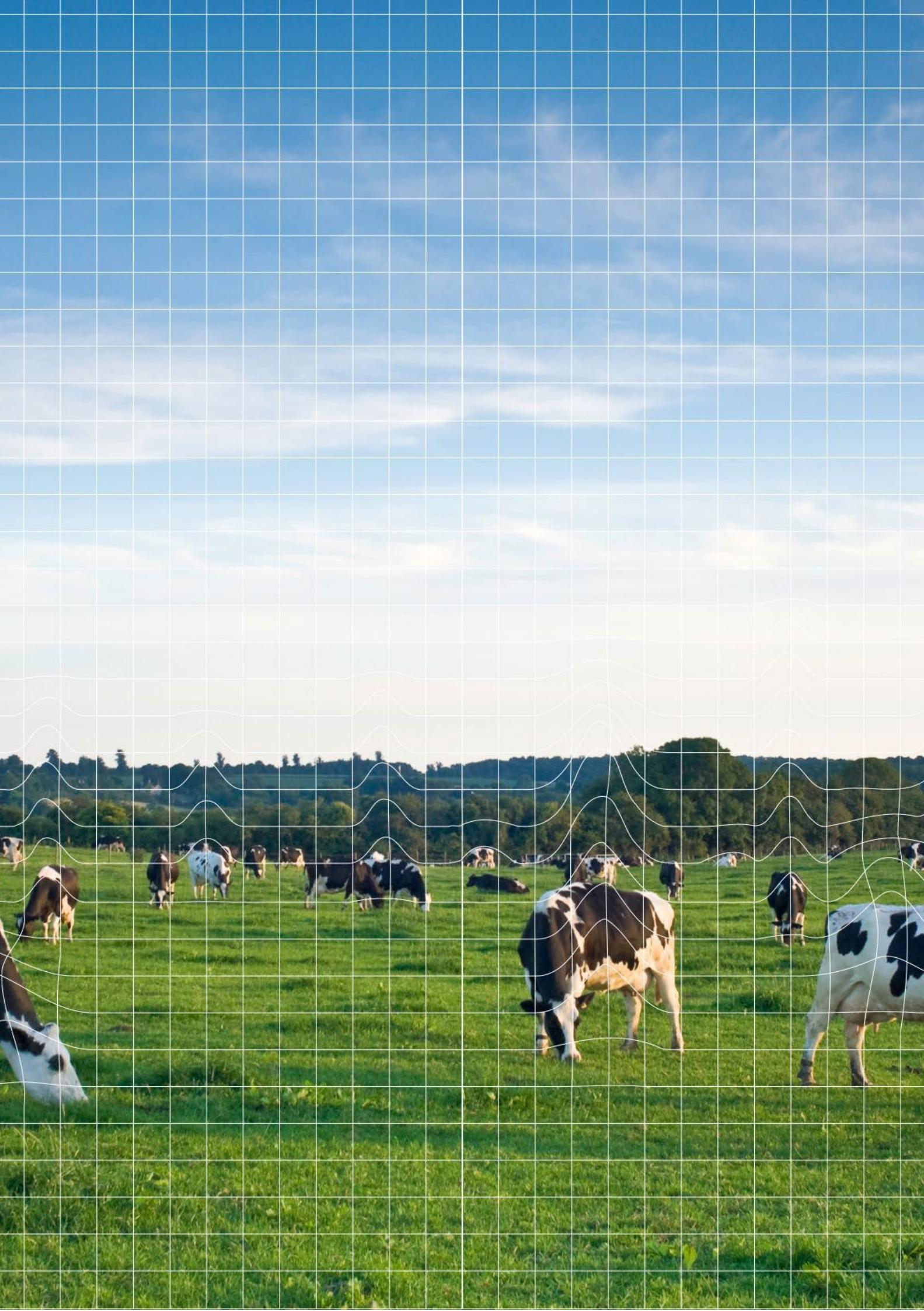
⁹ BEIS (2022) *North Sea Transition Deal: One Year On*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1061986/north-sea-transition-deal-one-year-on.pdf.

¹⁰ HM Treasury (2022) *Energy Profits Levy Factsheet - 26 May 2022*, <https://www.gov.uk/government/publications/cost-of-living-support/energy-profits-levy-factsheet-26-may-2022>.

¹¹ OGUK (2021) *Methane Action Plan 2021*, <http://oeuk.org.uk/wp-content/uploads/2021/06/OGUK-Methane-Action-Plan-2021.pdf>.

¹² UK Government (2020) *The ten point plan for a green industrial revolution*, <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>.

¹³ BEIS (2022) *Hydrogen BECCS Innovation Programme*, <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>.



Chapter 8: Agriculture and Land Use

50 MtCO₂e, 12% of UK emissions, in 2020

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Introduction and key messages

This chapter reviews progress reducing emissions from the UK agriculture and land use sectors.

Emissions in agriculture and land use were 50 MtCO₂e in 2020 (46 MtCO₂e from agriculture and 4 MtCO₂e from land use), representing 12% of all UK greenhouse gas emissions. This is a reduction of 2 MtCO₂e on 2019.

The land use sector must become a net sink by the mid-2030s (i.e. it should be removing CO₂ from the atmosphere). This implies major increases in peatland restoration to reach 67,000 hectares/year by 2025, and in annual tree planting to 30,000 hectares by 2025 and 50,000 hectares by 2050. By 2050, woodland cover needs to increase to 18% of UK land area, from 13% currently, and around 80% of peatland must be restored. Due to the time lag before they impact on emissions, these land use changes need to start now.

The UK Government's Net Zero Strategy targets similar emissions reductions to the CCC path at around 34% by 2035 (relative to 2019) across the agriculture and land sectors. This requires a rapid ramp-up of action, driven by strengthened policy. Greater transparency in the Government's pathway – for example splitting out the agriculture and land sectors – would make it easier to assess if action is meeting Government ambition.

Our key messages are:

- **Slow sector progress.** Emissions from agriculture and land use have been relatively flat since 2008, which is inconsistent with the Net Zero target and reflects insufficient progress across the board. Take-up of low-carbon farming and productivity measures has been too low. Land-use changes, such as peat restoration and afforestation, are well below required levels and have yet to meet delivery targets across the UK.
 - How land can deliver its required multiple functions, including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, and wider environmental goals. Currently these goals are scattered over multiple Government documents, missing or unclear. They should be brought together and filled out, with a clear vision for what they collectively imply for UK land use.
 - How these multiple objectives can be met without increasing stresses on land or leading to carbon leakage by increasing imports. Productivity improvements can help but may be challenging to achieve as the climate changes. The Committee's analysis emphasises the importance of the demand-side, particularly the potential to release land through reduced meat and dairy consumption and production.
 - How the UK and devolved governments will collectively ensure that new arrangements are coherent, co-ordinated and consistent. The multiple objectives can be complementary but risk running into conflict with each other if policies are developed separately in siloes. The transition from the Common Agricultural Policy (CAP) is a once-in-a-generation opportunity to improve policy across agriculture and land at a national scale that is in danger of being missed.

A comprehensive strategy for the agriculture and land sectors is urgently needed.

- How the UK and devolved governments will collectively act to enable positive changes to occur. Key enablers include: innovation support; information, training and skills; funding and access to finance; support for tenant farmers.

The Government's reluctance to encourage a shift to healthier diets introduces significant risks.

Getting the right incentives for farmers to deliver public goods including carbon sequestration is vital.

- **A reliance on innovation.** Plans to decarbonise the agriculture sector in the Net Zero Strategy are highly reliant on the take-up of low-carbon farming practices and productivity improvements. This comes with significant risks, as approaches are voluntary, may not yet be mainstream and are dependent on future innovation. As well as reducing emissions at source, measures will need to release land to sequester carbon. A reluctance to consider demand-side measures (i.e. encouraging healthier diets with reduced consumption of meat and dairy) as a complementary measure therefore puts both emissions reduction from agriculture and removals from land at risk.
- **More details needed on CAP reform.** Further detail on the transition from the CAP is urgently needed across the UK, especially for new agricultural subsidies and land management. Incentives must encourage take-up of low-carbon farming measures and land-use changes such as afforestation and peatland restoration. Changes to land management can take significant time periods and investment to implement. Subsidy agreements must be set over long enough time periods (i.e. beyond the current 2025 focus) and with enough notice to underpin decisions to support farmers and land managers during the transition.

The rest of this chapter is set out as follows:

1. Emission trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

In this section we report emission trends and drivers for the agriculture sector and land use, land-use change and forestry (LULUCF) sector, as reported in the UK greenhouse gas (GHG) inventory. Though these sectors are separate, they are closely related.

- The agriculture sector includes emissions of GHGs from livestock, agricultural soils, and agricultural machinery.
- Changes in carbon stock from forests, wetlands, settlements, harvested wood products and from land under agricultural use, such as grassland and croplands, are allocated to the LULUCF sector. Also included within LULUCF are emissions of other non-CO₂ gases from drainage and rewetting of soils (excluding croplands and intensive grasslands which are assigned to Agriculture), nitrogen mineralisation associated with loss and gain of soil organic matter, and fires.

(a) Agriculture

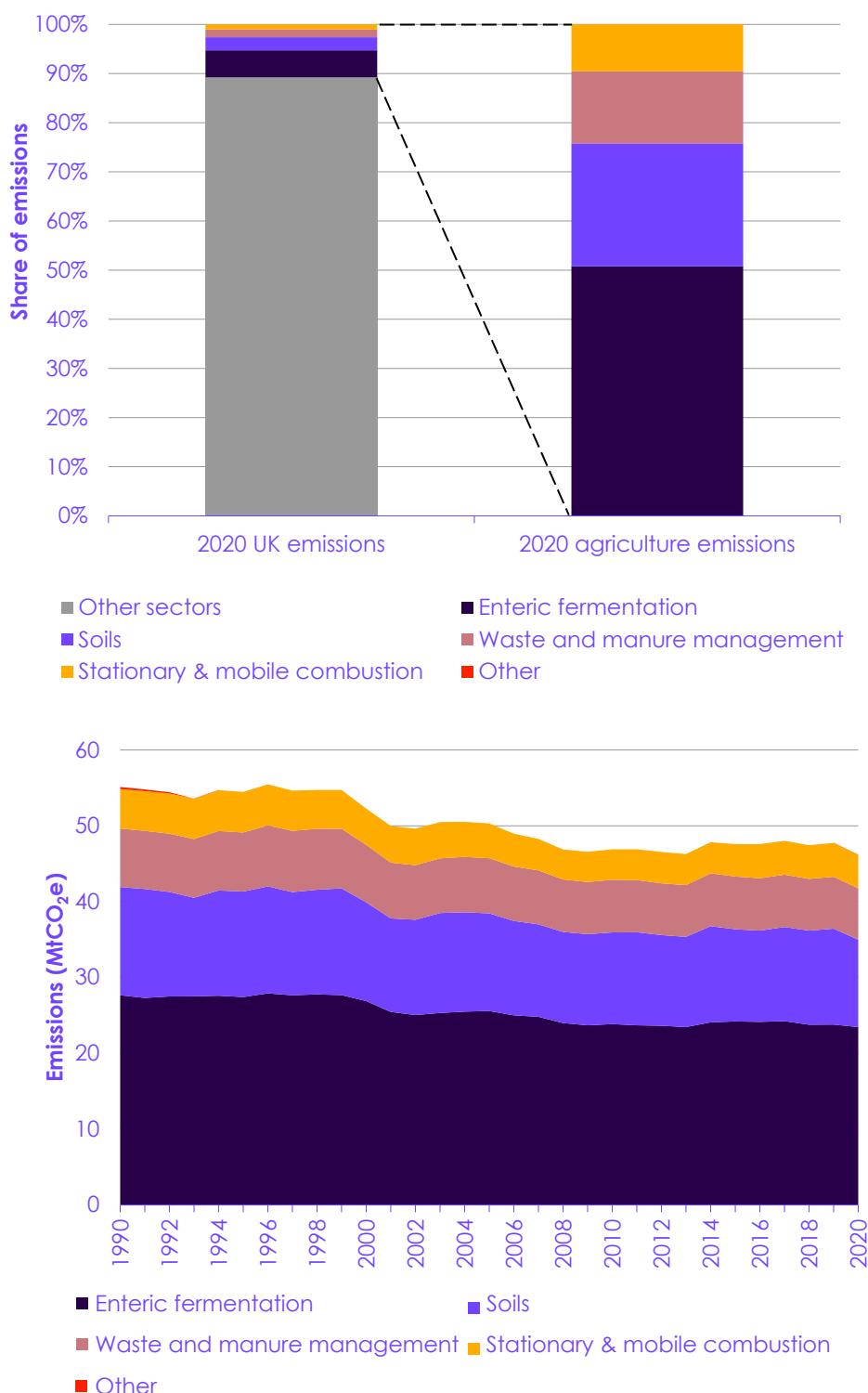
The agriculture sector includes emissions from livestock, agricultural soils, stationary combustion sources and off-road machinery. Carbon stock changes are reported in the land use sector.

Emissions from agriculture were 46 MtCO₂e in 2020, representing 11% of greenhouse gas emissions in the UK (Figure 8.1), mostly methane and nitrous oxide (Figure 8.2). Emissions estimates are not yet available for 2021. Between 2019 and 2020 emissions from this sector declined by around 3% after a decade of being virtually flat, following falls in preceding decades.

- Much of the longer-term reduction was driven by CAP reforms leading to a reduction in livestock numbers, and reduced use of inorganic fertilisers.
- Methane is the dominant source, driven by enteric fermentation from the digestive processes of livestock, and storage and management of livestock waste and manures (Figure 8.3).
- Nitrous oxide emissions are driven by use of agricultural fertilisers on soils, and like for methane, agriculture is the dominant source nationally (Figure 8.4).
- Though stationary and mobile combustion accounts for the vast majority of carbon dioxide emissions (12% of agriculture emissions in 2020), the reduction of carbon dioxide from the liming of agricultural soils contributed to the sector's overall decline in emissions in 2020.
- Beef and dairy cattle are the main sources of livestock emissions (Figure 8.5). Livestock are responsible for additional agriculture emissions, through fertiliser applied to grassland and through land used for growing fodder crops.
- In recent years there has been a gradual decline in emissions intensity from beef, dairy and pigs, as the production of meat and milk has increased at a faster rate than emissions (Figures 8.6 and 8.7). Emission intensity for sheep has been variable across the time period, however the level in 2020 is similar to that in the 1990s.

Emissions from agriculture represented 11% of greenhouse gas emissions in the UK in 2020.

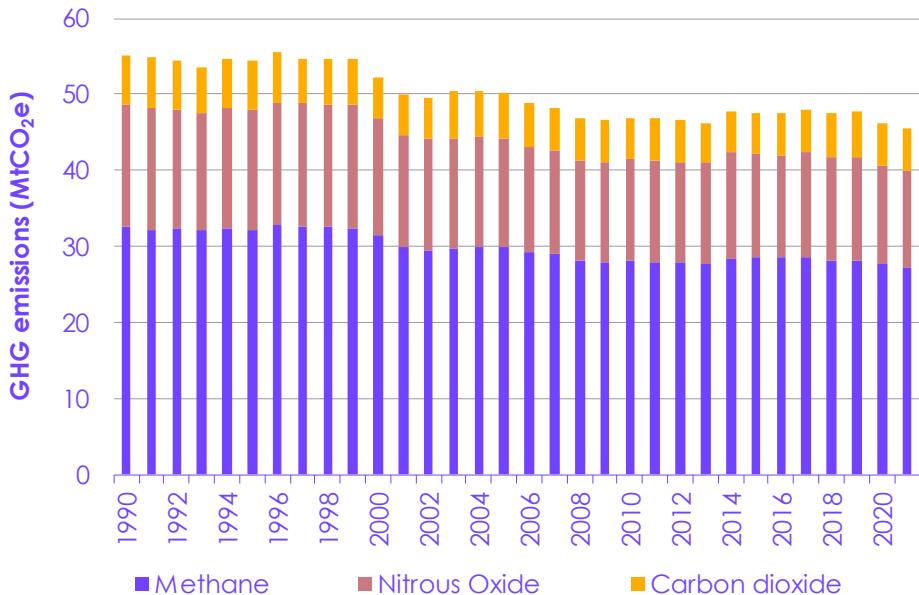
Figure 8.1 Agriculture emissions by sub-sector as a share of UK total



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.
Notes: Global warming potentials from IPCC AR5 without feedback are used.

The agriculture sector is unusual in that the emissions of the non-CO₂ gases methane and nitrous oxide dominate.

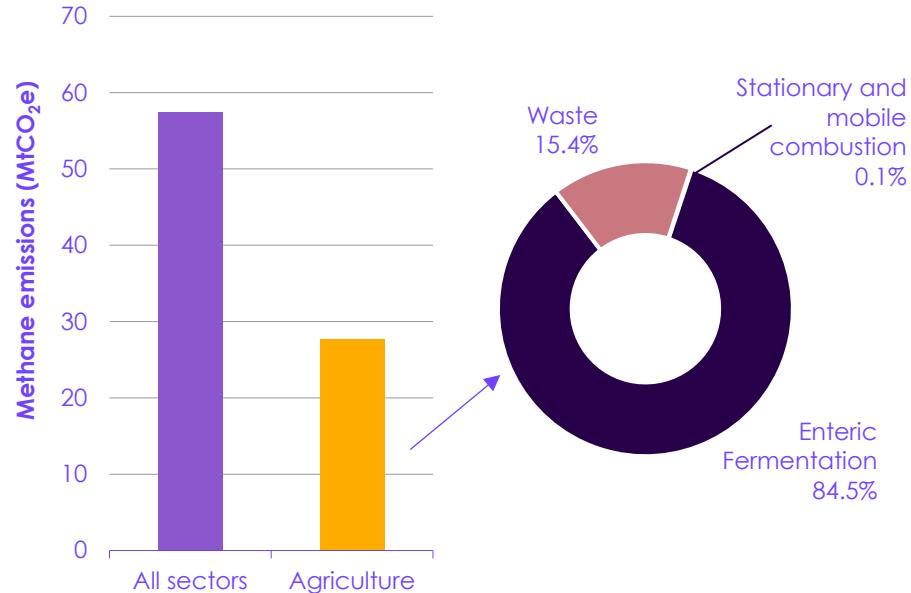
Figure 8.2 Agricultural emissions broken down by greenhouse gas (1990 – 2021)



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.

Agriculture represents 28 MtCO₂e (48%) of UK methane emissions. Within the sector, the digestive process of ruminant livestock (e.g. cattle, sheep) is the main source of the gas.

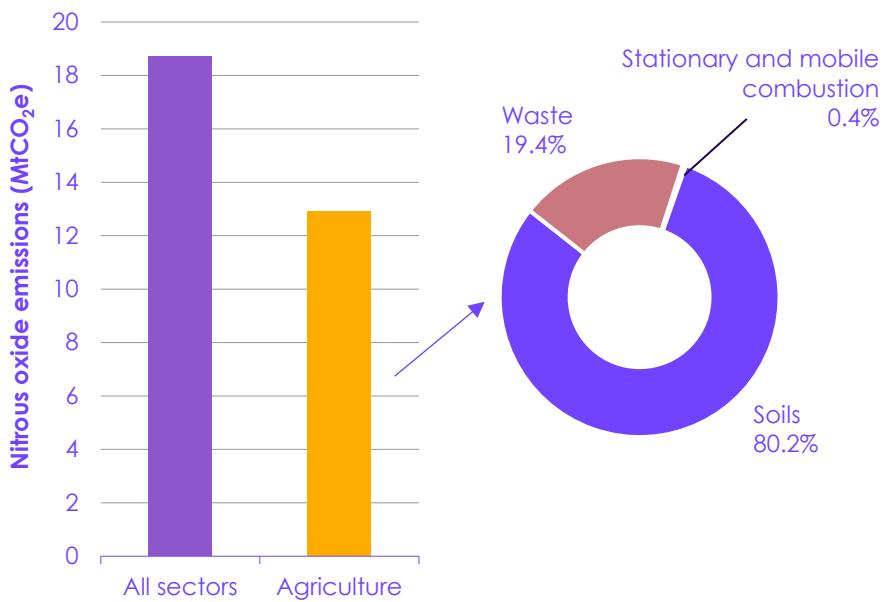
Figure 8.3 Agricultural methane emissions (2020)



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.

Agriculture represents 13 MtCO₂e (69%) of UK nitrous oxide emissions. Within the sector, emissions from the use of agricultural fertilisers on soils is the main source of the gas.

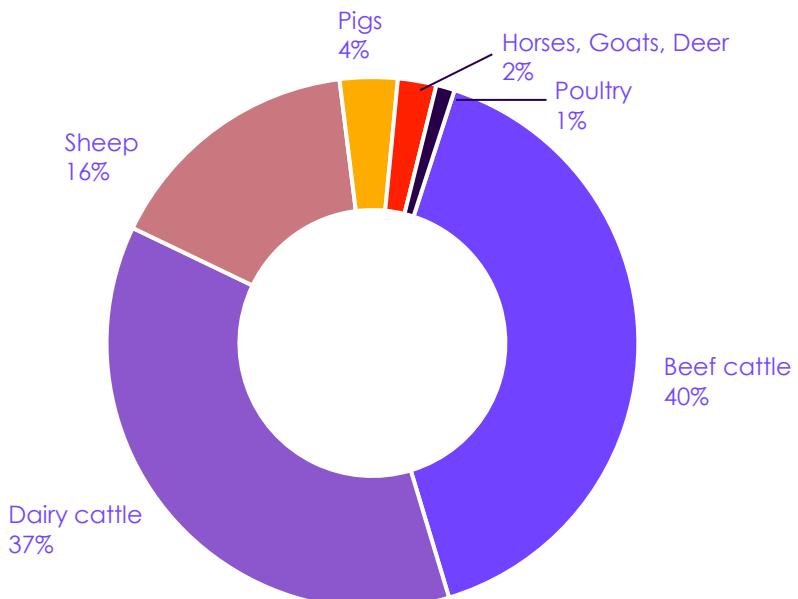
Figure 8.4 Agricultural nitrous oxide emissions 2020



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.

Dairy and beef cattle represented 77% of direct agricultural emissions in 2020.

Figure 8.5 Livestock contribution to agricultural emissions by animal type (2020)

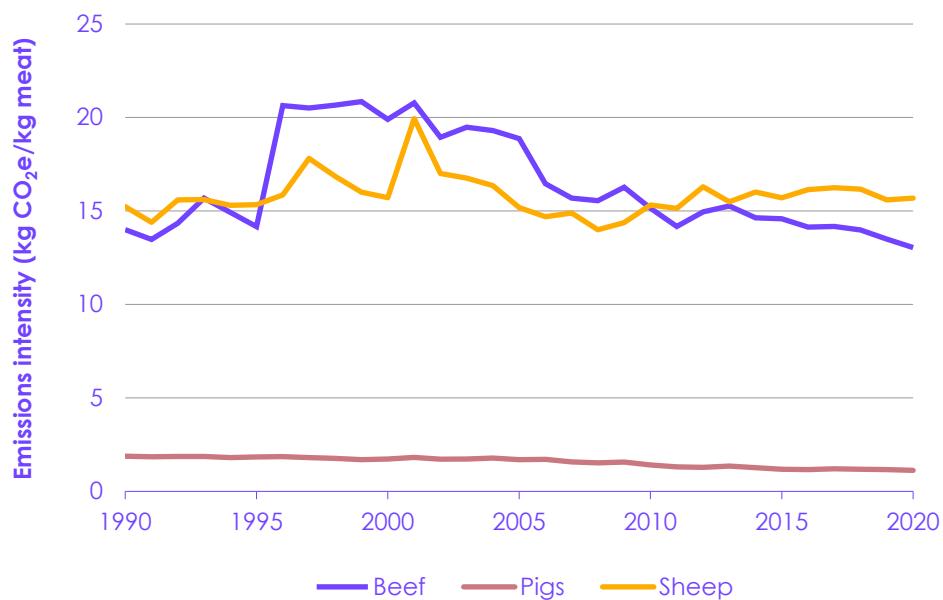


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.

Note: Includes both methane and nitrous oxide emissions, from enteric fermentation, waste and manure management. Does not include indirect emissions such as from fertiliser use on grassland, or fodder crops.

There has been a gradual decline in emissions intensity from beef, dairy and pigs since the 1990s. Emission intensity for sheep has been variable but with little change overall.

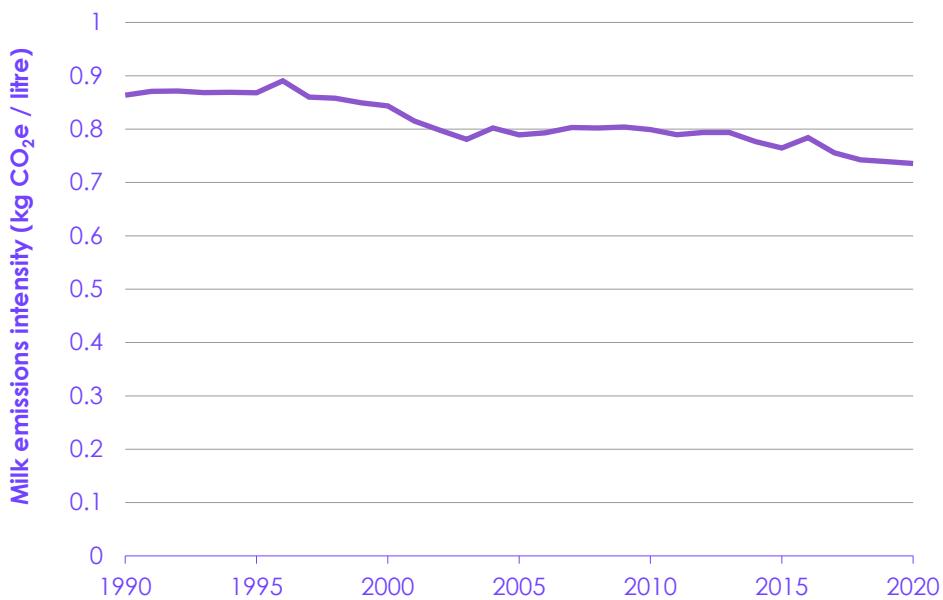
Figure 8.6 Emissions intensity – meat production (1990 – 2020)



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; Defra (2022) Agriculture in the United Kingdom 2020; CCC analysis.

Notes: Emissions intensity is calculated as the emissions attributed to each livestock type in ktCO₂e divided by the output of meat in k tonnes. Emissions included are methane and nitrous oxide emissions from enteric fermentation and waste.

Figure 8.7 Emissions intensity – dairy production (1990 – 2020)



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; Defra (2022) Agriculture in the United Kingdom 2020; CCC analysis.

Notes: Emissions intensity is calculated as the emissions attributed to dairy cattle in MtCO₂e divided by the output of milk in million litres. Emissions included are methane and nitrous oxide emissions from enteric fermentation and waste. Indirect emissions not directly attributable to livestock types (e.g. from animal feed or agricultural machinery) are not included and therefore this is a lower bound estimate of emissions intensity.

(b) Emissions from Land Use, Land-Use Change and Forestry

Net emissions from the land use sector are a balance between the forestry net sink, and net sources such as settlements and carbon changes in croplands.

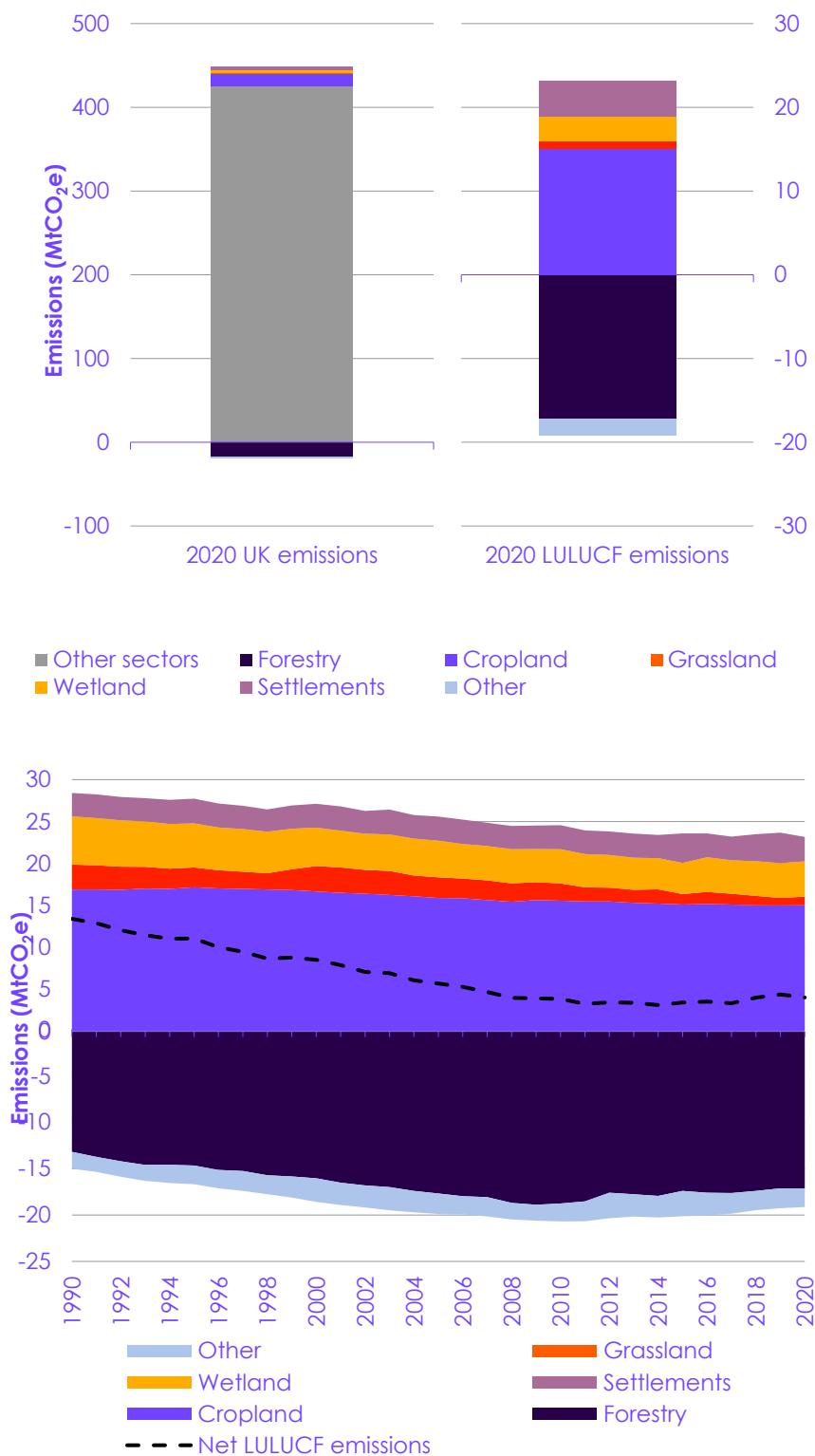
Net emissions from the LULUCF sector represent the balance between land emissions, from sources such as settlements and carbon changes in croplands and grasslands, and removals through natural sequestration such as by forests as they grow.

In 2020 UK land use had net emissions of 4 MtCO₂e, 0.9% of total GHGs in the UK, and down 0.4 MtCO₂e from the previous year. Net emissions have been virtually flat since 2008 but have decreased by 70% since 1990.

- **Trends.** Over the long term, net emissions reductions have come from cropland, grassland, and forests, which respectively made up 18%, 51%¹ and 13%² of the UK's land use in 2020. In 2020 there was a slight increase in the sink status of forests and a small decline in emissions from wetlands and croplands (Figure 8.8).
- **Forestry** is the UK's largest sink, sequestering 17 MtCO₂e in 2020. Historical high rates of afforestation (e.g. pre-2000) have driven long-term increases in sequestration. However, lower tree planting in recent years and the aging profile of existing woodlands have led to a levelling off of sequestration by forestry. Scotland has consistently reported greater planting rates than the rest of the UK combined, with few exceptions since 1990 (Figure 8.9).
- **Peatlands** are the largest source of land emissions, although emissions have fallen by 15% since 1990 (Figure 8.10). Drainage and management of peat for use as croplands and grasslands are the major contributors, with conversion to cropland and settlements further sources of emissions (Figure 8.11). This is despite the low share of peatlands that are currently farmed for crops or intensively managed as grasslands (Figure 8.12).

LULUCF emitted 4 MtCO₂e (0.9%) of total UK GHGs in the UK in 2020. This is the net of larger sinks and sources. Cropland is the largest emitter, at 15 MtCO₂e and forest land the largest sink at 17 MtCO₂e.

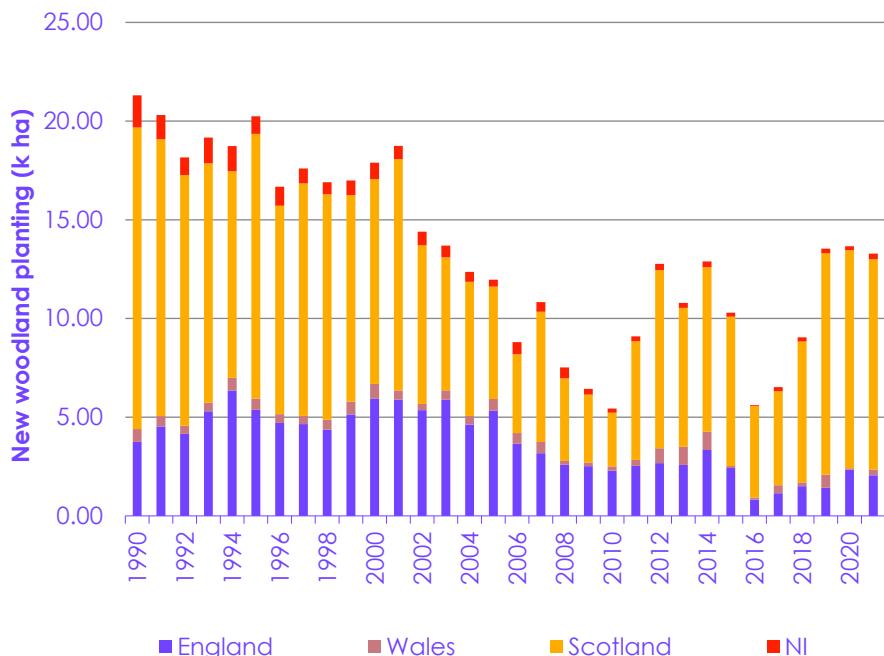
Figure 8.8 Land based emissions and removals by sub-sector as a share of UK total



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.
Notes: Global warming potentials from IPCC AR5 without feedback are used.

Tree planting rates have declined since the 1990s. Together with the aging profile of woodlands, this is weakening sequestration by forestry and woodlands. Most new planting occurs in Scotland.

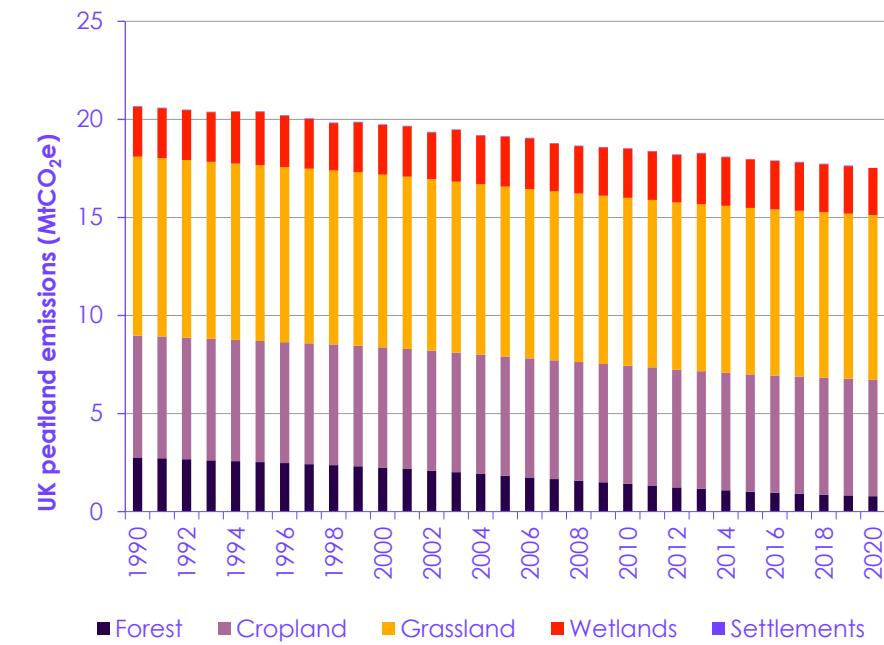
Figure 8.9 UK afforestation rates (1990 – 2021)



Source: Forest Research (2021) *Forestry Statistics 2021*.

Across land uses, peatland soils are a particularly important emissions source.

Figure 8.10 Emissions from peatland soils, by land use (1990 – 2020)

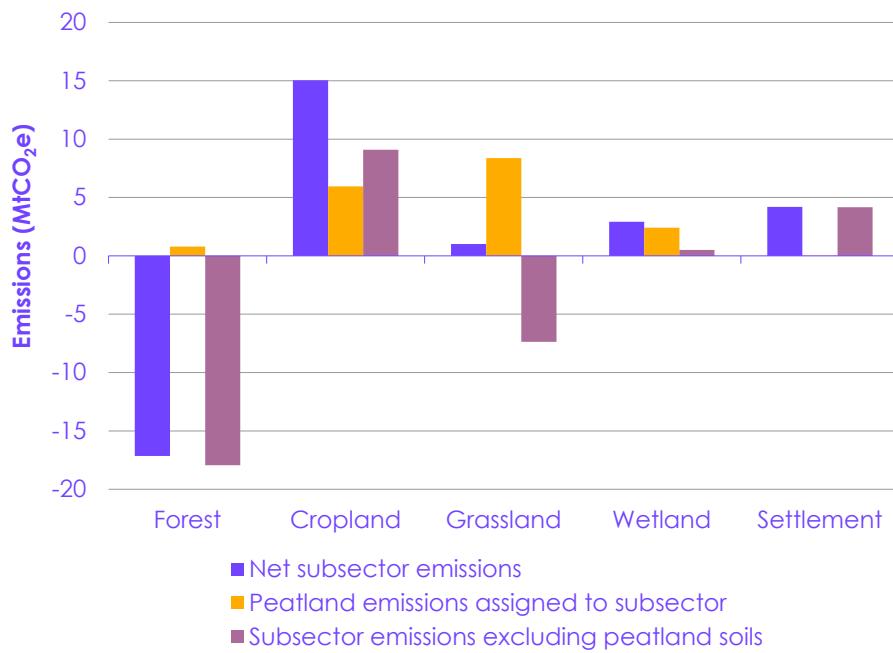


Source: CEH (2022).

Note: This chart shows the gross emissions from peatland soils, whereas Figure 8.7 shows the net emissions by land type.

Emissions from peatland soils are significantly impacted by their management. Croplands on peatland soils make up 40% of total peat emissions. The draining and management of peatlands for their use as grassland more than offsets the sequestration from grasslands.

Figure 8.11 Contribution of peatland GHG emissions to each LULUCF subsector (2020)

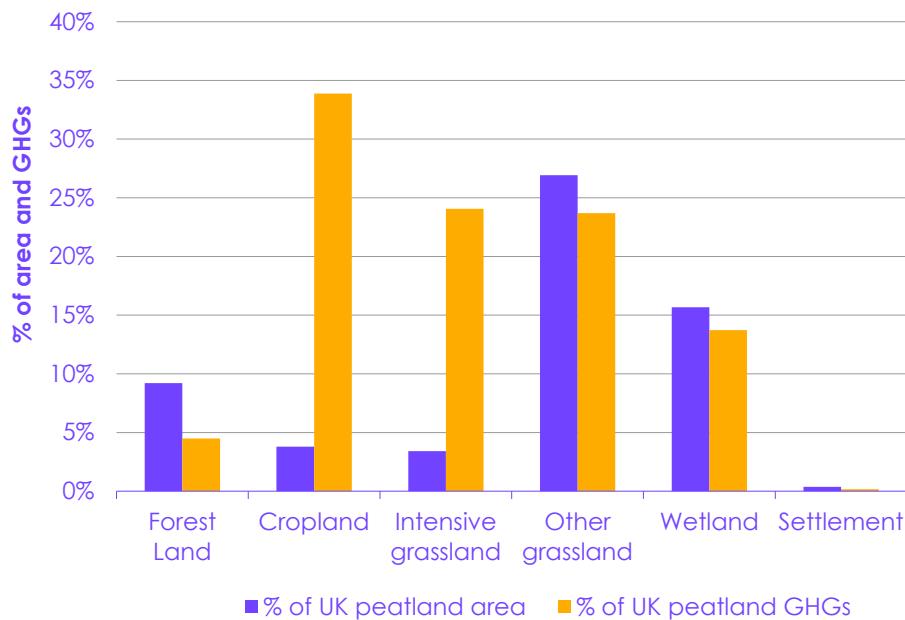


Source: CEH (2022) and CCC analysis.

Notes: LULUCF land categories contain the following peat condition categories³: Forest land: forest; Cropland: cropland; Grassland: eroding modified bog, modified bog, extensive grassland, intensive grassland, rewetted modified bog, rewetted bog or fen; Wetland: near natural bog/fen, extracted domestic, extracted industrial, rewetted bog or fen; Settlement: settlement.

Despite representing only 7% of UK peatland area, the use of peatland soils for crops and intensive grassland contributes 58% of the total emissions from peatlands.

Figure 8.12 Contribution of peatland GHG emissions to each LULUCF subsector (2020)



Source: CEH (2022) and CCC analysis.

Notes: LULUCF land categories contain the following peat condition categories³: Forest land: forest; Cropland: cropland; Grassland: eroding modified bog, modified bog, extensive grassland, intensive grassland, rewetted modified bog, rewetted bog or fen; Wetland: near natural bog/fen, extracted domestic, extracted industrial, rewetted bog or fen; Settlement: settlement.

2. Indicators of progress

The monitoring map and indicators summarise the actions and conditions needed for decarbonisation across agriculture and land use.

This section sets out the key indicators of progress in reducing emissions in the agriculture and land use sectors.

Our monitoring map (Figure 8.13) summarises the actions and conditions required for emissions reduction across the agriculture and land use sectors. The accompanying Monitoring Framework provides further detail on how these work together to deliver the decarbonisation pathway for the two sectors, and on the set of identified data and indicators we use to track progress.

Our indicators (Table 8.1) show a lack of progress in low-carbon farming and productivity measures needed to decarbonise the agriculture sector. Delivery of land-use change measures that are necessary to reduce greenhouse gas emissions from degraded peatlands and to promote carbon sequestration via tree planting have yet to meet delivery targets.

- **Farming practices.** The proportion of farmers taking actions to reduce emissions (such as recycling waste materials, improving energy efficiency and improving application of nitrogen fertiliser) declined in 2021.⁴ When asked about how important it was to consider GHGs when making decisions about crops, land and livestock, 68% responded it was ‘very’ or ‘fairly’ important, a slight increase on that reported in 2020 (64%).
- **Livestock numbers and diets.** Total livestock numbers have plateaued over the last decade (Figure 8.14). Between 2009 and 2019, consumption of meat and dairy has reduced (Figure 8.15). Both currently align with our Balanced Pathway, with meat consumption showing a consistent decline, but milk consumption being more variable in recent years. Over the same period, the percentage of people reporting consumption of plant-based alternatives has risen from 7% to 13%.⁵
- **Production and Productivity.**
 - **Crops.** Crop yields have remained static over the last two decades for wheat (Figure 8.16). In 2020, this fell to 7 tonnes, and at 9.7 million tonnes the harvested production of wheat was at its lowest since 1981.⁶ This partly reflects the particular weather conditions in 2020, showing that longer-term trends are more relevant. In our Balanced Pathway, wheat yields need to increase sustainably to 11 tonnes per hectare by 2050.⁷
 - **Livestock.** As noted in the previous section, the emissions intensity of beef, pork and dairy has slowly declined since 1990, while the sheep sector has seen little net change (Figure 8.6). We have not yet identified further effective indicators of livestock productivity.
- **New woodland creation.** Rates of afforestation have consistently been over 13,000 hectares per year for the last three years of reported data for the first time in 20 years (Figure 8.9). The majority of this has been in Scotland. However, planting rates remain well below the UK Government’s commitment, which will require a rapid increase of 4,000 ha annually to reach 30,000 hectares/year in 2025. To support wider environmental objectives, it is also important that planting is suitably mixed:

Woodland creation and peatland restoration rates are well below Government targets.

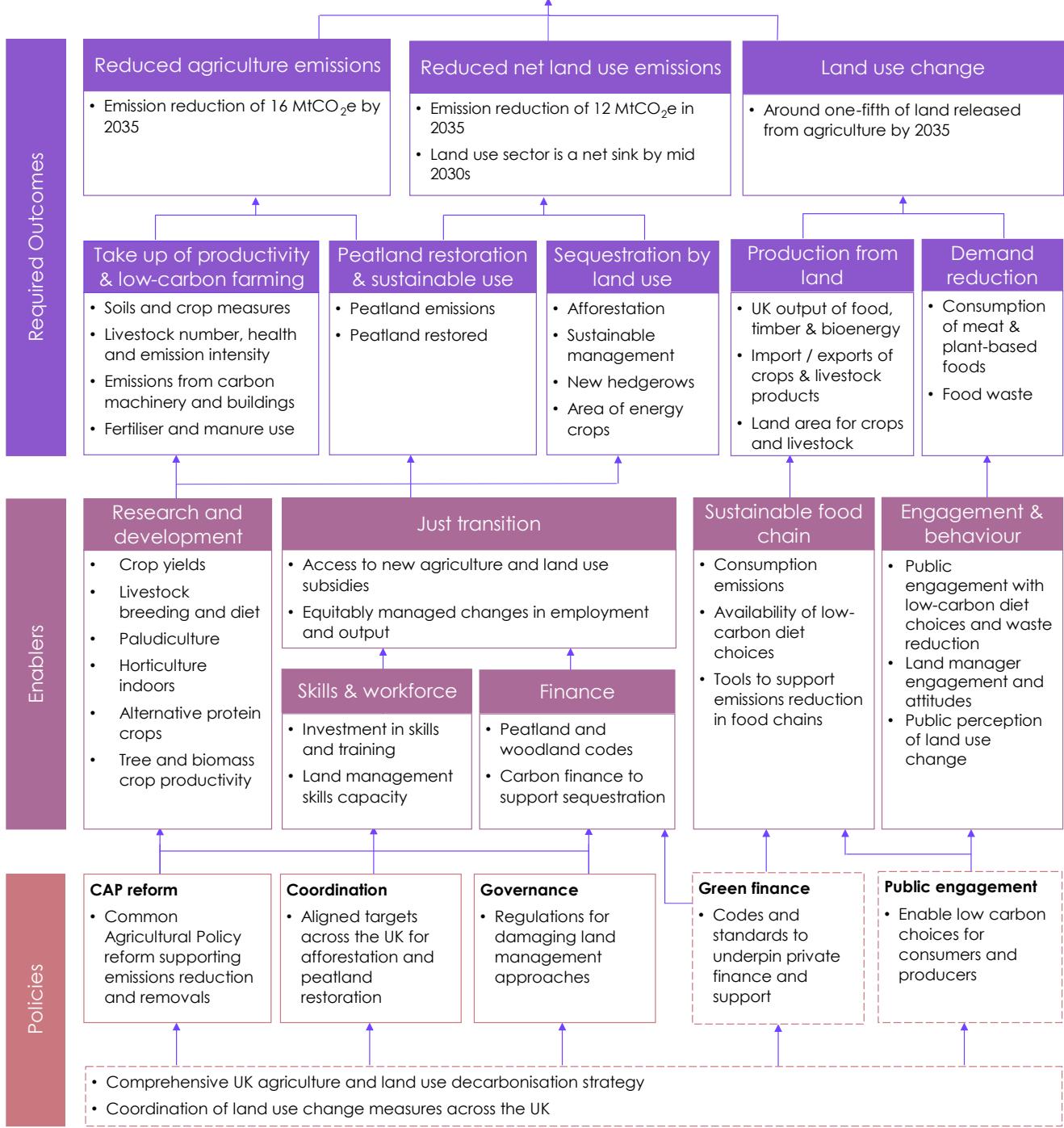
- CCC scenarios reflect different objectives* for new woodland, with higher ratio of broadleaf planting for biodiversity (particularly for England) compared to where commercial forestry dominates (e.g. Scotland).
- The UK Forestry Standard prohibits the planting of monocultures. From the 1990s, broadleaved species have made up the majority of woodland creation, but since 2017 the split has been more even, with conifers making up 54% of new UK planting in 2021 (Figure 8.17). This is variable, with new conifer woodland making up 5% of new woodland in England, compared to 65% in Scotland.
- **Woodland management.** The sustainable management of woodland is important for ongoing carbon sequestration, biodiversity and climate resilience. However, it has flatlined in recent years, with just over half of all woodland in England being managed in this way (Figure 8.18 and 8.19). Management can also release harvested material for timber, fuel and other uses. In 2021, management was weighted towards conifers, with 81% under sustainable management, compared to 46% of broadleaved woodlands. Our Balanced Pathway requires 80% of broadleaf woodland under sustainable management by 2030.
- **Energy crops.** The area of perennial energy crops (miscanthus and short rotation coppice) remains constant at around 10,000 hectares (Figure 8.20, England only). The role of biomass in the UK Government's plans to reach Net Zero are yet to be set out, with a Biomass Strategy due in 2022 that should address this.
- **Peat.** There is no long-term national reporting of peat restoration rates, with reporting frameworks differing in each home country. In 2021, we estimate around 7,700 hectares of peat were put under restoration management across England, Wales and Scotland. This is a decrease from 8,500 ha in 2020. Action must be ramped up to meet ambition, particularly in England and Scotland, where established strategies have set targets to restore 35,000 ha in England by 2025 and 20,000 hectares/year in Scotland from 2021 – both of which are currently being missed. The Welsh Government achieved its annual restoration target of 600- 800 ha in 2020/21 through its National Peatland Action Programme.

* The CCC Balanced Pathway assumes a 67:33 planting ratio in favour of broadleaves for the UK where the focus is on biodiversity. Taking account of regional differences, the ratio increases to 80:20 in England, and is lower in Scotland at a ratio of 50:50. Where the focus is on productive forestry, a 33:67 planting ratio in favour of conifers is assumed. This increases to 75% for conifers in Scotland, due to the conditions conducive to commercial forestry.

Figure 8.13 Monitoring map for agriculture and land use



Emissions in the agriculture and land use sectors fall by around 34% by 2035 (relative to 2019)

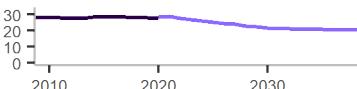
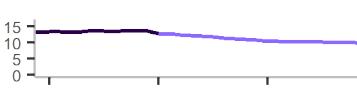
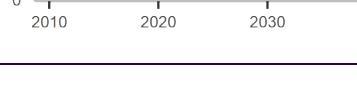
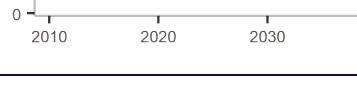
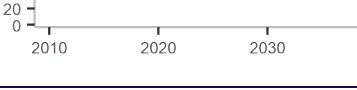


Source: CCC analysis.

Notes: Policy boxes with a dashed line indicate areas not yet addressed by the Government's plans.

Table 8.1

Agriculture and land use key indicators

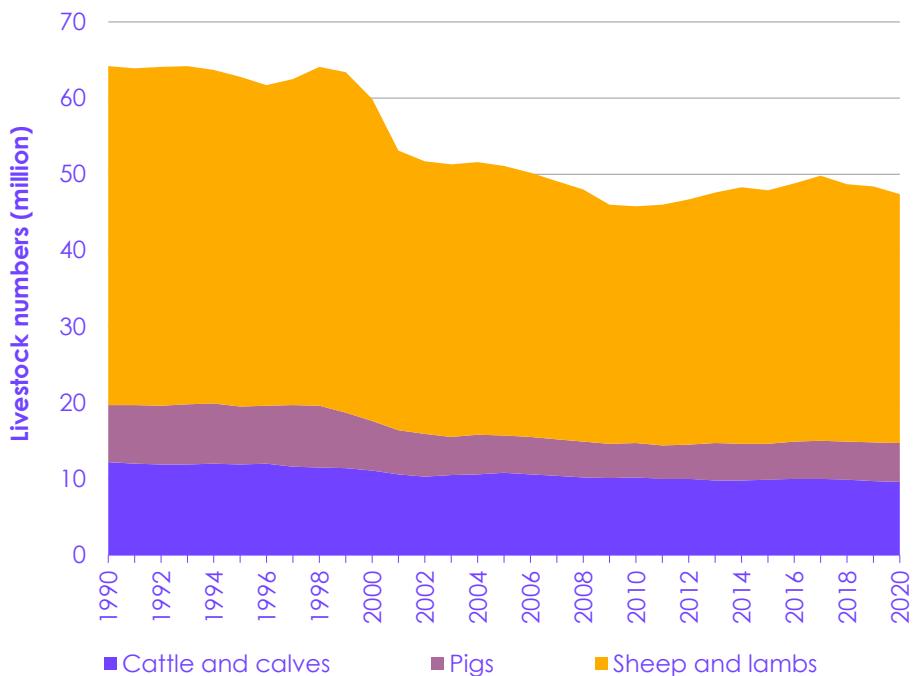
Agriculture & land use indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Emissions	Methane emissions from agriculture	2020	28 MtCO ₂ e; CCC benchmark: 28	-1% from 2019	
	Nitrous oxide emissions from agriculture	2020	13 MtCO ₂ e; CCC benchmark: 13	-5% from 2019	
Land Outcomes	New woodland creation	2021	13 kha	-3% from 2020	
	Woodland under sustainable management ¹	2021	59%	0% from 2020	
	Peatland under restoration management ²	2021	7.7 kha/year; CCC benchmark: 21 ³	-9% from 2020	
	Land area used for energy crops ⁴	2020	10 k ha	-1% from 2019	
Productivity and low-carbon agricultural practices	Farmers undertaking measures to reduce GHG emissions on farm	2021	56% of farmers	-15% from 2020	
	Crop yield (wheat)	2020	7 t/ha	-21% from 2019	
	Number of livestock	2020	47 million; CCC benchmark: 50	-2% from 2019	
Food production and consumption	Consumption of meat	2019	600 g/person/week; CCC benchmark: 640	-2% from 2018	

Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.

Notes: All values are rounded to 2 significant figures; solid lines represent pathways; points represent in-year benchmarks; dotted lines show the linear rate of change required to meet in-year benchmarks; indicators are for the UK unless indicated otherwise; ¹England only; ²Restoration in 2020/21 funded by the Nature for Climate Fund (England), Scottish Government funding administered by Peatland Action, and the National Peatlands Action Programme (Wales); ³CCC pathway trajectory to reach 67 kha/year by 2025; ⁴England only.

Livestock numbers have plateaued over the last decade having declined by 27% overall since 1990.

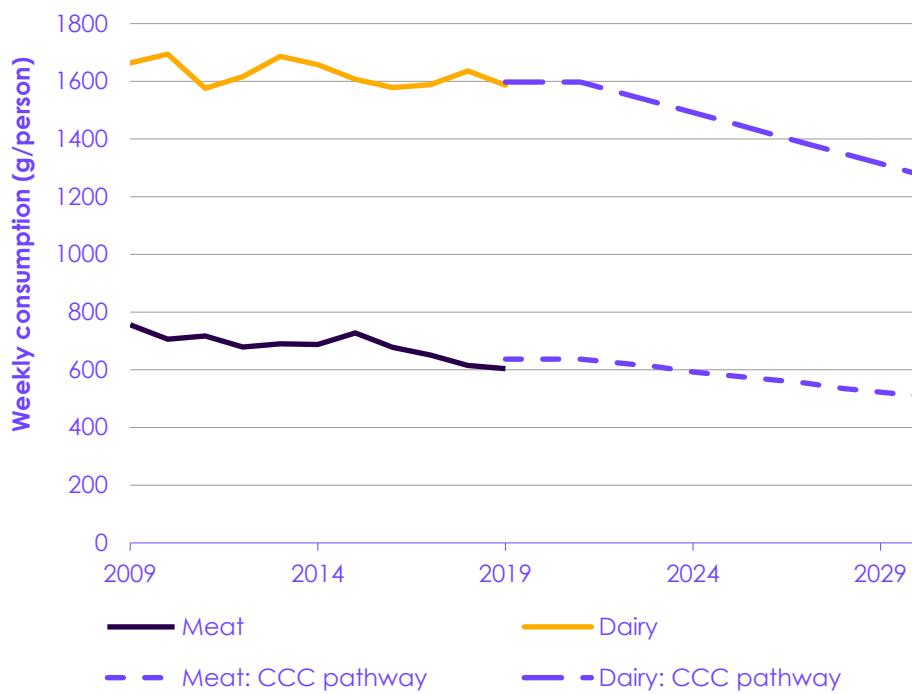
Figure 8.14 Livestock numbers in the UK (1990 – 2020)



Source: Defra (2022) Agriculture in the United Kingdom 2020; CCC analysis.

Consumption of meat has reduced from 756 to 604 g /person/week during the decade 2009 – 2019.

Figure 8.15 Weekly meat and dairy consumption in the UK (2009 – 2019)

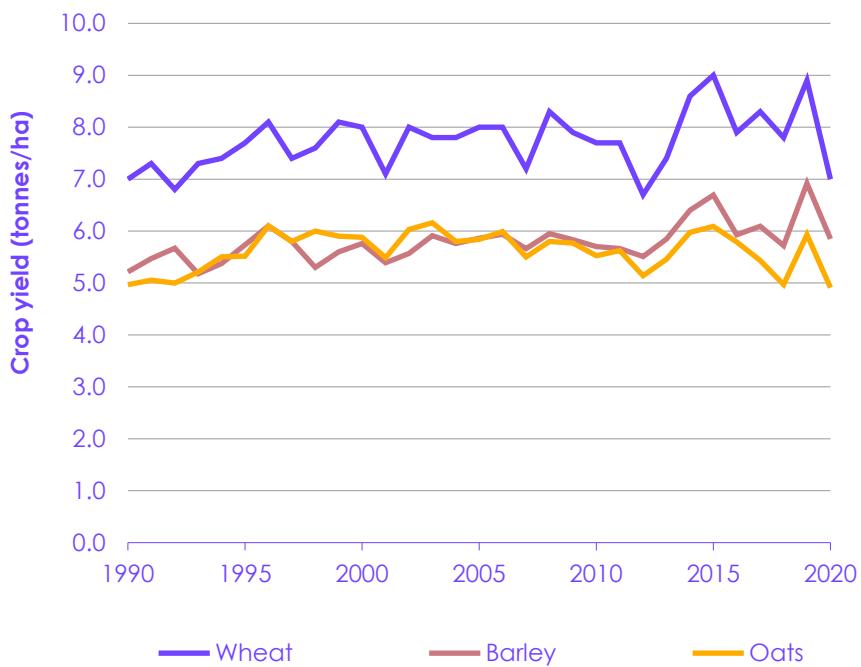


Source: PHE (2020) NDNS: results from years 9 to 11 (2016 to 2017 and 2018 to 2019); CCC analysis.

Notes: Meat consumption includes all processed and unprocessed meat and poultry: pork, lamb, beef, chicken, turkey etc. Dairy consumption includes all milk, and milk products such as yoghurt and cheese, all in grams. Historical data is only currently available until 2019.

Crop yields need to increase to support the release of land from agriculture. Yields of wheat, barley and oats have remained static over last two decades, with a decline recorded in 2020.

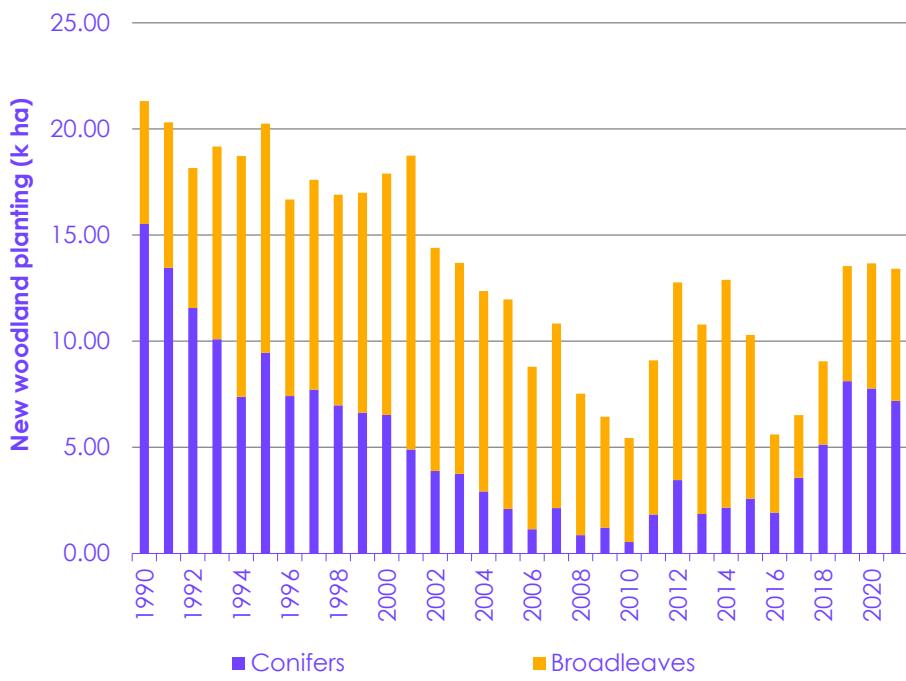
Figure 8.16 Yields of wheat, barley and oats in the UK (1990 – 2020)



Source: Defra (2022) *Agriculture in the United Kingdom 2020*.

Planting rates remain well below the UK Government's commitment, needing to reach 30,000 hectares/year in 2025. A mix of broadleaf and conifer planting is needed to support biodiversity, timber production, climate resilience and other environmental outcomes.

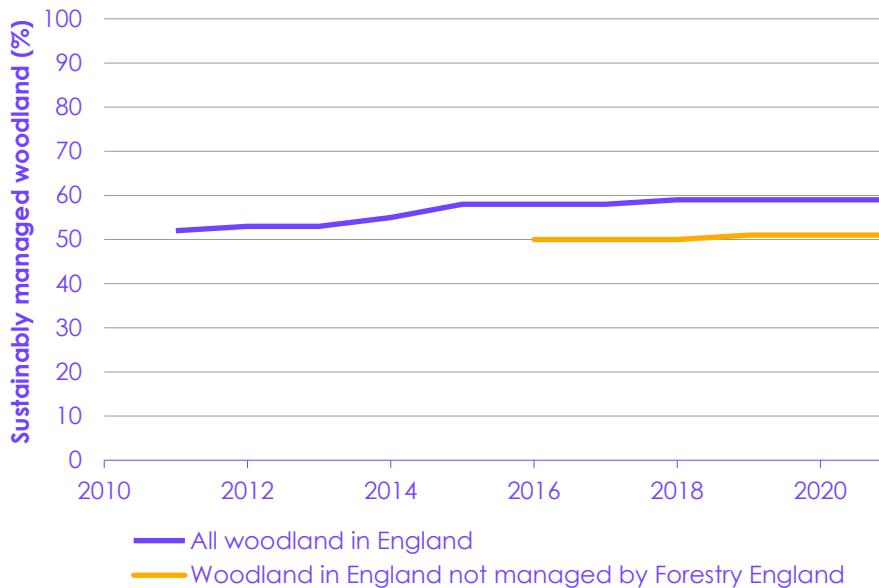
Figure 8.17 UK broadleaf and conifer planting (1990 – 2020)



Source: Forest Research (2021) *Forestry Statistics 2021*.

The sustainable management of woodland is important for ongoing carbon sequestration, biodiversity, and climate resilience, but has flatlined in recent years.

Figure 8.18 Sustainable management of woodland in England (%) (2011 – 2021)

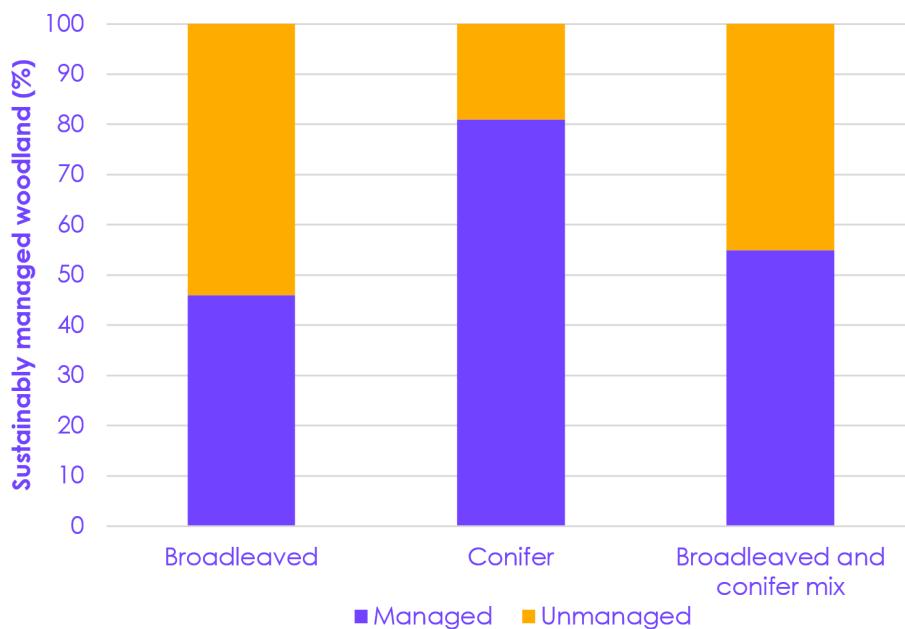


Source: Forestry Commission (2021) *Forestry Commission Key Performance Indicators: Report for 2020-21; 2021 breakdown* provided by the Forestry Commission.

Notes: Sustainably managed according to the Forestry Commission definition: 'woodland managed to the UK Forestry Standard that has a Woodland Management Plan, or for which the Forestry Commission have made a previous grant of felling licence in the last 15 years. It also includes all woodland in the nation's forests managed by Forestry England and all woodland on Defence Infrastructure Organisation training areas.'

Our Balanced Pathway requires 80% of broadleaf woodland under sustainable management by 2030, but in 2021 just 46% was managed in this way.

Figure 8.19 Sustainable management of woodland in England (%) – Breakdown by woodland type (2021)

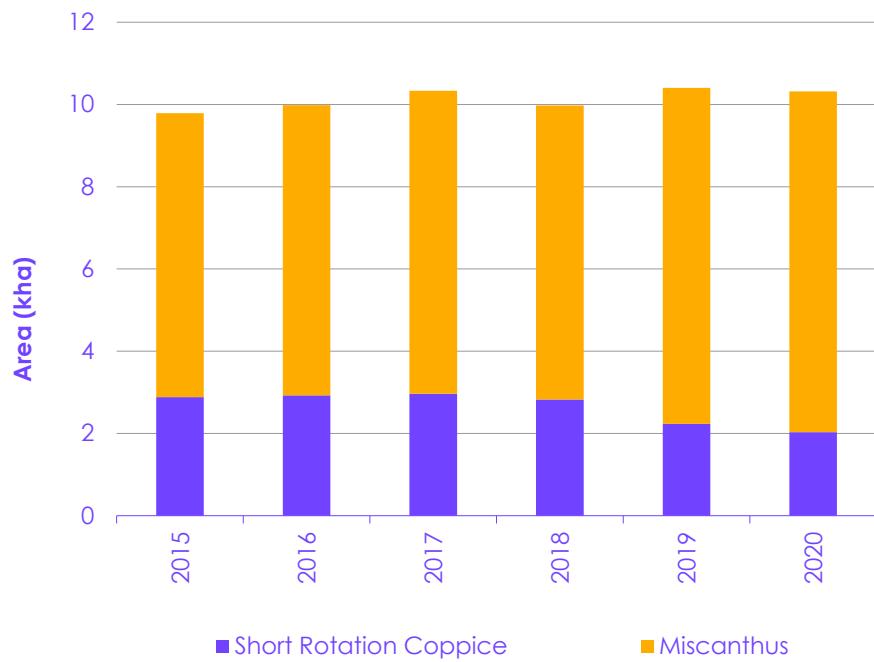


Source: Forestry Commission (2021) *Forestry Commission Key Performance Indicators: Report for 2020-21; 2021 breakdown* provided by the Forestry Commission.

Notes: Sustainably managed according to the Forestry Commission definition: 'woodland managed to the UK Forestry Standard that has a Woodland Management Plan, or for which the Forestry Commission have made a previous grant of felling licence in the last 15 years. It also includes all woodland in the nation's forests managed by Forestry England and all woodland on Defence Infrastructure Organisation training areas.'

The total area of perennial energy crops (miscanthus and short rotation coppice) remains constant at around 10,000 hectares. Planting rates need to reach 30 kha by 2035.

Figure 8.20 Area of perennial energy crops – England (2015 – 2020)



Source: Defra (2021) *Area of crops grown for bioenergy in England and the UK: 2008-2020*.

3. Policy progress, assessment and next steps

This is a pivotal period for the agriculture and land use sectors as the UK continues to navigate leaving the EU CAP. Since the Committee's last Progress Report, information has been released regarding development of agricultural subsidies and land management schemes following CAP reforms, but this remains incomplete and lacks detail.

The agriculture and land use sectors do not have a dedicated Net Zero delivery plan or strategy. This is particularly problematic given the overlap with other key goals, and the importance of both UK and devolved policy. A strategy is urgently required to navigate the complex policy landscape and transition period to ensure that land is managed to deliver for food security, climate, biodiversity, and other environmental objectives.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

Productivity and low-carbon farming practices

The new Environmental Land Management schemes have begun to open in England, including the Sustainable Farming Incentive which aims to be open to all farmers and land managers.

In England the new Environmental Land Management (ELM) schemes have begun to open to applicants to begin the transition from EU land-based subsidy payments to "public money for public goods".

- The Sustainable Farming Incentive (SFI) focuses on agricultural activities. It will pay for actions that all farmers can choose to take while keeping land in production. Currently only a restricted range of standards and levels are available relating to soils, moorland and rough grazing and animal health, with others being released over 2022-2024 in advance of the national roll-out in 2025. However, ELM schemes have suffered from delays and the lack of detail so far has received criticism from both agriculture and environment stakeholders.
- The legacy agri-environment Countryside Stewardship scheme has had payment option rates increase by an average of 30% in 2022. This is to increase applicants to the scheme and support farm transition as the Basic Payment Scheme is phased out. The legacy scheme saw a 40% increase in applicants in 2021, reflecting both the raised payment rates but also uncertainty felt regarding the ELM schemes.
- The Farming Investment Fund was launched in England in late-2021. It provides grants with the aim of sustainably improving productivity and associated environmental benefits.

Improvement in the production of food and fibre alongside measures addressing consumption are needed to deliver necessary land use changes while maintaining food production.

Delivering deep emissions reduction in the land sector will require a transformation in the way land is used. To achieve this as well as maintaining a strong food production sector will require some land to be released from its current use. This can be achieved through improved productivity and a shift away from animal products:

- Productivity improvements support climate change mitigation by enabling the same level of food and fibre production, while using less inputs and reducing the area of land required.
- Demand measures (such as promoting a shift to low-carbon diets), release land from agriculture which can then be used for carbon sequestration measures.
- Agroecology represents an alternative farming approach, a less intensive system that is based on utilising natural interactions and reducing external inputs to support food production, whilst restoring ecosystem services and building resilience to climate change. We have commissioned work to assess its potential application to reduce emissions from the UK agriculture sector (Box 8.1).
- The Government's Net Zero Strategy is highly reliant on productivity measures to reduce emissions from the agriculture sector, setting out that around 7 MtCO₂e of reduction could be achieved by 2035. Without addressing the associated demand-side measures (see Demand and consumption – below) this is ambitious, and more clarity is required to assess how this will be achieved.

Replacements for the Common Agricultural Policy in the devolved administrations are at different stages of implementation.

The devolved administrations have committed to maintain the CAP subsidy system until at least 2023, while developing their plans for the future.

- Scotland's Climate Change Plan update⁸ (2021) set out a high-level vision of future agriculture policy, with elements including maximising the take-up of low-carbon farming practices, innovation in food and use of fertilisers, improving productivity, and contributing to climate and wider environmental and biodiversity targets. However, more detail is required on how these will contribute to emissions reduction.
- In February 2022 Scotland enacted in law a national Nitrogen Balance Sheet which will set out a baseline figure for how efficiently nitrogen is used compared with losses to the environment. This will be reviewed and updated at regular intervals to help track progress on improving nitrogen use efficiency.
- The Welsh Government has announced that Glastir Connect, the sustainable land management scheme in Wales, will receive funding to allow its extension until December 2023. A full roll-out of the replacement Sustainable Farming Scheme is expected in 2025. The Welsh Agriculture Bill is expected to be laid before the Senedd in 2022.
- In March 2022 Northern Ireland announced its Future Agricultural Policy. Delivery and incentive details are to be developed, but the policy sets out the commitment to maintain subsidy support via a Farm Sustainability Payment, Farming for Carbon measures to incentivise low-carbon farming practices, Beef Sustainability Package to increase efficiency in the beef sector, and the intention to develop a Farming with Nature package to protect and restore habitats and species.

- Northern Ireland passed a Climate Change Bill in early 2022, setting a target of Net Zero greenhouse gas emissions by 2050. Reductions in methane emissions, significant in agriculture, are given special protections in the new legislation and are restricted to 46% by 2050. Agriculture in Northern Ireland will still need to deliver substantial sectoral emissions reduction through widespread adoption of low-carbon farming practices and increased farm productivity.⁹

Trees and woodland

Despite the UK's ambitious afforestation targets, there remains uncertainty about delivery due to long-term funding concerns and non-financial barriers.

The last year has seen raised ambition, new schemes and short-term funding for afforestation. However, there remain doubts whether the UK and devolved governments have the plans and tools in place to achieve afforestation targets.

- The Nature for Climate Fund is the main source of public funding to meet England's woodland creation target to 2025. The Nature for Climate budget was raised from £640 million to £740 million for the period 2021 – 2024. Over £500 million of this is now assigned to woodland grants. Longer-term funding plans beyond 2025 are less clear.
- Non-financial barriers include insufficient mapping to inform effective planting, tree nursery capacity, shortfall of skilled workers and strategic planning to increase domestic timber production.¹⁰
- In March 2022 the Government launched the consultation for the Environment Act targets. There is a target to increase tree canopy and woodland cover from 14.5% to 17.5% of total land area in England by 2050, an increase on the current ambition to increase woodland cover in England from 10% presently to 12% of total land area by 2060. The introduction of the term 'canopy', however, makes direct comparison difficult; further transparency is required.
- The Scottish Government has announced £150 million in funding for forestry to support an increase in tree planting to 18,000 hectares per year by 2024/25. Scottish Forestry are to receive £100 million to increase new tree planting and Forestry and Land Scotland has been allocated £30 million to expand Scotland's national forests and woodland. £20 million is allocated to increase tree nursery capacity.
- The Welsh Government launched the Woodland Creation Planning Pilot in 2021 which offers grants for the development of new woodland creation plans. Application to this scheme is a precursor to future public incentive support for tree planting. The National Forest for Wales also launched the Woodland Investment Grant, with a £2.5 million budget (in 2021/22) for the creation and improvement of woodlands accessible to the public.

Peatlands

The restoration and sustainable management of peatlands is supported by funding across the UK. However, ambition is not yet matched by effective delivery, and progress has been slow.

Progress in peatland restoration and banning peat extraction has been slow across England and the devolved administrations.

- In England the main funding incentive for peatland restoration at scale remains the Peatland Grant Scheme within the Nature for Climate Fund which runs until 2025. Beyond this it is envisioned that the new ELM scheme will be the principal delivery mechanism from 2025, along with blended private finance, both of which are yet to be set out in detail.

- The Peatland Grant Scheme, administered by Natural England, aims to set 35,000 ha of degraded peatland on a restoration trajectory by 2025 and reduce emissions from peat by 9 MtCO₂e by 2050. The area under the Peatland Grant Scheme targets both lowland and upland peatland restoration at a ratio of 15:85 respectively. The area under restoration by 2025, if achieved, represents only a small proportion of peatland in England (around 5%). It is unclear if a target will be set after 2025.
- Scotland and Wales have programmes in place that aim to address the restoration of peatlands:
 - The Scottish government has pledged £250 million over ten years to restore 20,000 ha of degraded peatland annually, and 250,000 ha by 2030. So far, this target has been missed, and an increase in effective action to meet it is urgently needed.
 - The Welsh Government published the National Peatland Action Programme in 2020, which aims to deliver 600 – 800 ha of restoration management annually. Grants are available to support land managers.
- Peat restoration in Northern Ireland is behind progress being made across the rest of the UK, and it remains the only nation without a dedicated peat strategy. In June 2021 DAERA launched the consultation on a Northern Ireland Peatland Strategy spanning 2021–2040, which sets out identified actions to conserve and restore peatlands. Formal decisions on the strategy are expected in 2022.
- Lowland peatlands under agricultural management are currently not represented under the new ELM scheme or baseline regulation. In 2021, Defra convened the Lowland Agricultural Peat Task Force to develop recommendations on water management, new management approaches such as paludiculture (farming with high water-levels) and innovation in technology to support economically viable and sustainable farming systems on peat soils. The Taskforce is due to report in Summer 2022.
- Peat extraction is a highly degrading practice and progress addressing this has been slow across England and the devolved administrations.
 - In December 2021, Defra launched the horticultural peat extraction consultation which will ban the retail sale of peat in horticulture in England and Wales by 2024, and by 2028 in the professional horticulture sector. The changes do not affect current licences for peat extraction or seek to mandate the restoration of extraction sites, leaving them vulnerable to continued degradation.
 - In Scotland, the proposed fourth National Planning Framework states that 'new commercial peat extraction, including extensions to existing sites, should not be supported' but lists several caveats where it may continue.
 - Peat extraction continues in Northern Ireland, though the recent strategy consultation has indicated the possible phase-out of the use, import and sale of peat compost in Northern Ireland by 2025, and an intent to explore the potential for a ban on peat extraction on all publicly owned land by 2022.

Energy crops and biomass

The role of biomass in Net Zero commitments is expected to be set out in the 2022 Biomass Strategy.

The UK will need to sustainably increase production of perennial energy crops and short rotation coppice in order for biomass to play a full sustainable role in meeting Net Zero commitments.

- The UK Government is set to release a new Biomass Strategy in 2022, building on the 2012 Bioenergy strategy, where it will coordinate across government departments to assess how biomass should be sourced and used across the economy to contribute best to Net Zero. The Committee recommended this as a priority action in our June 2021 Progress Report.
- A Biomass Policy Statement¹¹ was released in November 2021 as a precursor to the strategy. In it the Government reiterates the commitment to using only sustainable biomass, derived from either domestic or international sources. The statement signposts to the 2022 Biomass Strategy for several key details, including the scale of future domestic supply.

Wider land use policy

New schemes have been proposed for habitat restoration and a UK Government consultation includes a target for wildlife-rich habitat extent.

New schemes and targets have been proposed for habitat restoration that will have emissions implications. These either are expected to be small or have not yet been quantified.

- The first round of applications under the Landscape Recovery scheme, one of the three ELM schemes, was launched in January 2022.
 - The scheme is open to individuals and groups working at scales of 500 –5000 ha, funding will be provided to cover initial planning, alongside long-term management support (20 years and above) if projects progress to the delivery stage.
 - Up to 15 pilots will be set up over 2022–2024, and outcomes of the scheme include delivery of 20,000 ha of restored habitat, saving around 0.1-0.2 MtCO₂ emissions per year by 2024.¹²
- The Local Nature Recovery scheme, also under ELM, will target conservation actions in farmed landscapes replacing the Countryside Stewardship Scheme. Despite its launch scheduled for 2025, Defra is yet to estimate outcomes of the scheme or provide scheme rules and payment rates.
- The Government consultation on Environment Act targets includes one for habitat extent: create or restore in excess of 500,000 ha of a range of wildlife-rich habitats outside protected sites by 2042, compared to 2022 levels. Depending on the baseline, habitat restoration and creation could offer an effective nature-based solution for climate mitigation. If targeted effectively, land-use change from a degraded habitat to a functioning one will support sequestration and protection of carbon, alongside biodiversity and other environmental benefits. In the absence of an overarching land use strategy, it is unclear how this target overlaps with others (e.g. for tree planting and peatland restoration).

Carbon in marine and coastal ecosystems is not currently included in the UK's GHG inventory. In March 2022 we released a briefing on 'Blue Carbon'¹³ which looked at the evidence on the potential for carbon contained in coastal and marine ecosystems to contribute to climate mitigation and the associated benefits, such as for climate adaptation and biodiversity (see recommendations in section (c); Box 8.2.). The briefing sets out four recommendations to the Government, including inclusion of blue carbon in the GHG inventory, improvements in monitoring, protection and restoration of marine areas, and the consideration of blue carbon in land policy.

Demand and consumption

The Government Food Strategy does not set out clear targets or a vision for a sustainable food system.

Domestic emissions reduction should not be at the expense of increasing commodity imports that risk carbon leakage and higher consumption emissions. That is a risk if efforts to reduce emissions or increase sequestration in the UK lead to reductions in food production that are not matched by demand-side changes in UK food consumption or reductions in food waste.

There is minimal UK policy targeting the demand side at present:

- The Government Food Strategy,¹⁴ a response to the independent review of the UK food system delivered in 2021, was published as this report was being finalised. Our initial assessment is that it falls short of what is required to tackle emissions from agriculture, land use and food production, and to create a sustainable food system. There remains a lack of clear targets and strategy regarding the food system's impact on health, nature and climate.
- While the Net Zero Strategy and the Government Food Strategy do not address dietary shifts to low-carbon alternatives, there is evidence that consumer trends are moving in that direction. Meat consumption has fallen consistently since 2015, with an increase of people reporting regular consumption of plant-based alternatives. Local authorities are implementing their own policy in this area, with councils going plant-based at catered events and the School Plates programme supporting 25 school caterers to provide plant-based meals to over 2,500 schools.^{15,16}
- In Net Zero Wales the Welsh Government has a proposal to 'develop a long-term strategy to promote a dietary shift to a healthier and suitable diet' recognising the benefits for climate, health and wider sustainability.¹⁷ This is unique across the four home nations.
- The Environment Act 2021, passed into law in November 2021, prohibits larger UK businesses from using commodities, such as beef, leather, cocoa, coffee, rubber, palm oil, soy and maize produced on land associated with large-scale deforestation and not in accordance with local laws, with the aim of mitigating overseas deforestation driven by UK actions. Business will need to undertake and report on an annual due diligence exercise on their supply chains. The UK Government consulted on these provisions in March 2022. The equivalent risk for commodities from legal deforestation, and those derived from ecosystems other than forests, are not addressed by Government policy.

Reducing food waste is cost and resource efficient for consumers. It could reduce agricultural emissions by reducing the need for food production, alongside releasing agricultural land to measures that sequester carbon. It would also reduce emissions downstream (e.g. from avoided emissions from landfill), which is covered in the Waste chapter (chapter 11) of this report.

Food waste mostly occurs at household level, as well as on-farm and through the supply chain. Policy to reduce food waste was limited in the Government Food Strategy to a consultation on improved food waste reporting for large food businesses. Therefore, Government policy is still needed on reducing food waste across the food system, from farm to fork.

Box 8.1

Agroecological approaches in UK agriculture

CCC Balanced Pathway for agriculture

Our Balanced Pathway for agriculture is characterised by productivity improvements to both crops and livestock systems and take-up of lower-carbon farming practices:

- Crop yield improvements are achieved through R&D and innovation in crop breeding, better agronomy across all farms and movement of horticulture crops indoors.
- Livestock breeding and focus on low-carbon diets improves productivity and reduces emissions.
- Our scenarios also include measures to reduce GHG inputs on land and improve soil structure and organic matter (e.g. cover crops, grass/legumes mix and grass leys).
- Planting trees on farm and restoring hedgerows also provides a range of benefits aside from climate mitigation.

Agroecology

However, there is an on-going debate about the role of an alternative farming approach towards agroecology, a less intensive farming system that is based on utilising natural interactions and reducing external inputs to support food production, whilst restoring ecosystem services and building resilience to climate change.

In Spring 2022 the CCC commissioned the University of Aberdeen to review a range of agroecological farm practices – such as reduced and minimum tillage, leys, extensive livestock systems and cropping approaches – to assess their impact on GHG emissions, vegetation and soil carbon stocks, and changes to yields. Benefits and trade-offs with regards to resilience and wider environmental objectives were also considered.

Key findings from the work are:

- **Barriers to uptake.** Uptake of agroecological farm practices may be restricted by still-limited scientific knowledge or low practical on-farm experience. Significant investment, training and re-design of the farm business may be required.
- **Established practices.** However, farming practices that score high in agroecological principles such as rotational cropping, cover crops, legume crops, and permanent pastures are already well integrated in the UK, indicating that there are opportunities to speed the agroecological transition with relatively low investments.
- **Uncertainty.** The response to agroecological farming practices is highly variable. Increases in soil carbon are commonly reported, but significant knowledge gaps remain in understanding the net impact on GHG emissions, while productivity at farm level may be reduced.
- **Wider benefits.** If effectively targeted, agroecological approaches can deliver multiple benefits beyond climate change mitigation, including soil health, biodiversity, water quality, air quality, and climate resilience.

Further work

Some agroecological approaches have been included in CCC scenarios but there needs to be a more robust assessment of the potential for more widespread adoption of less intensive farming systems.

Particular areas where evidence needs strengthening are:

- Modelling of the impacts of high/low input agriculture systems on yields, land use and food production.

- Changes in methane emissions from adoption of agroecological approaches in ruminant livestock systems.
- The impact of these approaches on wider environmental outcomes including soil health, biodiversity, water quality, the impact of pests and diseases on plants and resilience under a changing climate.

Better evidence on these aspects would enable the CCC to integrate these approaches more fully within mitigation pathways, and to explore trade-offs and synergies between climate, food security and wider environmental objectives. We will continue to monitor evidence in this area and consider agroecology as we assess the role of agriculture in UK emissions abatement.

Source: Albanito et al. (2022)¹⁸

(b) Assessment of policies and plans

The reform of the Common Agricultural Policy is a key opportunity to coordinate policy and targets across the UK.

Agricultural emissions have not fallen during the last decade, while transformational land-use change is required across the UK. The reform of the CAP represents a once-in-a-generation opportunity to coordinate policy and targets, to deliver on the multiple functions society requires from land, including food security, climate mitigation and resilience, biodiversity and wider environmental goals. However, that opportunity currently risks being missed given a lack of detail on subsidy mechanisms and slow progress in wider policy development, including tackling barriers such as on skills.

- Targets and policies remain largely short-term and incomplete across the UK, particularly on subsidy mechanisms that will replace the CAP. Increased detail and commitment over effective time periods to delivery incentives are needed to support land use change approaches to achieve tree and peat targets.
- Limited progress has been made on the CCC's June 2021 Progress Report recommendations relating to the agriculture and land use sectors. Of the 27 recommendations, one has been achieved, eight are underway or making sufficient progress, 13 are partially achieved or have made insufficient progress, and four are not achieved.
 - Afforestation ambition set out across the UK nations aligns to the Government targets until 2035, with an assumed planting increase to 50 kha past this milestone. We have therefore judged the 2021 recommendation to extend woodland creation ambition as achieved. While short-term funding to achieve the ambition is in place, there remain risks in terms of long-term financial support, and the capacity and skills to achieve targets.
 - Of the actions deemed to be partly achieved these relate to the setting of policies and strategies rather than delivery of action on the ground. Recommendations for action to introduce low-carbon farming measures and land-use change are all scored as partially or not achieved.

There has been limited progress on the CCC agriculture and land use recommendations from 2021.

- The Government Food Strategy has not addressed the recommendation to support consumers to adopt low-carbon dietary choices. The Strategy promises trials, information measures and consultations on public procurement in public sector food and catering, but it is unclear how far these will target a shift away from carbon-intensive meat and dairy. This needs to be clarified if these plans are to support individuals to make healthy and sustainable choices sufficiently to drive the changes required at a society level in diet and demand.
- The transition to Net Zero will require those working in the agriculture and land use sectors to have the appropriate skills at the scale required for change. These include increasing capacity to process woodland creation applications, skills in sustainable forestry and peatland restoration and knowledge exchange in low-carbon farm practices to give confidence in their uptake. Government must address this, otherwise a lack of a skilled workforce in these areas will be a significant barrier in achieving targets (e.g. for woodland creation).

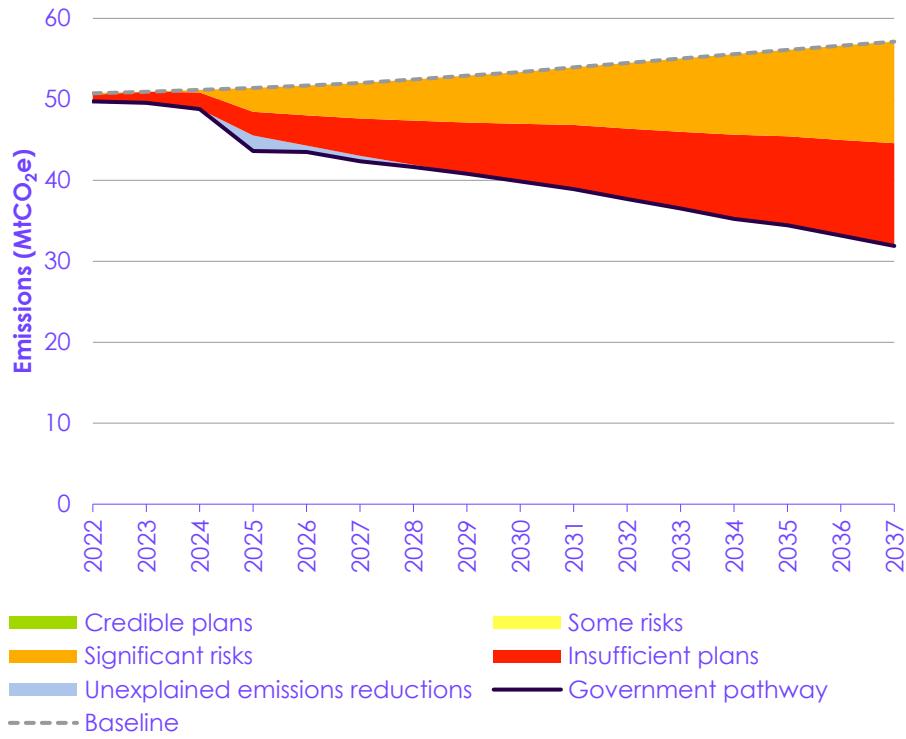
Table 8.2 and Figure 8.21 set out our policy scores and assessment of policies and plans for each abatement category set out in the Government's Net Zero Strategy. The agriculture and land sectors are the worst scored sectors in this report, reflecting the lack of an overall strategy and the lack of detail on key policies, in the context of the need for a huge scale-up in progress.

- For half of the targeted emissions reduction, we have identified significant risks, and for the other half plans are insufficient.
- Diet and demand are not addressed in the Net Zero or Government Food Strategy, and it is unclear how the Government intends to make up the shortfall in emissions abatement from the associated reduction in livestock numbers. While the lack of policy means we cannot score diet and demand in Figure 8.21, we have addressed this in our policy scorecard (Table 8.2).

Our assessment is focused on the risks to delivery of the required emissions reduction. Further shortcomings and gaps are likely to exist in how policy proposals support other objectives, emphasising the need for a coherent strategy to bring these together.

We have identified significant risks and policy gaps across each area of abatement in the agriculture and land use sectors.

Figure 8.21 Assessment of policies and plans for agriculture and land use



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Table 8.2

Policy scorecard for agriculture and land use

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Productivity and low-carbon farming¹ 38% of 2035 abatement	R	R	R	O	R
		<ul style="list-style-type: none"> The limited roll-out of the Sustainable Farming Incentive remains the main delivery incentive for low-carbon farming measures in England. There is some funding for low-carbon farming in the devolved administrations, but gaps remain. Timescales and incentives remain short-term, with scheme detail incomplete. There is a reliance on farmers to voluntarily take up low-carbon farming measures, as well as a high dependency on future technology and innovation. 			
Afforestation 9% of 2035 abatement	Y	Y	O	O	O
		<ul style="list-style-type: none"> Current afforestation targets match the CCC's assessment of what is needed but planting rates currently do not meet the trajectory to hit UK-wide annual targets of 30 kha by 2025. UK targets are reliant on planting action in the devolved administrations, particularly in Scotland, where woodland creation rates are at 12,000 ha/year. Non-financial barriers remain, such as contractual issues preventing tenant farmers from planting on land, nursery capacity, and availability of skills and workers. The Environment Act target consultation contains a target to increase tree canopy and woodland cover from 14.5% to 17.5% of total land area in England by 2050. However, it is unclear how 'tree canopy' is defined, which makes it difficult to assess if this is an increase on previous aspirations. 			
Agroforestry and hedges 11% of 2035 abatement	Y	O	O	O	O
		<ul style="list-style-type: none"> Hedgerow creation and management options are currently delivered by the Countryside Stewardship scheme in England. Sustainable Farming Incentive standards are forecast to be launched for hedgerows and agroforestry in England in 2023 and 2024, respectively. Standard details and payment rates are currently unavailable. While Scotland's Climate Change Plan update does address agroforestry and hedgerows, detail is limited. 			
Peatlands 30% of 2035 abatement	O	Y	O	O	O
		<ul style="list-style-type: none"> Funding for peatland restoration is pledged via the Nature for Climate fund and action across the devolved administrations. However, this is typically short-term and risks that delivery will not meet ambition. Beyond the Nature for Climate scheme in England, there is a high dependency on ELM to deliver peatland restoration from 2025 onwards. However, detail is lacking, particularly for the Local Nature Recovery tier of ELM that will contribute to statutory and departmental targets for nature including peatland restoration. Some regulatory action has occurred, but it does not address peat extraction, restoration of extraction sites, or that lowland peat soils should not be left bare. Furthermore, a significant area of habitats on peatland soils fall outside of burning regulations. 			

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Biomass 12% of 2035 abatement	R	R	R	O	R
<ul style="list-style-type: none"> A Biomass Policy Statement was released in November 2021, reiterating the Government's commitment to sustainable biomass. The Government is yet to set out a clear indication of its exact role and its wider impact on land use and the environment. A Biomass Strategy is due to be published in 2022 which should set out the role that domestic production of perennial energy crops will contribute towards Net Zero. 					
Demand and consumption² No quantified abatement in the Government pathway	R	R	R	R	R
<ul style="list-style-type: none"> The Government Food Strategy does not set out clear targets for the food system's impact on health, nature and climate. Regarding the role of consumers, the Strategy emphasises the role of the individual to make healthy and sustainable choices. Government can influence diet shifts, through mandating plant-based options in public settings and requesting health and education providers to incorporate carbon foot printing in their menus. Capital funding support is to be provided to local authorities to implement free, separate food waste collections from 2025. 					
Overall sector assessment (emissions sources)³	R	O	R	O	R
Overall sector assessment (emissions sinks)⁴	O	O	O	O	O

Notes: ¹ We include stationary machinery within this category; ² The Net Zero Strategy does not include demand and consumption measures in the Agriculture and Land use emission reduction pathway. ³ Within 'sinks' we assess afforestation, agroforestry and hedgerows, and biomass. ⁴ Within 'sources' we assess productivity and low carbon farming, peatlands and demand and consumption.

(c) Recommendations

Due to limited progress, recommendations from last year are repeated, including focus on delivery, CAP reform and diet and demand.

The recommendations in this sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department.

Limited progress by Government since last year means recommendations included in the CCC's 2021 Progress Report are repeated this year:

- **Stronger delivery mechanisms are needed to bring action on land use in line with ambition.** Land-use change targets relating to trees, peat and biomass are not being met. This presents a significant risk due to the time profile of carbon sequestration in natural systems. Our 2022 recommendations repeat past calls for stronger delivery incentives and the unblocking of non-financial barriers to increase the take-up of these measures.
- **Policy detail must back up bold ambitions for CAP reform.** There is a reliance on the CAP replacement schemes to deliver multiple environmental objectives, including land and agriculture measures for climate. Available scheme detail and incentives focus on the short term, with elements of the schemes largely still in development. Further detail is urgently needed to assess if the agricultural transition will meet the scale of change required.
- **Diet and demand should not be ignored.** Addressing the UK food system and reducing the demand for high-carbon diets is an integral part of the CCC agriculture and land sectors' pathway to Net Zero. We repeat our recommendation for the Government to set out clear policy to address the interaction between food systems, climate and nature, detailing how the 'sustainable, nature positive, affordable food system' in the Government Food Strategy will be achieved.

New recommendations this year focus on coordination of measures, timber and trade data to facilitate action on consumption emissions, supporting a just transition across these sectors and blue carbon.

Alongside our recommendations still standing from last year, we include several new recommendations:

- **Strategy and coordination.** A combined strategy for agriculture and land use is urgently needed to bring together ambition and delivery mechanisms in these sectors across the UK. The ambition that has been set is high, and currently not being achieved. Policy and delivery measures must be coordinated across the UK to ensure effective spatial and temporal targeting of measures. Within the Government Food Strategy, the Government has promised a land use framework in 2023. It should be a comprehensive plan that sets out:
 - How land can deliver its required multiple functions, including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, and wider environmental goals. Currently these goals are scattered over multiple Government documents, missing or unclear. They should be brought together and filled out, with a clear vision for what they collectively imply for UK land use.
 - How these multiple objectives can be met without increasing stresses on land or leading to carbon leakage by increasing imports. Productivity improvements can help but may be challenging to achieve as the climate changes.

The Committee's analysis emphasises the importance of the demand-side, particularly the potential to release land through reduced meat and dairy consumption and production.

- How the UK and devolved governments will collectively ensure that new arrangements are coherent, co-ordinated and consistent. The multiple objectives can be complementary but risk running into conflict with each other if policies are developed separately in siloes. The transition from the CAP is a once-in-a-generation opportunity to improve policy across agriculture and land at a national scale that is in danger of being missed.
- How the UK and devolved governments will collectively act to enable positive changes to occur. Key enablers include: innovation support; information, training and skills; funding and access to finance; support for tenant farmers.
- **Timber.** Woodland creation is an important net sink of emissions in the UK. Government must work with the forestry sector and other stakeholders to ensure that domestic production of trees can meet the planting ambition. Where appropriate, the long-term economic viability of domestic commercial forestry should be supported by policies to encourage the production and use of UK-sourced timber in construction.
- **Trade data.** Delivering emissions reduction should not be at the expense of increasing food and commodity imports that risk carbon leakage and higher consumption emissions or damaging other environmental objectives (see the Chapter 14 section on Trade, Carbon Leakage and Reducing Consumption Emissions). Government should develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application via due diligence or at the border. The first step towards this should be to improve data collection and standardise methodologies on the environmental impacts of food across different countries.
- **Just transition.** The transition to Net Zero in the agriculture and land use sectors will affect employment in the sector with new and different skill requirements needed by the workforce. These are expected to include an increase in employment required for afforestation and peatland restoration, expansion of the knowledge base for low-carbon farming measures and the development of new areas such as sustainable proteins. This transformation should be managed to be fair and equitable, with opportunities to gain new skills widely available, and planned to facilitate the transition.
- **Blue carbon.** Marine and coastal ecosystems have implications for UK greenhouse gas emissions. Following the Committee's briefing on Blue Carbon in March 2022¹⁹ we recommend that saltmarsh and seagrass should be included in the UK GHG inventory (Box 8.2).

Blue carbon is not currently included in the UK's GHG inventory. The restoration and creation of saltmarsh and seagrass ecosystems is likely to yield an additional GHG abatement of below 1 MtCO₂e/yr, as well as underpinning a range of wider benefits.

Box 8.2

Carbon in marine and coastal ecosystems

Blue carbon is defined as marine and coastal carbon which can be managed to contribute to greenhouse gas (GHG) mitigation. In the UK, saltmarsh and seagrass fall into this category. A recent CCC blue carbon briefing evaluated the potential for these ecosystems to contribute to climate mitigation and considered the associated benefits, such as for climate adaptation. It was assessed that restoration and creation of saltmarsh and seagrass ecosystems is likely to yield an additional GHG abatement of well below 1 MtCO₂e/yr. This is small compared to total UK emissions, and actions to pursue this abatement should be proportionate to its scale.

In addition to their carbon value, these ecosystems deliver a wide array of co-benefits, such as mitigating flood risk, biodiversity, water quality, fisheries and tourism. Effective management of these ecosystems is critical to protect and enhance these benefits, and to build resilience to the numerous and severe risks these ecosystems face from climate change.

The briefing made four recommendations for the Government:

- Produce a roadmap to inclusion of saltmarsh and seagrass in the UK GHG inventory.
- Encourage efforts to monitor the extent, condition and functioning of marine and coastal ecosystems.
- Continue strengthening protection and restoration in marine areas, including support for sustainable management.
- Recognise the interaction of marine and coastal ecosystems with wider catchments in the design of initiatives to replace the CAP.

Blue carbon is not currently included in the UK's GHG inventory. There remains significant uncertainty in quantifying the contribution of marine and coastal ecosystems to carbon stores and sequestration in the UK. However, the link between management of these ecosystems and GHG emissions is most clear for saltmarsh and seagrass ecosystems. We therefore make a recommendation, carried over into this report, for the inclusion of saltmarsh and seagrass in the UK GHG inventory.

Source: CCC (2022) Briefing: Blue Carbon.

4. Major risks

The agriculture and land sectors face inevitable risks from the changing climate, which should be better managed. More generally, the need to engage a large number of individual farmers and land managers who themselves face multiple pressures creates an inherent risk, which is currently exacerbated by a lack of policy detail.

Risks to emissions reduction have been heightened by the Government's reluctance to consider options on the demand side (e.g. diets and waste), which also risk missing co-benefits such as better health. And the lack of a comprehensive strategy introduces further risks that the various objectives for land come into conflict and that policies are developed in siloes leading to undesirable outcomes. These risks, and actions to mitigate them, are set out in table 8.3.

Table 8.3

Major risks and required mitigating actions for agriculture and land use

Risk category	Description	Mitigating actions	
		Details	In place?
Absence of a comprehensive land use strategy that takes account of climate, food and wider environmental goals.	<ul style="list-style-type: none"> The Net Zero Strategy sets out widespread changes to land use, particularly for peatland restoration and afforestation. However, it does not assess how climate measures interact with other key land objectives such as food security, biodiversity, and other environmental services, leading to risks that optimal use of land will not be achieved, and of unintended consequences (e.g. widespread conifer plantations in inappropriate geographies). 	<ul style="list-style-type: none"> A comprehensive UK land use strategy is urgently needed to provide confidence that all objectives for land can be met. This should set out key geographies where climate measures are best delivered, delivering multiple outcomes such as benefits for flood prevention, water and soil health and biodiversity. The UK Government should co-ordinate this together with the devolved administrations. 	No
Farmers and landowners do not take up mitigation measures at the scale needed.	<ul style="list-style-type: none"> The ELM scheme in England and corresponding CAP replacement proposals across the devolved administrations are incomplete and lack transparency. Schemes are voluntary and present significant risks that farmers will not be willing to take up measures at the scale and timings needed to achieve land transformation across the sector. 	<ul style="list-style-type: none"> Post-CAP regimes across the devolved administrations need to set out a clear and stable pathway to enable farmers to make long-term investment decisions to deliver transformative land use change. Greater detail and clarity on all elements are required, including the role of private investment, and how finance and incentives will be stacked. 	Partly

Over reliance on technology and innovation, with demand side measures lacking.	<ul style="list-style-type: none"> The Government pathway for agriculture relies on innovation and technological approaches to low-carbon farming and productivity improvements. The lack of detail on these and our own assessment suggest these are highly optimistic. There is no ambition to shift diets away from the most carbon intensive foods such as meat and dairy. Action on this will also have co-benefits to health. Without changes in how land is used, it is not clear where the main land mitigation measures will sit alongside food production. 	<ul style="list-style-type: none"> Demand side measures should be integrated into the agriculture mitigation pathway, alongside innovation and technological approaches. The Government should set out policies and plans for reducing meat and dairy consumption, including the role of the public sector, industry, and consumers. The Government commissioned Independent National Food Strategy and the Net Zero Wales report indicates willingness in this area. 	No
Risks to the carbon storage and sequestration capacity of the natural environment.	<ul style="list-style-type: none"> Carbon storage and sequestration by soils, trees, wetlands, and the marine environment are at risk from anthropogenic and climate pressures.²⁰ Hotter and drier conditions will limit carbon sequestration by woodlands and threaten the existence of peatlands. Natural systems are also at risk from wildfire, waterlogging, drought risk and impacts from pests, diseases and invasive non-native species. Restoring and maintaining these natural carbon stores is critical to delivering the net removal of CO₂ from the atmosphere needed on the path to Net Zero by 2050. 	<ul style="list-style-type: none"> Understanding risks to land-based carbon stocks should form part of a comprehensive UK land use strategy (see above). Targeted actions to protect existing and restore degraded carbon stores, and appropriately sited measures (e.g. 'the right tree in the right place'), are needed to help build resilience of natural systems to changing climatic conditions. Government should support the agriculture and forestry industries to take an adaptive approach, considering the potential of new varieties of crops, trees and land management approaches that are climate resilient. 	No

Endnotes

- ¹ Defra, DAERA, Welsh Government and The Scottish Government (2021) *Agriculture in the UK*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1056618/AUK2020_22feb22.pdf.
- ² Forest Research (2021) *Forestry Statistics 2021*, https://cdn.forestresearch.gov.uk/2022/02/complete_fs2021_jvyjbwa.pdf.
- ³ BEIS (2022) *UK Greenhouse Gas Inventory 1990 to 2020: Annual Report for submission under the Framework Convention on Climate Change Annex 3*. <https://unfccc.int/documents/461922>
- ⁴ Defra (2021) *Farm practices survey February 2021 - greenhouse gas mitigation practices*, <https://www.gov.uk/government/statistics/farm-practices-survey-february-2021-greenhouse-gas-mitigation-practices>.
- ⁵ Alae-Carew et al. (2022) *The role of plant-based alternative foods in sustainable and healthy food systems: Consumption trends in the UK*, <https://pubmed.ncbi.nlm.nih.gov/34673070/>.
- ⁶ Defra, DAERA, Welsh Government and The Scottish Government (2021) *Agriculture in the UK*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1056618/AUK2020_22feb22.pdf.
- ⁷ CCC (2020) *The Sixth Carbon Budget – The UK's path to Net Zero*, <https://www.theccc.org.uk/publication/sixth-carbon-budget/>.
- ⁸ Scottish Government (2021) *Securing a green recovery on a path to net zero: climate change plan 2018–2032 – update*, <https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/documents/>.
- ⁹ CCC (2022) *Letter: Northern Ireland's Climate Change Bill*, <https://www.theccc.org.uk/publication/letter-northern-irelands-climate-change-bill/>.
- ¹⁰ House of Commons Environment, Food and Rural Affairs Committee (2022) *Tree Planting*, <https://committees.parliament.uk/publications/9364/documents/160849/default/>.
- ¹¹ BEIS (2021) *Biomass Policy Statement*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1031057/biomass-policy-statement.pdf.
- ¹² Defra (2022) *Landscape Recovery: more information on how the scheme will work*, <https://www.gov.uk/government/publications/landscape-recovery-more-information-on-how-the-scheme-will-work/landscape-recovery-more-information-on-how-the-scheme-will-work>.
- ¹³ CCC (2022) *Briefing: Blue Carbon*, <https://www.theccc.org.uk/publication/briefing-blue-carbon/>.
- ¹⁴ Defra (2022) *Government Food Strategy*, <https://www.gov.uk/government/publications/government-food-strategy>.
- ¹⁵ Oxfordshire County Council (2022) *Plant-based food will be served to councillors with further policies to be developed*, <https://news.oxfordshire.gov.uk/plant-based-food/#:~:text=2022%20Plant-based%20food%20will%20be%20served%20to%20councillors,menus%20to%20be%20worked%20on%20further%20by%20officers.?msclkid=a2f687c6fc011ec82883247be88acdb>.
- ¹⁶ Proveg International (2021) *ProVeg UK 2021 Highlights*, <https://proveg.com/uk/proveg-uk-2021-highlights/?msclkid=ea2f3848cf011eca5d907afb71e6237>.

- ¹⁷ Welsh Government (2021) *Net Zero Wales Carbon Budget 2 (2021 – 25)*, [https://gov.wales/sites/default/files/publications/2021-10/netzero-wales-carbon-budget-2-2021-25.pdf](https://gov.wales/sites/default/files/publications/2021-10/net-zero-wales-carbon-budget-2-2021-25.pdf).
- ¹⁸ Albanito et al. (2022) *Agroecology – a Rapid Evidence Review*. In review.
- ¹⁹ CCC (2022) *Briefing: Blue Carbon*, <https://www.theccc.org.uk/publication/briefing-blue-carbon/>.
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Chapter 9: Aviation

15 MtCO₂e, 3% of UK emissions, in 2021

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Introduction and key messages

Aviation emissions continue to be impacted by the COVID-19 pandemic. We estimate emissions in 2021 to be 15 MtCO₂e, similar to those in 2020, and still 62% below those in 2019. Of these emissions, 89% come from international aviation (with 4% from domestic and 7% from military aviation).

It remains to be seen whether there will be lasting effects on aviation emissions from the pandemic, high oil prices and increasing cost of living. The Government set a pathway to reduce emissions to 15 MtCO₂e by 2050, with the remaining emissions balanced by near-permanent, sustainable greenhouse gas removals. However, a full strategy on aviation has yet to be released, with the Government's Jet Zero Strategy due to be published in July 2022.

This Chapter reviews progress in reducing emissions from the UK aviation sector and outlines our recommendations for delivering the Government's aviation pathway and meeting future carbon budgets.

Our key messages are:

- **Reliance on technology.** Thus far, the Government's pathways for aviation in the Net Zero Strategy and Jet Zero Strategy rely heavily on technological changes in aviation as the sector's contribution to Net Zero and for the removal of the sector's residual emissions. This differs from the CCC's Balanced Pathway, which also limits demand growth alongside technological improvements. Such heavy reliance on technology presents significant risks that aircraft efficiency improvements and sustainable fuels will under-deliver on emissions savings. Much of the delivery of emissions reduction in the Government's pathway requires global cooperation, joint innovation and alignment.
- **Constraining demand.** The Government's announcements on aviation to date have not set any ambition to constrain aviation demand growth through policy, beyond vague proposals on carbon pricing, despite demand measures being one of the few interventions that lowers both CO₂ emissions and non-CO₂ effects from aviation. Given the risks outlined above, as well as risks of under-delivery on emissions reductions in other sectors, the Government should actively develop the option to implement policy to manage aviation demand.
- **Policy developments.** There have been funding announcements on the development of Sustainable Aviation Fuel (SAF) plants, low-emission aircraft technology, and a UK SAF clearing house. The Government has consulted on implementing a SAF mandate, options to reduce non-CO₂ emissions, and on UK domestic aviation reaching Net Zero by 2040.
- **Sustainable fuels.** The Government's aviation pathway has a high reliance on SAF, with the proposed mandate reaching 10% of fuels by 2030. It is essential that supported fuels deliver genuine significant lifecycle emission savings by then and that the resources used do not have adverse impacts on decarbonisation in other sectors (e.g. land use), in the UK or overseas.

In this chapter we review progress in reducing emissions from the UK aviation sector and outline the next steps required to ensure more progress and meet future carbon budgets. We set out the:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

1. Emissions trends and drivers

International aviation continues to make up the large majority of UK aviation emissions, at 89%.

Overall we estimate that aviation emissions in 2021 were around 15 MtCO₂e, an 8% reduction on 2020 levels (Figure 9.1). This was primarily driven by continuing suppressed aviation demand for the whole of 2021 due to the COVID-19 pandemic, while it was only suppressed for three-quarters of 2020. Emissions in 2021 were 62% below pre-pandemic (2019) levels. In 2021 international aviation continued to make up the large majority (89%) of aviation emissions, with domestic aviation at 4% and military at 7%.

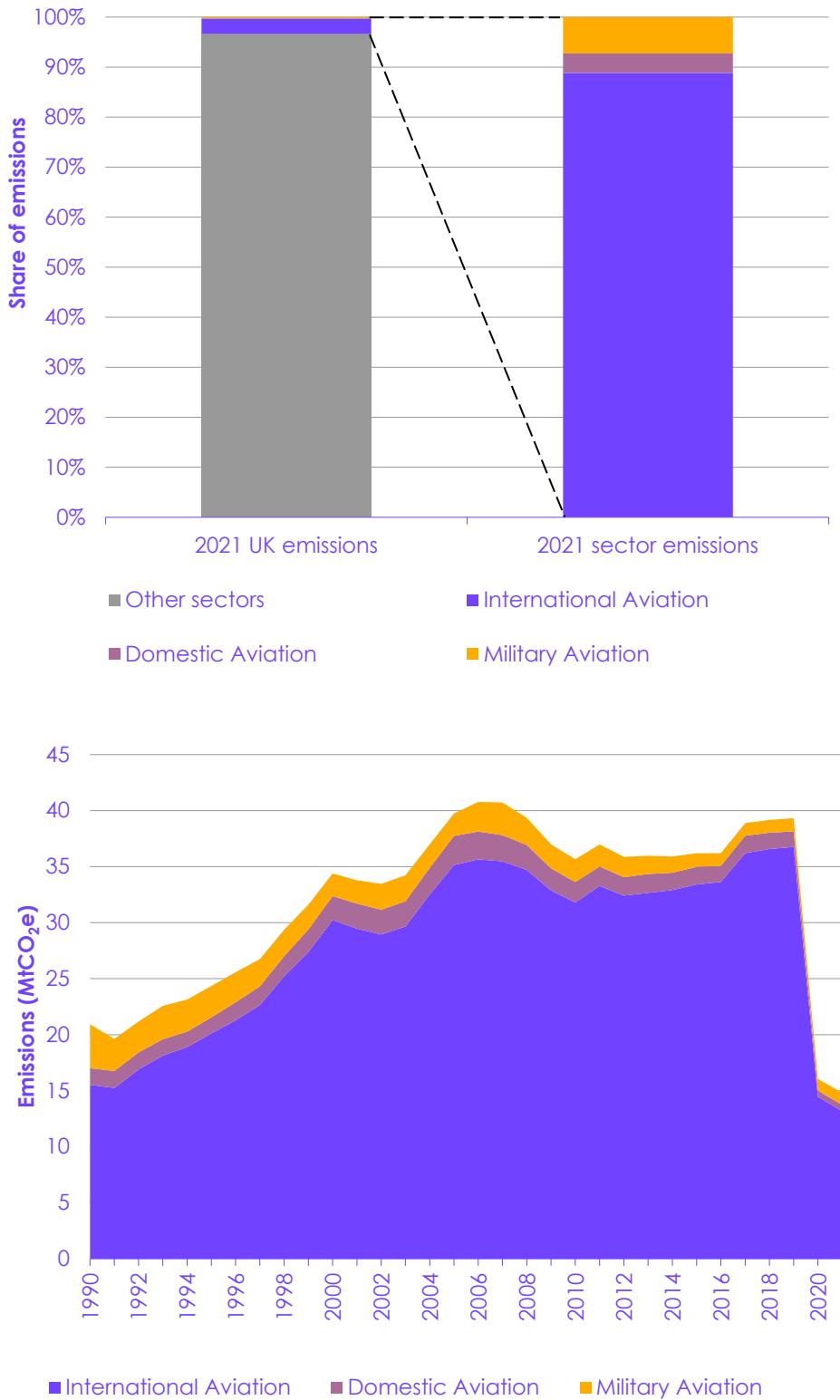
It remains to be seen whether the pre-COVID trend of emissions increases from demand growth exceeding reductions from efficiency improvements will continue once the acute impact of the pandemic has ended:

Efficiency improvements partially offset emissions increases from increased flight demand before the COVID-19 pandemic.

- Between 2010 and 2019, aviation emissions increased by 10%. This was driven by increased demand for international flights being partially offset by falling demand for domestic flights, together with increased plane loadings, falls in average flight distance and some efficiency improvements.
- The COVID-19 pandemic is continuing to dampen demand for air travel (Figure 9.2) and may continue to do so in the next few years, especially when combined with recent very high oil prices and the rising cost of living. A 59% reduction in aviation emissions was seen in 2020, and demand at the beginning of 2022 remained at a similarly suppressed level. It remains unclear whether demand will return to pre-pandemic levels and how long such a return might take (see section on policy progress, assessment and next steps).

The largest source of sector emissions continues to be from international aviation.

Figure 9.1 Aviation emissions by sub-sector as a share of UK total

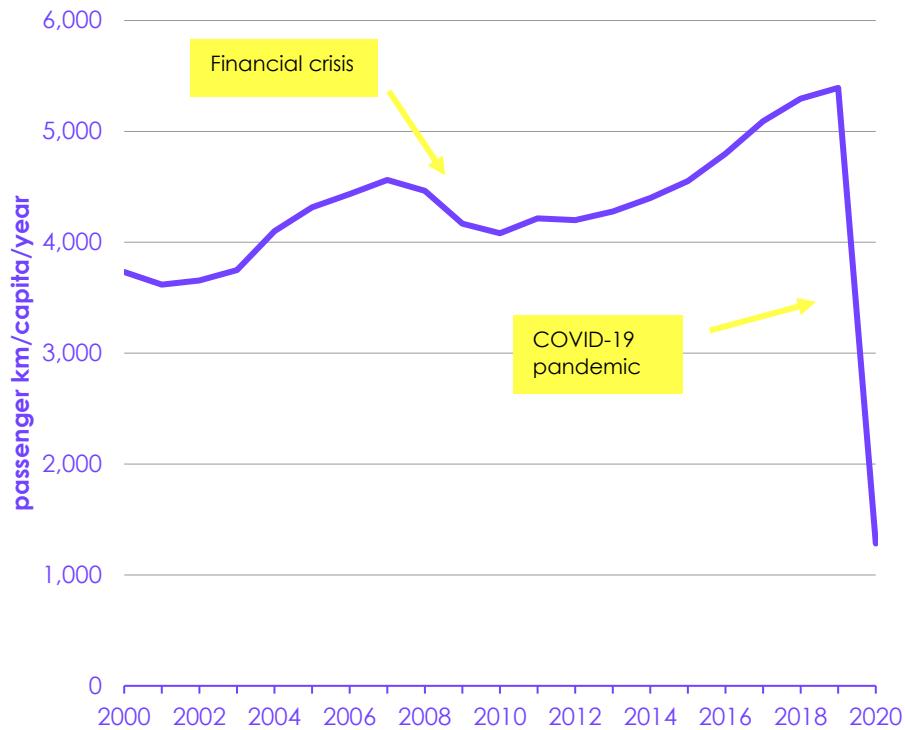


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020; BEIS (2022) Energy Trends: UK oil and oil products March 2022; CCC analysis.

Notes: Global warming potentials from IPCC AR5 without feedback are used

Annual passenger-kms per capita fell dramatically during the COVID-19 pandemic after a decade of sustained growth.

Figure 9.2 UK aviation demand: annual passenger-km per capita



Source: DfT (2022) Seat-km & passenger-km flown to/from UK airports on passenger services, 2020 (unpublished); ONS (2022) Population estimates; CCC analysis.

Notes: Chart shows total passenger-kms departing the UK divided by the UK population in that given year.

2. Indicators of progress

No progress has been made in addressing demand in the aviation sector, despite the significant risks in the technology required to decarbonise flying.

This section sets out the key indicators of progress for the aviation sector. There has been some progress on the technologies required for the transition within the sector through the FlyZero project by the Aerospace Technology Institute (ATI), but no progress has been made in addressing demand.

The actions and conditions required for the decarbonisation of aviation in the UK are summarised in Figure 9.3. The details of how these work together to deliver the sector's decarbonisation pathway, along with a full set of data indicators designed to track each of these elements, are introduced in the accompanying Monitoring Framework. Progress this year on the key indicators is shown in Table 9.1 and Figures 9.4 to 9.12. Progress on the full set of indicators is shown in the supporting data to this report.

Fossil fuel intensity in aviation has increased during the pandemic.

- Fossil fuel use per passenger-km increased substantially in 2020 (72% increase on 2019 levels) after two decades of progress to improve fuel efficiency, with an annual average change of -3% from 2010-2019 (Figure 9.4). This is likely to be due to reduced passenger demand and flights with a lower proportion of seats filled, including an increasing number of 'ghost' flights (Figure 9.5). It is important to track this as the sector recovers from the pandemic to ensure that it is only a temporary move away from long-term efficiency trends and that policies are implemented to alter routes and restrict 'ghost flights' if the pattern is not temporary.

Non-CO₂ effects from aviation have fallen during the pandemic.

- Non-CO₂ effects of aviation* have reduced as a result of the pandemic, after increasing in previous years in-line with the growing number of flights. Technological progress in the aviation sector primarily drives a reduction in CO₂ emissions-intensity, although there may be some small reductions in non-CO₂ effects. The most effective way of mitigating non-CO₂ emissions is through controlling demand for aviation (Figure 9.6).

The cost of flying does not reflect the emissions impact relative to lower-emission forms of travel.

- The number of international trips attributed to business travel fell significantly during the COVID-19 pandemic. The price elasticity of demand for business travel has historically been low, although with the much greater use of video-conferencing during the pandemic, the extent to which business aviation travel returns remains uncertain. There has been no policy change to attempt to maintain this trend of fewer business flights and, resulting lower demand and emissions (Figure 9.7).
- Prices per passenger-km of air travel have been decreasing since 2010 for short- and long-haul travel (despite increases in the Air Passenger Duty for ultra-long-haul flights). These price changes indicate improvements in the efficiency of aircraft and reductions in fuel consumption. Prices for long-distance rail journeys have increased substantially over the same period. To mitigate demand and reduce consumption, prices of air travel ought to be more expensive than lower emission modes to reflect the higher emissions of air travel relative to alternatives (Figure 9.8 and 9.9).

* Aviation non-CO₂ effects (including contrails, NOx emissions, sulphates and other factors) warm the climate but have high levels of uncertainty and exhibit regional and seasonal variation. Despite uncertainties, their net effect almost certainly contributes a warming effect to the climate.

The aviation industry is offsetting a substantial proportion of flights, although the quality of the offsets purchased is generally low.

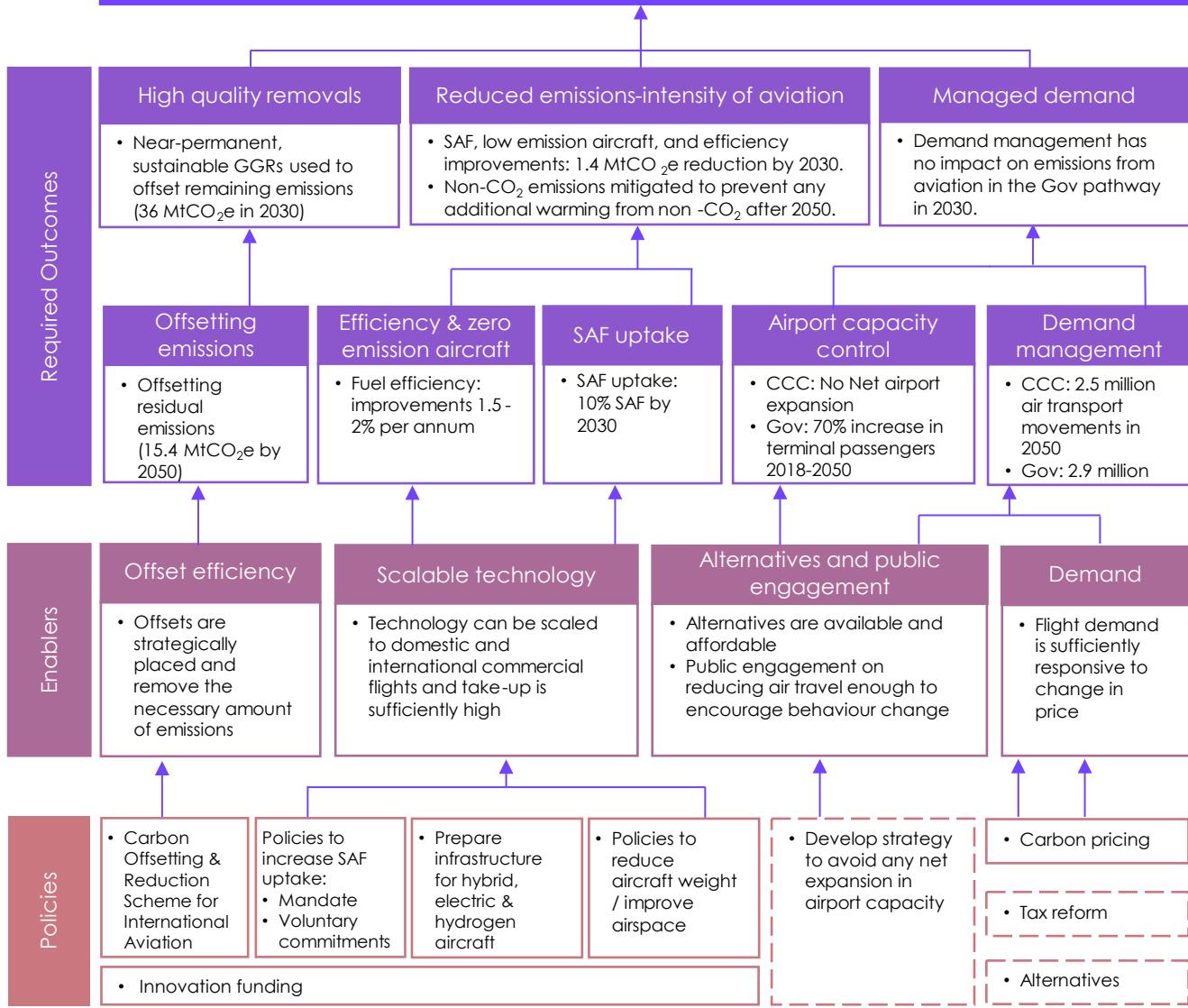
- An increasing proportion of people are thinking about the impact of air travel on the environment and are willing to pay more for their flights to reflect the environmental cost of air travel (Figures 9.10 and 9.11).
- 26 billion seat-kms flown in 2021 were offset by airlines out of a possible 114 billion (Figure 9.12). This is likely to increase once the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is fully operational and airlines start buying offsets through this programme.
 - The proportion of domestic flights offset is significantly higher than international flights, which rely more heavily on voluntary carbon offsetting by consumers. Only around 4% of consumers opt for these offsets according to research on the willingness-to-pay for carbon dioxide offsets.¹
 - However, the quality of offsets currently used is generally low and are often purchased by companies at a relatively low cost. To meet the emissions pathway for aviation by 2050, near-permanent, sustainable greenhouse gas removals must be used to balance residual aviation emissions.*
- UK aviation emissions per person in 2019, before the pandemic, were 33% higher than the OECD average (Figure 9.13). Other countries are moving faster than the UK with policies to reduce their aviation emissions. Box 9.1 provides a summary of key policy developments internationally over the last few years.
- We do not include an indicator on zero- or low-emission aircraft as they are not currently commercially viable. However, we summarise the progress on research into the possibility of low-emission aircraft through the Aerospace Technology Institute's FlyZero project (see Box 9.2).

* Removals must be sustainable, UK-based, with the quantity of CO₂ removed and the permanency of the removal quantified in a robust and transparent way.

Figure 9.3 Monitoring map for aviation



Around a 60% reduction in emissions 2019 to 2050, with removals for the remaining 15 MtCO₂e
Limit net warming from non-CO₂ effects to zero after 2050

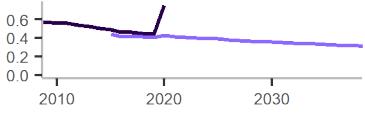
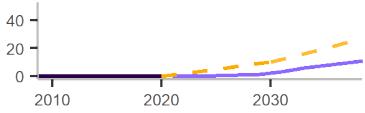
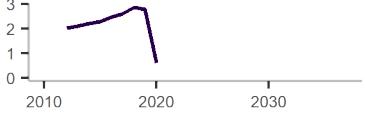
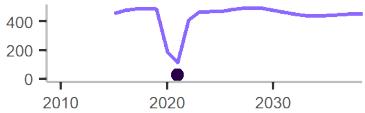
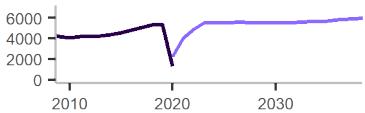
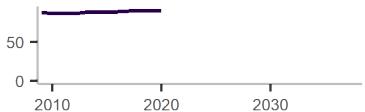
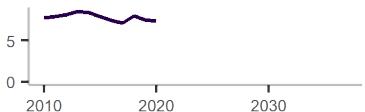
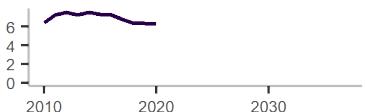
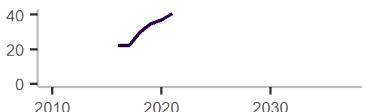


Source: CCC analysis.

Notes: Policy boxes with a dashed line indicate areas not yet addressed by the Government's plans.

Table 9.1

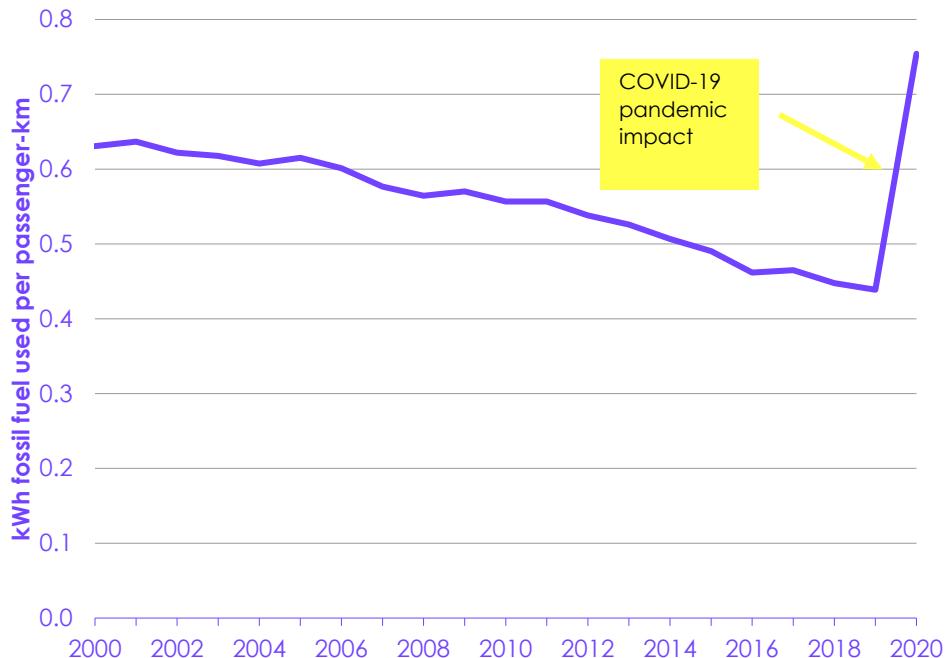
Aviation key indicators

Aviation indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Carbon-intensity of aviation	Fuel consumption	2020	0.75 kWh of fuel used per passenger-km; CCC benchmark: 0.43	+72% from 2019	
	Sustainable Aviation Fuel share	2020	0%	0% from 2019	
	Non-CO2 effects	2020	Effective non-CO2 radiative forcing 0.6 mW/m²	-78% from 2019	
	Use of offsets / removals	2021	26 billion seat-km/year offset; CCC benchmark: 110		
Demand	Passenger-km per person	2020	1,300 km per capita; CCC benchmark: 2,300	-76% from 2019	
	Type of travel (% non-business, e.g. leisure, visiting family)	2020	90%	-1% from 2019	
	Cost per km of short-haul flights	2020	7.4 pence per passenger-km	-2% from 2019	
	Cost per km of long-haul flights	2020	6.3 pence per passenger-km	0% from 2019	
	Public sentiment (% who think about the environmental impact when deciding to fly)	2021	41%	+11% from 2020	
International ranking	Rank of international aviation emissions	2021	11th in rank of OECD countries	+3 from 2020	
Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.					
Notes: All values are rounded to 2 significant figures; solid lines represent pathways; points represent in-year benchmarks; dotted lines show the linear rate of change required to meet in-year benchmarks; indicators are UK-wide, unless otherwise stated.					

Fuel efficiency

Fossil fuel intensity was improving up to 2020. During the COVID-19 pandemic it worsened due to lower demand and seat occupancy.

Figure 9.4 Fossil fuel intensity in aviation

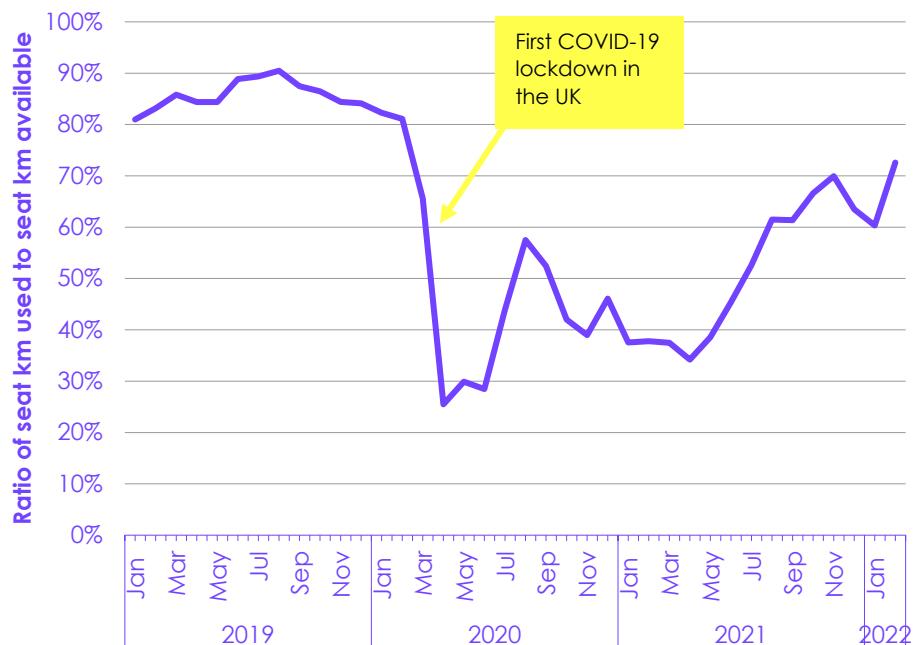


Source: BEIS (2022) Energy Trends: UK oil and oil products March 2022; DfT (2022) Seat-km & passenger-km flown to/from UK airports on passenger services, 2020 (unpublished); CCC analysis.

Notes: This chart shows the total kWh of fossil fuel use for aviation divided by the number of passenger-km for departing flights in the UK.

Seat occupancy fell and the number of 'ghost' flights increased during the pandemic, a likely driver for increased fuel intensity in Figure 9.4.

Figure 9.5 Proportion of seat-kms occupied by a passenger 2019-2022



Source: Civil Aviation Authority (2019-2022) UK Airline data, Table 03 All Services; CCC analysis.

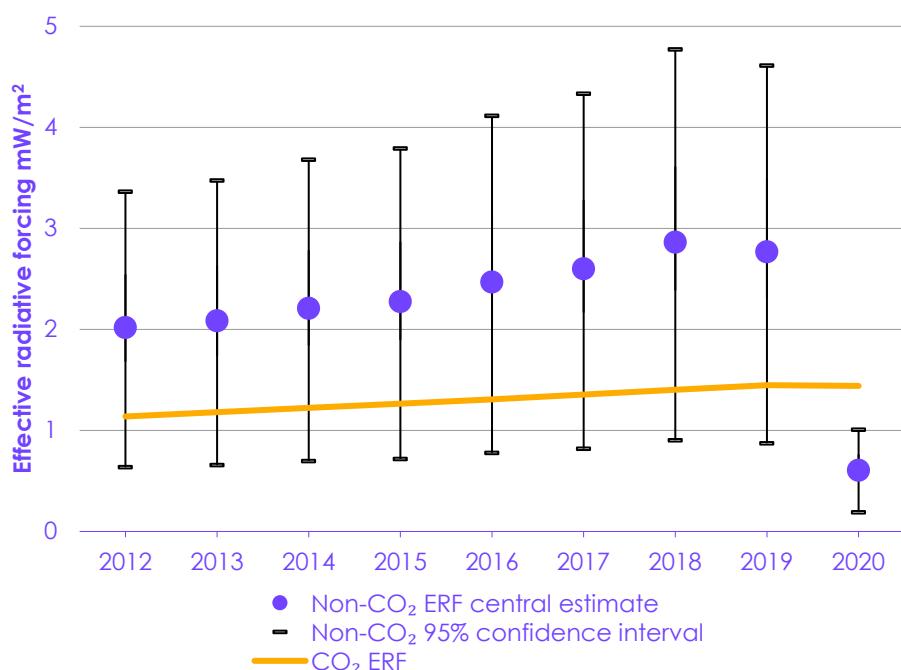
Non-CO₂ effects

Aviation non-CO₂ effects warm the climate but have high levels of uncertainty and exhibit regional and seasonal variation. Despite uncertainties, their net effect almost certainly contributes a warming effect to the climate. Best estimates suggest that they account for the majority of global aviation's warming impact on the planet to date. However, they are likely not as dominant for UK emissions, as UK aviation emissions are rising more slowly than the global average.²

- Figure 9.6 shows an estimate of the change in effective radiative forcing (ERF, heat trapping potential) from non-CO₂ effects (including contrails, NO_x emissions, sulphates and other factors) from UK aviation (using UK passenger-kms as a proportion of total global passenger-kms from aviation) relative to the change in ERF from CO₂ emissions. Globally in 2018, non-CO₂ effects sum to yield a net warming ERF. The climate impacts of non-CO₂ effects are shorter-lived than those of CO₂ and depend on sustained aviation activity to maintain them (unlike CO₂, which will continue to warm the climate even if emissions were stopped).³
- The 76% fall in air passenger demand due to COVID-19 and the short-lived nature of non-CO₂ effects results in a corresponding percentage reduction in the radiative forcing from aviation non-CO₂ effects. For comparison, radiative forcing from CO₂ emissions would have remained largely unchanged.

The non-CO₂ effects of aviation in the UK fell during the pandemic but remain a net positive impact. The impact of non-CO₂ emissions is highly uncertain.

Figure 9.6 Estimated changes in Effective Radiative Forcing from CO₂ and non-CO₂ effects from UK aviation



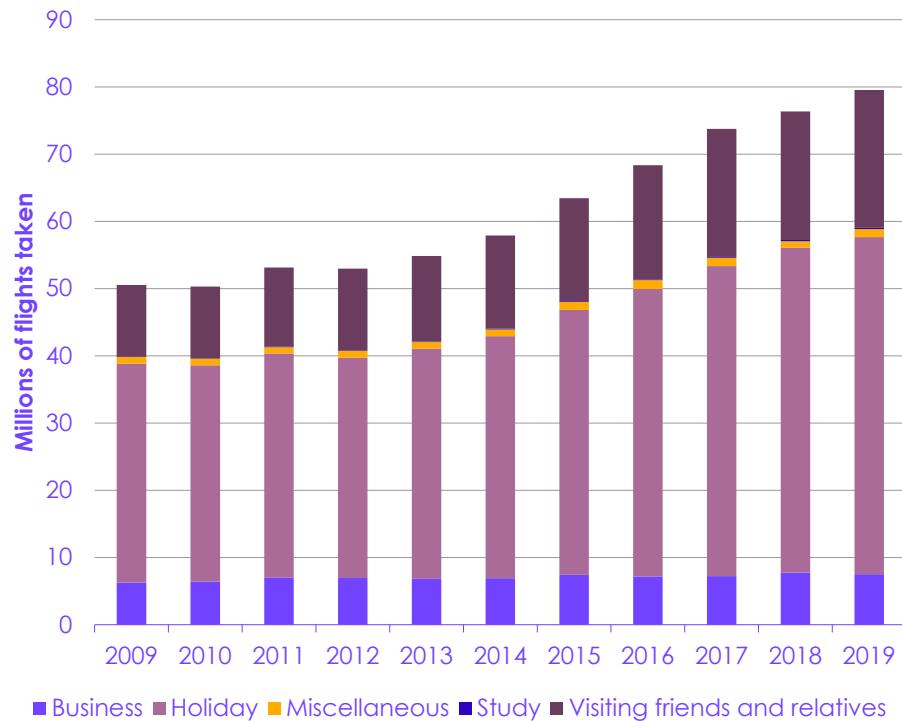
Source: Non-CO₂: Lee, et al. (2021) *The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018*; Atmospheric Environment, Volume 244; ICAO (2012-2020) *The World of Air Transport*; CO₂: BEIS (2022) *Provisional UK greenhouse gas emissions national statistics 2021*; BEIS (2022) *Final UK greenhouse gas emissions national statistics: 1990 to 2020*; Smith, et al. (2018) FAIR v1.3: A simple emissions-based impulse response and carbon cycle model, Geosci. Model Dev.; Millar, et al. (2017) A modified impulse-response representation of the global near-surface air temperature and atmospheric concentration response to carbon dioxide emissions, *Atmos. Chem. Phys.*: CCC analysis.

Notes: Global estimates for 2018 have been scaled to total global passenger-kms for 2012-2020 and then further scaled for UK passenger-kms.

Types of air travel

Business travel was falling as a proportion of total air travel even before the COVID-19 pandemic.

Figure 9.7 Types of international air travel, 2009-2019

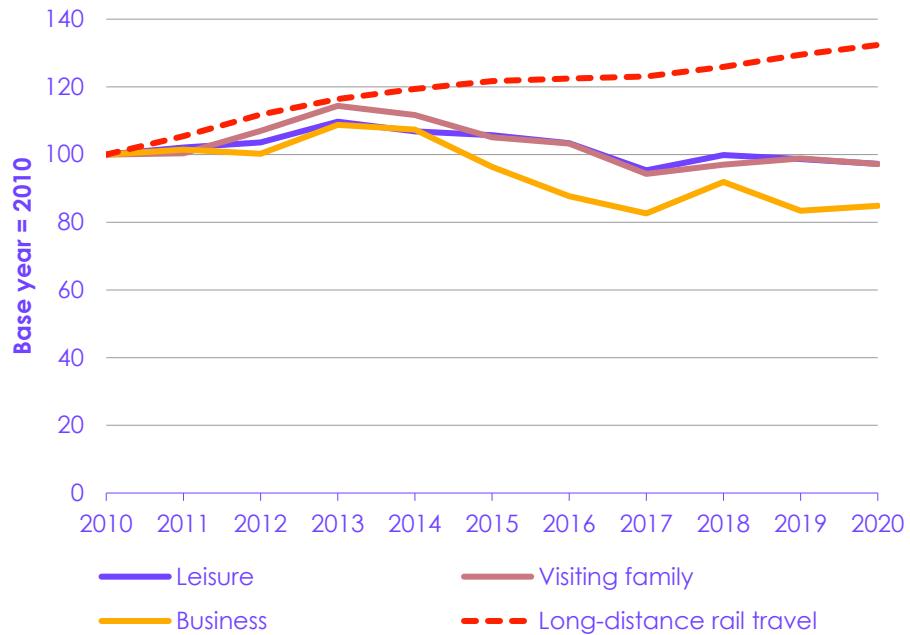


Source: ONS (2019) Travelpac: travel to and from the UK; CCC analysis.

Prices

Prices for both short- and long-haul air travel are falling as a result of efficiency improvements, while rail prices are increasing.

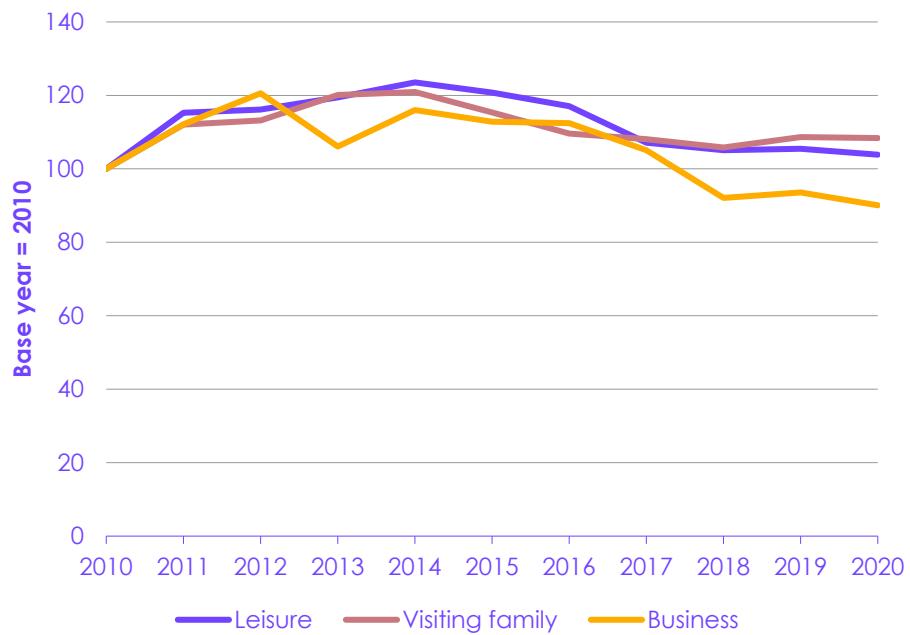
Figure 9.8 Trends in short-haul flight price vs. long-distance rail travel (indexed to 2010)



Source: ONS (2020) International Passenger Survey; HMT (2020) GDP Deflator; ORR (2021) Office of Rail and Road Rail Fares Index; CCC analysis.

Notes: Flight prices calculated from a 'basket' of 10 popular short-haul routes from the UK overtime. Converted to real prices using the GDP deflator and shown as a price index to highlight the trends in prices. Prices are ticket price paid by consumers and therefore include all relevant taxes.

Figure 9.9 Trends in long-haul flight prices (indexed to 2010)



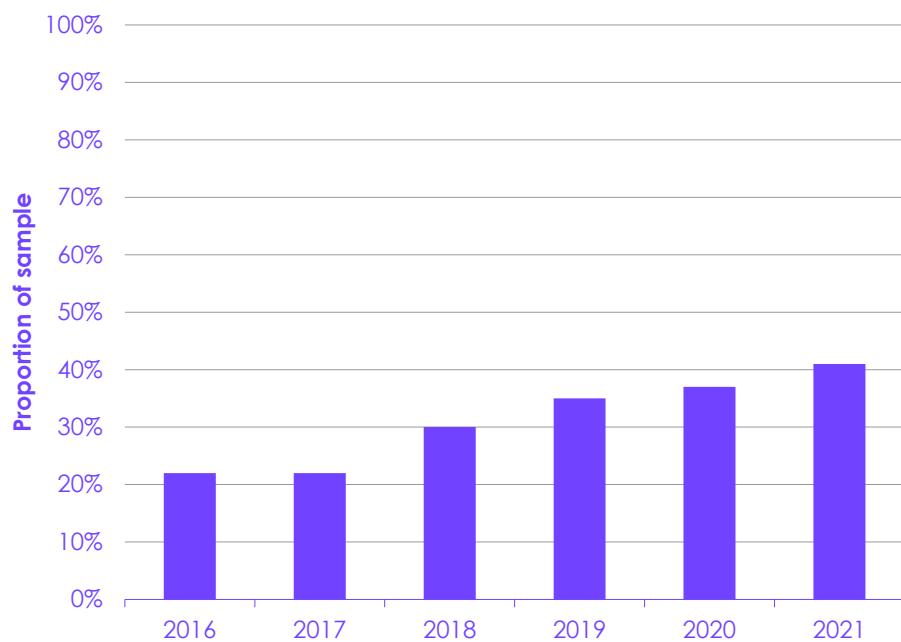
Source: ONS (2020) International Passenger Survey; HMT (2020) GDP Deflator; CCC analysis.

Notes: Flight prices calculated from a 'basket' of 10 most popular long-haul routes from the UK overtime. Converted to real prices using the GDP deflator and shown as a price index to highlight the trends in prices. Prices are ticket price paid by consumers and therefore include all relevant taxes.

Public attitudes

The proportion of people thinking about the impact of their air travel on the environment is increasing.

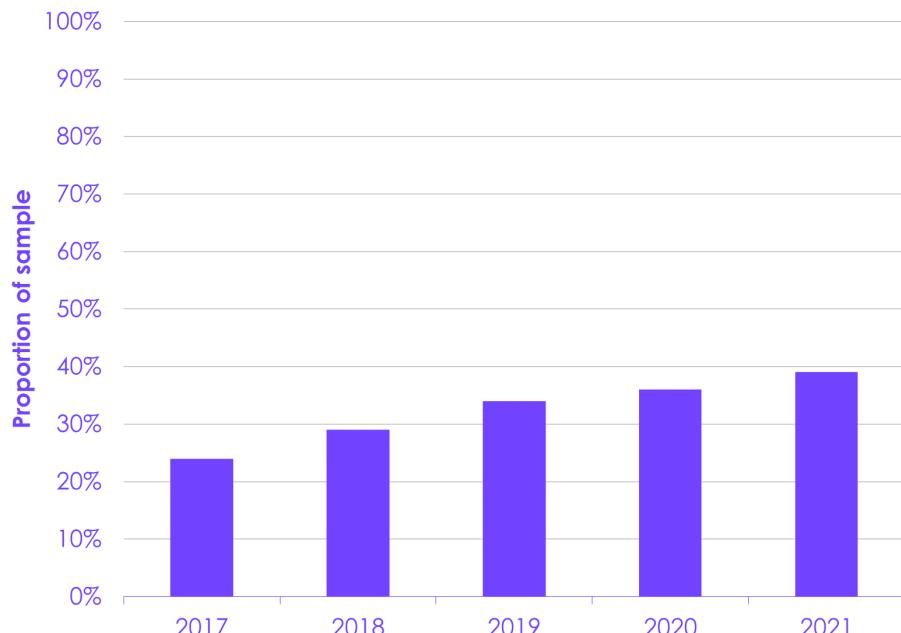
Figure 9.10 When deciding to travel by air, I think about the impact of flying on the environment: % who strongly agree or agree



Source: Civil Aviation Authority (2021) UK Consumer Survey Wave 10 Environmental Findings.
Notes: All respondents of a nationally representative sample of adults (18+), N=3,502.

An increasing proportion of travellers are willing to pay more for their flights to reduce the environmental impact of air travel.

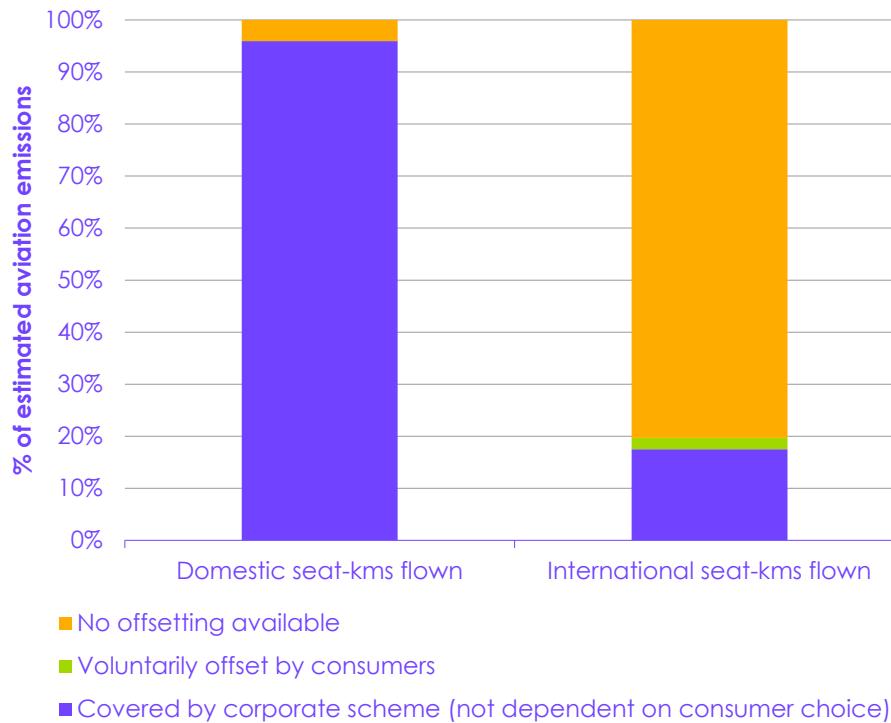
Figure 9.11 I would pay more for flight tickets to reduce the environmental and/or noise impact of flying: % who strongly agree or agree



Source: Civil Aviation Authority (2021) UK Consumer Survey Wave 10 Environmental Findings.
Notes: All respondents of a nationally representative sample of adults (18+), N=3,502.

Offsets

Figure 9.12 Corporate offsetting schemes and take-up of voluntary offsets in the aviation industry as a % of flight kms, 2021



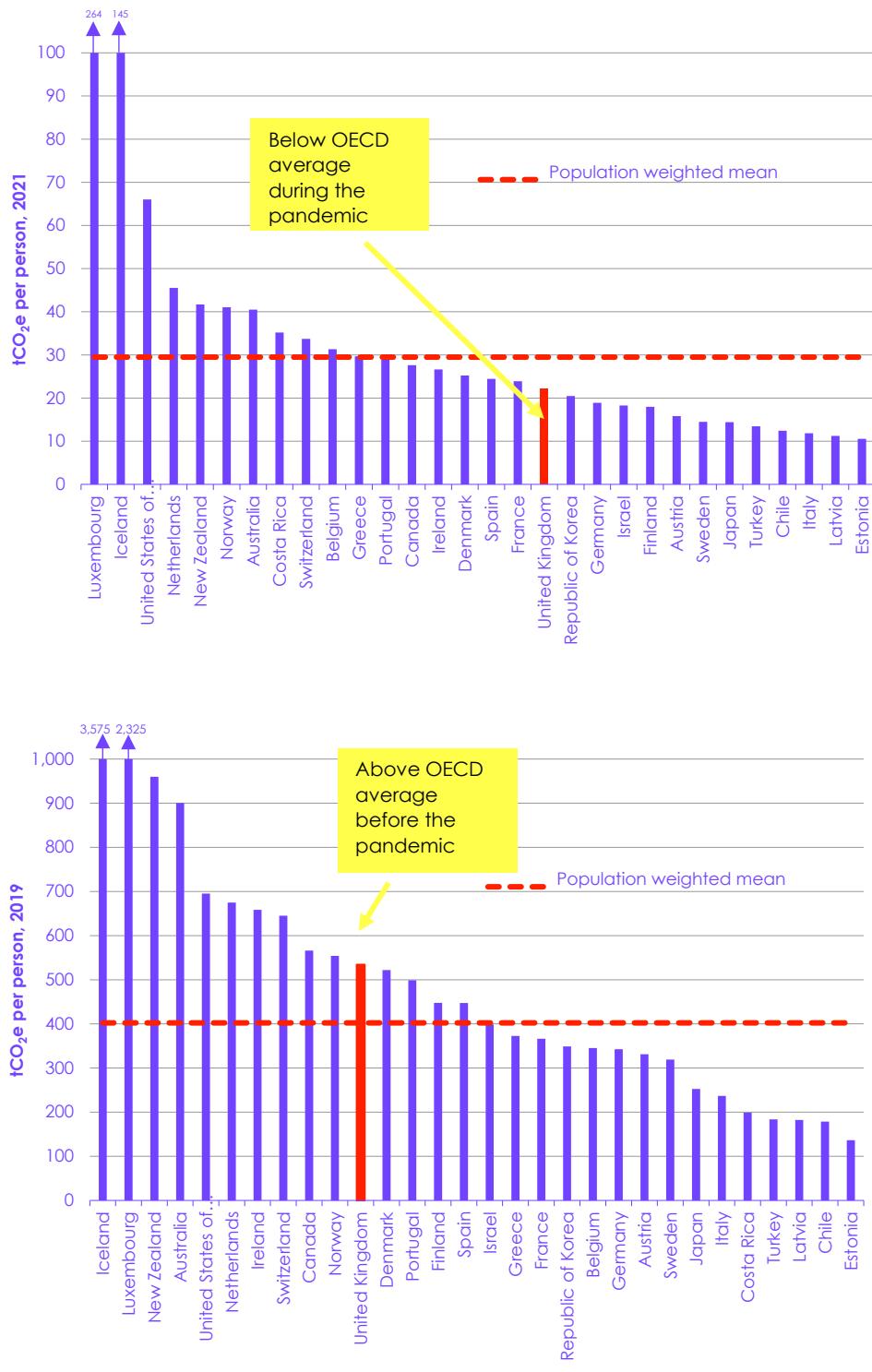
Source: Civil Aviation Authority (2019-2022) UK Airline data, Table 03 All Services; DfT (2022) Seat-km & passenger-km flown to/from UK airports on passenger services, 2020 (unpublished); Company reports: Acropolis Aviation (2021) Carbon offsetting: Towards sustainable luxury; Aer Lingus (2020) Sustainability: Our flight path to a carbon neutral future; Gama Aviation (2022) Carbon Footprint reduction plan; EasyJet (2021) Annual report and accounts; EasyJet (2021) Sustainability plan; IAG (2021) Sustainability report 2021; Blueslands LTD (2021) Caring for Our Plant; Jet2 PLC (2020) Sustainability; LoganAir (2021) Environmental Engagement; LuxAviationUK (2020) The Environment; RyanAir (2021) Sustainability Report 2021; TAG Aviation (2021) Our Green Commitment; Virgin Atlantic (2022) Our Line in the Sand; Wizz Air (2021) Sustainability; Berger, et al. (2022) Willingness-to-pay for carbon dioxide offsets: Field evidence on revealed preference in the aviation industry; CCC analysis.

Notes: Chart shows the purchase of offsets by airlines and makes no judgement on the quality, additionality or sustainability of these offsets. Therefore, this chart cannot be interpreted as the proportion of aviation emissions offset, but rather the % of flight kms with an offset attached.

International comparisons

The UK's per-capita aviation emissions were slightly above the OECD average prior to the COVID-19 pandemic. During the pandemic, the UK was below average.

Figure 9.13 Ranking of the United Kingdom in per-person aviation emissions compared to OECD countries (2021 and 2019)



Source: OECD (2021) Air travel emissions; United Nations (2021) Population Estimates; CCC analysis.

Box 9.1

International aviation policies

There have been several recent examples of international leadership on aviation:

- **France** has banned domestic flights where there is an alternative train journey of less than two and a half hours, from April 2022. Although the policy only covers 12% of domestic travel,⁴ it sends a signal to consumers that alternative forms of travel have significant emissions savings and may result in a fall in emissions elsewhere in the sector.
- **Sweden:** Flygskam ('flight shame') is an anti-flying social movement originating in Sweden. It resulted in an increase in train use, while domestic flying reduced. The main train company in Sweden reported that it sold 1.5 million more tickets in 2018 relative to the previous year and domestic air travel fell 9%. Also, passenger numbers at Sweden's 10 busiest airports decreased 5% in the summer 2019 relative to the previous year. It cannot be determined whether this was the primary reason that air travel reduced during this period – there may have been other factors.⁵
- **US:**
 - The 'Sustainable Skies Act' (May 2021) aims to boost incentives to use SAF. Credit starts at US\$1.50 per gallon for blenders that supply SAF with demonstrated 50% or greater lifecycle GHG savings. Includes a \$1 billion grant over 5 years to expand the number of SAF-producing facilities.
 - The US Government announced in September 2021 a new SAF goal to increase production to 3 billion gallons per year by 2030. New actions include: a tax credit to cut cost and rapidly scale domestic production of SAF, continuous funding opportunities to support SAF projects and fuel producers and work with international partners to support the global scale up and availability of SAF.⁶
- **EU:** As part of the 'Fit for 55' initiative, the European Commission proposed the 'ReFuelEU Aviation' regulation mandating minimum SAF blends to 5% in 2030 and 63% in 2050.⁷

The 'FlyZero' programme has made significant progress in understanding the potential of zero-emission aircraft. However, uncertainties on the timelines for commercial availability of these aircraft remain.

Box 9.2

Progress on zero-emission aircraft – 'FlyZero'

Key findings from the Aerospace Technology Institute's intensive and thorough research programme, supported by the UK Government on zero-emission aircraft, 'FlyZero':⁸

- The programme assessed aircraft based on liquid hydrogen as the most viable route to achieving zero-carbon flights.
- Given the slow rate of fleet turnover, even if the new hydrogen aircraft are available in the 2030s it will take decades for them to roll through the fleet fully. In the meantime, drop-in SAF will be important to decarbonise existing aircraft designs.
- 'FlyZero' developed three concepts for low-emission aircraft aimed at different market segments:
 - **The regional concept:** powered by fuel cells, carries 75 passengers up to 800 nautical miles (nmi) so addresses short-haul emissions (4% of UK aviation emissions). Although it uses slightly more energy than that required to run a similar aircraft on SAF, it may address non-CO₂ impacts as it only emits water and eliminates all other exhaust emissions (CO₂, NOx, particulates).
 - **The narrowbody concept:** carries 179 passengers up to 2,400 nmi. The concept has the energy storage and propulsion system located at the rear of the aircraft, this includes the fuel tanks, fuel system and gas turbines.
 - **The midsized concept:** carries 279 passengers up to 5,250 nmi. 'FlyZero' analysis concluded that a midsized hydrogen aircraft could address 93% of existing long-haul flights (89% of UK aviation emissions) and use less energy than the equivalent SAF baseline.
- However, the technologies described are at a very early stage, and are unlikely to be commercially viable for some decades.

Given the likelihood that hydrogen aircraft will have only a small impact on aviation emissions even by 2050, their long-term prospect should not distract from efforts to decarbonise using SAF, demand mitigation and efficiency improvements in the meantime.

3. Policy progress, assessment and next steps

The Department for Transport is yet to publish its Jet Zero Strategy, and many policies continue to lack detail.

Since our 2021 Progress Report, the Government has released a consultation on the Jet Zero Strategy, with some new policy proposals. It is yet to publish the full Jet Zero Strategy, which is due in July 2022. There have been some new commitments, funding and ambition, but many policies are still lacking in detail. A major step has been the commitment to an emissions pathway for UK international aviation by 2050.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

In the absence of the full Jet Zero Strategy and with minimal detail on emissions reductions in the Government's May 2022 Flightpath to the Future policy paper,⁹ we do not have a full policy package to assess for aviation. The following areas have seen new policy proposals:

- **International Civil Aviation Organisation (ICAO)** and international action. The UK has taken some action to lead on aviation internationally, including pushing to secure a long-term goal for international aviation emissions consistent with the Paris Agreement and a strengthened CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) offsetting scheme. However, the Government has provided limited detail on future interactions and what it aims to achieve through international cooperation. Further detail must be provided as soon as possible in the upcoming Jet Zero Strategy.
- **Offsetting/removals.** BEIS and DfT have consulted on the interaction of the UK Emissions Trading Scheme (UK ETS) and CORSIA but are yet to commit to a policy on this. The Government should commit to preventing operators using CORSIA credits as a substitute for a UK Emissions Trading Allowance, due to the insufficient quality and additionality of existing offsets. Their quality prevents them being an acceptable contribution to UK carbon budgets and should only qualify as part of the UK ETS once they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability).

The Government is also consulting on other matters relating to aviation and the UK ETS:

- How sustainable aviation fuels (SAF) are treated under the UK ETS and how take-up can be incentivised.
- The feasibility and appropriateness of expending the UK ETS to include non-CO₂ effects from aviation (although any policy will only be implemented in the long-term).

- Including UK-Switzerland flight paths under the UK ETS.
- How the free allocation of UK ETS allowances for airlines should operate.
- **Operational efficiency.** The UK Government has committed to work through the ICAO to ensure stringent international standards for aircraft emissions are implemented as technology improves. It is seeking voluntary agreement from all airlines to avoid tankering (i.e. carrying more fuel than is needed for the immediate flight) where there is no practical reason to carry extra fuel. It is asking for additional contributions on wider changes to policies that may improve efficiencies.
- **Sustainable Aviation Fuels (SAF).** The Department for Transport is consulting on a UK SAF mandate from 2025 to enable the delivery of 10% SAF by 2030 and will be providing £180 million in funding to UK industry to support the development of SAF plants. It has further committed £3m to the development of a SAF clearing house.
- **Zero-emission aircraft.** The Government has set an aspiration to have zero-emission routes connecting the UK by 2030 and are looking at the feasibility of using zero-emission aircraft on UK Public Service Obligation routes. It has committed to £685 million of funding which, alongside industry funding, will provide £1 billion to support the development of zero-carbon and ultra-low-emission aircraft technology, alongside previous funding for 'FlyZero'.¹⁰
- **Demand management.** The Government has proposed to strengthen carbon pricing in the aviation industry as a way of increasing the price of air travel and reducing demand. There is minimal detail in its strategy on how this would work. Also, the Civil Aviation Authority, in their May 2022 sustainability strategy, have committed to consulting on carbon labelling for flight routes to encourage consumers to choose the lowest emission flights by the end of 2022.¹¹
- **Non-CO₂ effects.** The Government has published a Call for Evidence on whether the UK ETS could be expanded to cover non-CO₂ emissions, focusing initially on NO_x.

(b) Assessment of policies and plans

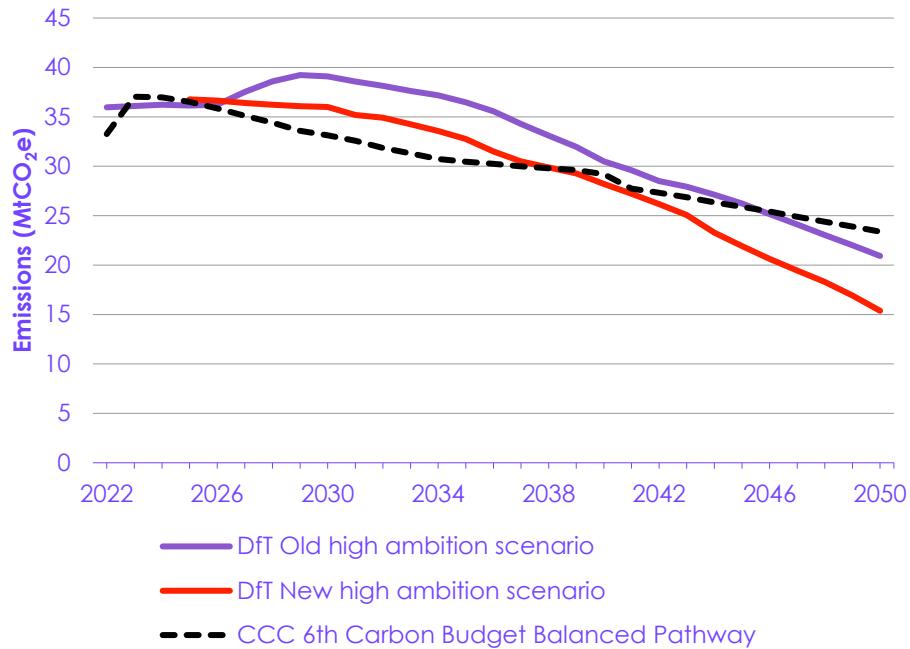
Only two of 13 recommendations in 2021 have been achieved or are making sufficient progress.

Of the 13 recommendations in the 2021 Progress Report relating to the aviation sector, one has been achieved and one has been partly achieved, while of the ongoing recommendations, one is making sufficient progress, four are making some but insufficient progress and six are not making progress. Figure 9.14 shows the ambition of the Department for Transport's scenarios relative to the CCC's Sixth Carbon Budget Balanced Pathway, together with the previous modelled scenario produced by the Department for Transport and adjusted for the Net Zero Strategy. Unlike other sectors, we include the pathway to 2050 due to the importance of the later periods for aviation decarbonisation as technology required to abate emissions in this sector will take a significant period to be commercially deployed. For this analysis we use the baseline and pathway from the Jet Zero Strategy March 2022 further technical consultation, as it has the Department for Transport's most up-to-date assumptions. This assessment of progress in the aviation sector shows there are significant risks to achieving the Government's pathway (Figure 9.15 and Table 9.2), particularly due to the heavy reliance on a technology-driven approach without sufficient attempts to constrain demand.

The policy scorecard for aviation is based on our judgement of current Government commitments for the decarbonisation of the sector and may change once the full Jet Zero Strategy has been published.

Since the Net Zero Strategy, the Department for Transport has produced a more ambitious pathway for aviation.

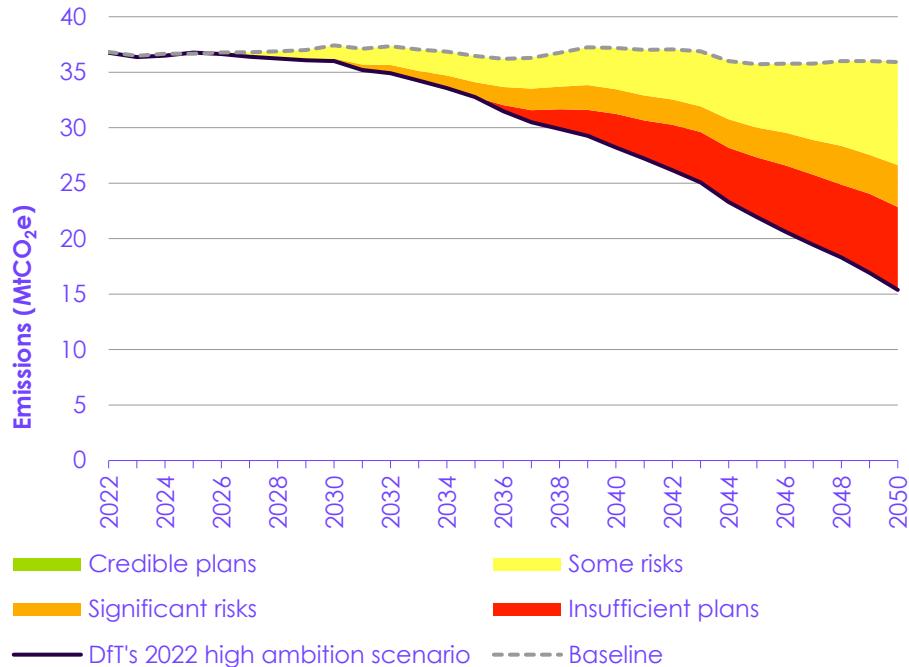
Figure 9.14 Jet Zero Strategy scenario comparisons



Source: Department for Transport (2022) Jet Zero Further Technical Consultation scenarios; CCC analysis.

There are significant risks in the aviation pathway up to the mid-2030s, with a heavy reliance on nascent technologies. Demand-side policies are mostly non-existent.

Figure 9.15 Assessment of policies and plans for aviation



Source: Department for Transport (2022) Jet Zero Further Technical Consultation scenarios; CCC analysis.

Table 9.2

Policy scorecard for aviation

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Demand mitigation	R	O	R	O	R
0% of 2035 abatement	<ul style="list-style-type: none"> Demand reduction is only included through carbon pricing and an upcoming CAA consultation on encouraging consumers to switch to lower-emission aviation routes. If implemented well, this has the potential to reduce demand. However, alternative policies to encourage reduced air travel should be explored to mitigate risks with this approach. No commitment to manage airport capacity expansion or encourage consumers to shift away from aviation to lower-emission alternative forms of transport. Need for further mechanisms to manage demand in the situation where technologies are not commercially available sufficiently quickly. These will also be required if the scale of global cooperation required is insufficient to facilitate the development and implementation of new technologies and to address the non-CO₂ effects of aviation. The Government have suggested that they would review their aviation strategy every five years to judge if the sector's decarbonisation is off-track and implement new policies in response to this. There is a risk that this review will be too late to implement the required mechanisms to manage demand if technologies are not commercially available in time. 				
Sustainable aviation fuels	O Y Y O O				
64% of 2035 abatement	<ul style="list-style-type: none"> Recently finished consulting on mandating 10% SAF by 2030, a very high level of ambition. Will be providing £180 million in funding to UK industry to support the development of SAF plants. A further £3 million committed to the development of a SAF clearing house. No commitment yet on the type of SAF that can be included, with a risk that supported fuels will not have significant lifecycle emission savings or will have opportunity costs within other sectors (although a level of lifecycle emissions is acceptable as part of the transition to 2050). 				
Zero-emission aircraft	Y Y O O O				
3% of 2035 abatement	<ul style="list-style-type: none"> High ambition to have zero-emission routes connecting the UK by 2030 and are looking at the feasibility of using zero-emission aircraft on UK Public Service Obligation routes. Committed to £685 million of Government funding which, alongside industry funding, will provide £1 billion to support the development of zero-carbon and ultra-low-emission aircraft technology. 'FlyZero' project findings (see Box 9.2). However, 'FlyZero' only gives a very early indication of potential technologies which will require extensive testing before being commercially viable. Furthermore, these will only have a small impact on total aviation emissions, especially in the near-term. The roll-out of technologies will also require high levels of international cooperation to be successful; a considerable risk within this sector. 				

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Fuel efficiency 34% of 2035 abatement	O	O	Y	O	O
	<ul style="list-style-type: none"> Only new policy this year is voluntary avoidance of tankering by airlines. Insufficient policy progress made to meet the emissions reduction required in the Department for Transport's scenarios. This pathway (involving a step-change growth to 2% annually from historic levels of 1.5%) would require significant research and development. It also requires a high level of international cooperation, which is a significant risk in the Government's pathway. 				
Offsets/removals	R	O	O	Y	O
	<ul style="list-style-type: none"> Near-permanent, sustainable greenhouse gas removals will need to be used by the aviation industry to remove any remaining emissions after implementing new technologies to reduce existing emissions. These, unlike the current low-quality offsets purchased by the industry, will have significantly higher costs and must be purchased at a much larger scale than currently. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is in its early stages and the COVID-19 pandemic has meant a delay to emissions increasing above the 2019 baseline and therefore being required to be offset. There is no decision on the interaction between the UK ETS and CORSIA. Significant risks that CORSIA is not stringent enough and the offsets are of insufficient quality and additionality to be an acceptable contribution to UK carbon budgets. They also will not develop a market sufficiently large to deal with the future requirements for removals within the sector. 				
Overall sector assessment (based on 2035 abatement)	O	Y	Y	O	O
Overall sector assessment (based on 2050 abatement)	R	O	R	O	R

Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; DfT (2022) *Jet zero: further technical consultation*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

(c) Recommendations

The recommendations in this sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department.

The key priorities in the aviation sector are:

Key priorities for the Department for Transport should be to implement a SAF mandate and manage demand growth.

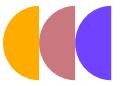
- The Government must publish its Jet Zero Strategy as soon as possible. This should provide a clear strategy for the sector to decarbonise and to provide certainty to airlines, airports, and supporting industries.
- To implement a SAF mandate as soon as possible in 2022 with strong safeguards to ensure significant lifecycle emissions savings.
- To consider the following criteria in the SAF mandate, without allowing this to delay its implementation:
 - Measure the lifecycle savings from SAF and only include those with minimal opportunity costs in other sectors in the mandate
 - Rule out any SAF that have greater non-CO₂ effects relative to those of fossil kerosene
 - Consider including high-quality, near permanent greenhouse gas removals as a way of airlines meeting the SAF mandate
 - Only include SAF or other technologies that support a swift transition to zero-carbon aviation
 - Fiscal policy (e.g. taxation, quotas or a frequent flyer levy) should be used to increase the price of flying to reflect the high emissions cost of air travel and incentivise low-emission alternatives. For example, the 50% Air Passenger Duty cut for domestic flights could be reversed to signal the high emissions cost of flying and incentivise low-emission forms of surface transport (e.g. rail travel)
 - Assess the Government's airport capacity strategy in the context of Net Zero. There should be no net expansion of UK airport capacity unless the carbon intensity of aviation can accommodate additional demand
- The Government should use its position at the 41st ICAO General Assembly to influence international cooperation and to protect, strengthen and extend CORSIA such that all residual emissions in 2050 are covered by near-permanent, sustainable greenhouse gas removals.
 - We also recommend that the Government commits to a policy on the UK ETS/CORSIA interaction as soon as possible, ensuring that it is sufficiently environmentally stringent and that no credits from the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) are used for flights currently covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability). The interaction should avoid double-compliance.

- To encourage airlines to quickly take steps to reverse the recent rapid increase in fuel consumption intensity (see Figure 9.4) by eliminating the use of ‘ghost flights’ and taking steps to increase seat occupancy by altering routes and flight frequencies.
- To measure aviation non-CO₂ effects regularly and include a target to limit the warming effects of both CO₂ and non-CO₂ emissions from aviation.
- Encouraging airlines and airports to set transition plans and, within these, set separate targets for emissions reductions and high quality, technology-driven removals (see Business and Finance Section in Chapter 14).

Demand management is particularly important as it can address both the CO₂ and non-CO₂ emissions from aviation, whereas technology primarily addresses the CO₂ emissions and relies on international cooperation.

Figure 9.16 shows a policy implementation timeline for aviation, including key government commitments and gaps in the Government’s aviation strategy as it stands.

Figure 9.16 Policy implementation timeline



Planning and decisions	Implementation					Outcomes					
H1 2022	H2 2022	2023	2024	2025	2026	2030					
Cross-cutting											
Department for Transport Jet Zero Strategy technical consultation	Department for Transport publish the Jet Zero Strategy				UK Government's 5-year strategy review						
Efficiency and low emission aircraft											
Average efficiency improvements 2% per year (2017-2050)											
'FlyZero' reports key findings on how the UK can best contribute to zero emission aircraft by 2030				2030: Ambition to have zero emission routes connecting the UK							
£685 million of Government funding for Aerospace Technology Institute to support the development of zero-carbon and ultra-low-emission aircraft technology.						2035: DfT planned entry date for class 1 and 2 zero emission aircraft.					
Track seat occupancy rates and consider regulating aircraft occupancy standards if the trends do not return to pre-pandemic levels in the next 12 months.											
Sustainable Aviation Fuel											
Consulting on mandating SAF from 2025	Commit to a SAF mandate as soon as possible in 2022				2030: Sustainable Aviation Fuel Mandate (10%) implemented						
						2035: SAF specific review by 2030 and use this to confirm a SAF trajectory to 2050					
Demand management											
Consultation on 'influencing consumers' - focuses on providing CO ₂ flight information to allow consumers to choose least polluting routes											
Implement a policy to manage aviation demand as soon as possible so the mechanisms are in place in the likely event that low emission technology are not commercially available to meet the Government's aviation pathway. The demand strategy should include a commitment to preventing any net airport expansion.											
Offsets / removals											
CORSIA's voluntary pilot phase			First phase of the voluntary offsetting participation in CORSIA			CORSIA's second phase					
CORSIA Periodic review			CORSIA Periodic review								
Commit to decision on the interaction between CORSIA and the UK ETS as soon as possible.			UK Government committed to have full legislation for CORSIA in force no later than the start of UK ETS Phase IIb in 2024								
Use the ICAO general assembly to strengthen CORSIA											
Key											
Planning Research, consultations, pilot schemes	Decisions Consultation responses, concrete policy plans	Legislation Legislation, updating regulations	Implementation Legislation into force, funding starts, deployment starts	Aviation Strategy Outcomes							
Necessary milestone that is not included in the Government's aviation strategy to date			Necessary milestone that is included in the Government's aviation strategy, but in this timeline, we suggest either an earlier date, or a specific date where their strategy has no date								

4. Major risks

Table 9.3 shows the key risks for the aviation sector in the Government's pathway. As highlighted in Figure 9.17, the primary risk is the heavy reliance on technological solutions and lack of focus on demand management. Figure 9.17 shows the 'high risk' emissions pathway which would result if the CCC's energy intensity assumptions were applied to the Jet Zero Strategy's demand assumptions.

Table 9.3

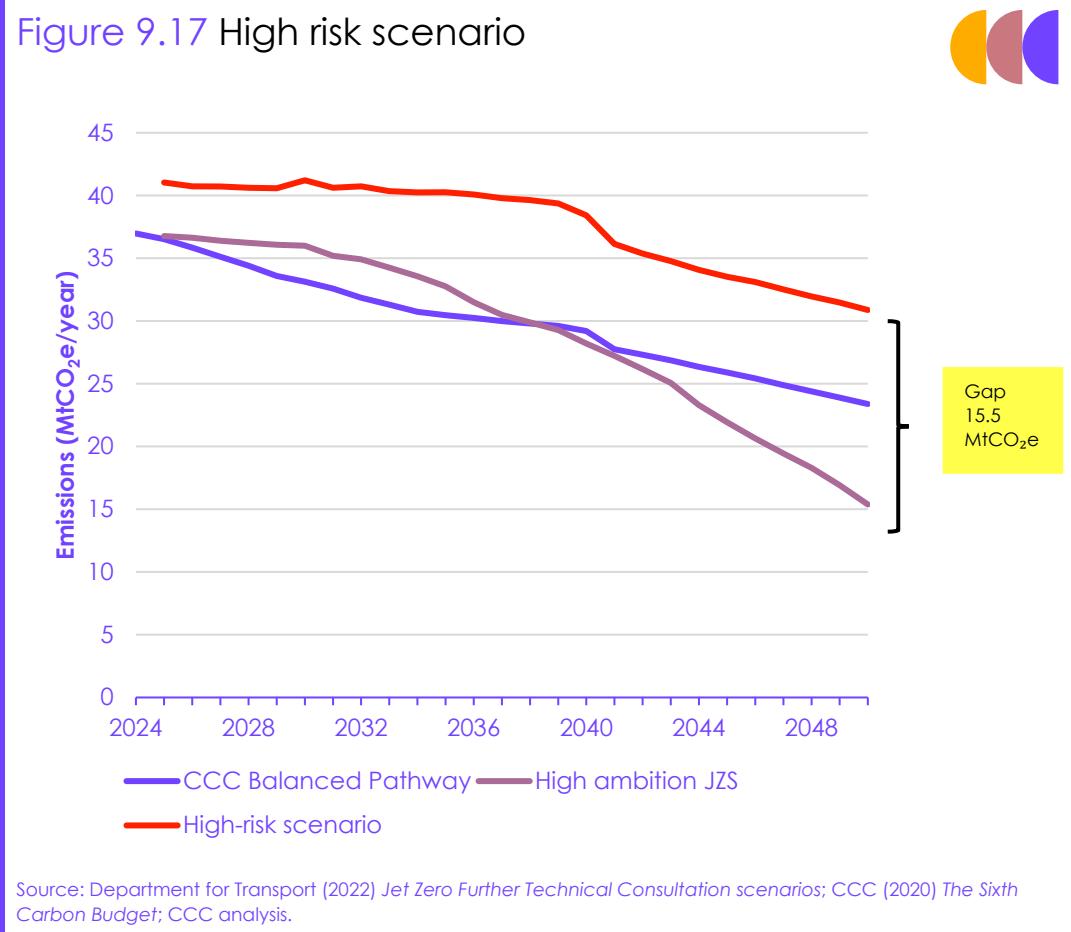
Major risks and required mitigating actions for aviation

Risk category	Description	Mitigating actions	
		Details	In place?
Dependence on rapid technological change	The Government's pathway for aviation relies heavily on very nascent technology being scalable and deployed relatively quickly for commercial use. There is no policy framework ready to implement that would mitigate demand growth if these technologies are not deployed as planned. Figure 9.16 highlights the risk of this strategy. It shows the emissions pathway taking the CCC's Balanced pathway assumption on emissions intensity per passenger and scales it to the demand scenario in the Government's pathway.	The Jet Zero Strategy consultation indicates that the Government will review the Strategy every five years. Fiscal policies, e.g. taxes, frequent flyer levies, quotas or subsidies for low-emission alternative forms of transport should be developed to mitigate demand now. These policies could be reviewed if the required technologies become commercially viable and address all the climate impacts of aviation (including non-CO ₂ impacts).	No
Non-CO₂ impacts of aviation	Unlike other sectors, a substantial fraction of the warming impact from aviation comes from non-CO ₂ impacts that are outside carbon budgets. If aviation CO ₂ emissions overshoot the Government's pathway, this would imply both greater efforts to reduce emissions in other sectors and a greater net impact on the climate due to the non-CO ₂ effects from aviation.	Use demand management to reduce both CO ₂ and non-CO ₂ impacts.	No
Sustainable Aviation Fuel do not contribute sufficient emissions reduction	SAF may not deliver sufficient abatement if airlines do not take up SAF to the level required in the Government's pathway for aviation and/or those fuels that are procured do not have a sufficient CO ₂ and non-CO ₂ saving.	If the SAF mandate is implemented as suggested by the consultation, this should be partially mitigated. However, if the source of SAF included in the mandate permits the use of SAF with high life-cycle emissions or opportunity costs in other sectors (e.g. first-generation feedstocks) or countries, the emissions savings will not be sufficiently high for the aviation sector and alternative policies, such as demand mitigation, will need to be implemented.	No

Post-pandemic low seat occupancy	There is potential that restricted air travel demand following the COVID-19 pandemic leads to persistent low seat-occupancy and therefore higher emissions intensity per flight in the absence of route adjustments. This is particularly an issue if 'ghost flights' are permitted to continue.	Monitor seat occupancy as the sector recovers from the pandemic. Introduce policies to adjust routes and encourage airlines to reduce, or implement policies to restrict their ability to run, flights with seat-occupancy below a reasonable level.	Partially
Zero-emission aircraft	Zero-emission aircraft are not commercially viable by the required timelines in the Government's aviation pathway (i.e. for zero-emission domestic flights by 2030).	Implement demand mitigation techniques, such as increasing the price of domestic aviation to encourage consumers to switch to low-carbon surface transport alternatives.	No

The cumulative difference in emissions between the high-risk scenario and the Government's Jet Zero Strategy pathway for 2025-2050 is 226 MtCO₂e.

Figure 9.17 High risk scenario



Endnotes

- ¹ Berger, S., Kilchenmann, A., Lenz, O., Schlöder, F (2022) *Willingness-to-pay for carbon dioxide offsets: Field evidence on revealed preferences in the aviation industry*, <https://doi.org/10.1016/j.gloenvcha.2022.102470>.
- ² Lee, D., Forster, P (2020) Guest post: *Calculating the true climate impact of aviation emissions*, <https://www.carbonbrief.org/guest-post-calculating-the-true-climate-impact-of-aviation-emissions/>.
- ³ Lee, D. et.al. (2020) *The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018*, <https://doi.org/10.1016/j.atmosenv.2020.117834>.
- ⁴ Murray, L (2021) *France's ban on short flights should be a wake-up call for Britain*. The Guardian, 13 April 2021, <https://www.theguardian.com/commentisfree/2021/apr/13/france-ban-short-domestic-flights-britain-air-travel>.
- ⁵ BBC (2019) *Why flight shame is making people swap planes for trains*, <https://www.bbc.com/future/article/20190909-why-flight-shame-is-making-people-swap-planes-for-trains>.
- ⁶ IATA (2022) *Fact Sheet: EU and US policy approaches to advance SAF production*, <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/fact-sheet---us-and-eu-saf-policies.pdf>.
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- ⁸ Gear, C (2022) *FlyZero Executive Summary*, <https://www.ati.org.uk/wp-content/uploads/2022/03/FZO-ALL-REP-0003-FlyZero-Executive-Summary.pdf>.
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- ¹¹ Civil Aviation Authority (2022) *CAA's Environmental sustainability strategy*, <https://publicapps.caa.co.uk/docs/33/CAP2360%20CAA%20Environmental%20Sustainability%20Strategy.pdf>.



Chapter 10: Shipping

12 MtCO₂e, 3% of UK emissions, in 2021

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Introduction and key messages

Shipping emissions had been steadily reducing over recent years, before a sharp fall during the pandemic, with emissions now beginning to rebound. The Government's Net Zero pathway requires sectoral emissions (including both domestic and the UK's share of international shipping) to fall by around 28% by 2035, relative to 2019 levels. The UK's share of international shipping emissions is included in the UK's Net Zero target and, from 2033, will be included within carbon budgets.

This Chapter reviews progress in reducing emissions from shipping and outlines the next steps required to ensure that the UK builds on this progress and meets future Carbon Budgets.

Our key messages are:

- **The path to Net Zero.** Delivering deep emissions reductions in shipping will require a transition to low-carbon fuels (such as ammonia or methanol, produced from green hydrogen).* The development of commercial production of such fuels, as well as the availability of competitive engine technologies and retrofit solutions to enable vessels to use them, will take time leading to a relatively back-loaded decarbonisation pathway – as expected, current uptake is essentially zero. Delivering this transition is the pivotal outcome for the shipping sector.
- **International action.** Effective international policy is essential to deliver reductions in global maritime emissions. Progress at the International Maritime Organisation (IMO) has been slow. The UK must take a leadership role in pushing for adoption of a Net Zero target for the sector – as backed by the majority of the industry – together with international mechanisms to deliver it, in the 2023 update of the IMO's initial GHG strategy. This target should minimise the use of offsetting, to drive ambitious decarbonisation of vessels, fuels, and operations.
- **UK policy.** The Government has made important commitments on decarbonising shipping and begun efforts to implement them in the last year:
 - The Government has stated its ambition to achieve Net Zero emissions from domestic shipping by 2050 at the latest.
 - The new National Shipbuilding Strategy includes commitments that all new UK-built vessels for use in UK waters must be designed with zero-emission capabilities by 2025, and that zero-emission fuel bunkering will be widely available across the UK by 2035. DfT will consult on phasing out the sale of new non-zero-emission domestic vessels, and an extension of the ETS to domestic shipping has been proposed.
 - The establishment of a UK Shipping Office for Reducing Emissions (UK-SHORE) is a significant development. This office is expected to publish a strategy for achieving full decarbonisation of the sector later in 2022, after which we will update our indicators and assessment of the sector.

* Further discussion on the production of hydrogen-based fuels can be found in the Fuel supply chapter.

The Chapter is set out in three sections:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps

1. Emissions trends and drivers

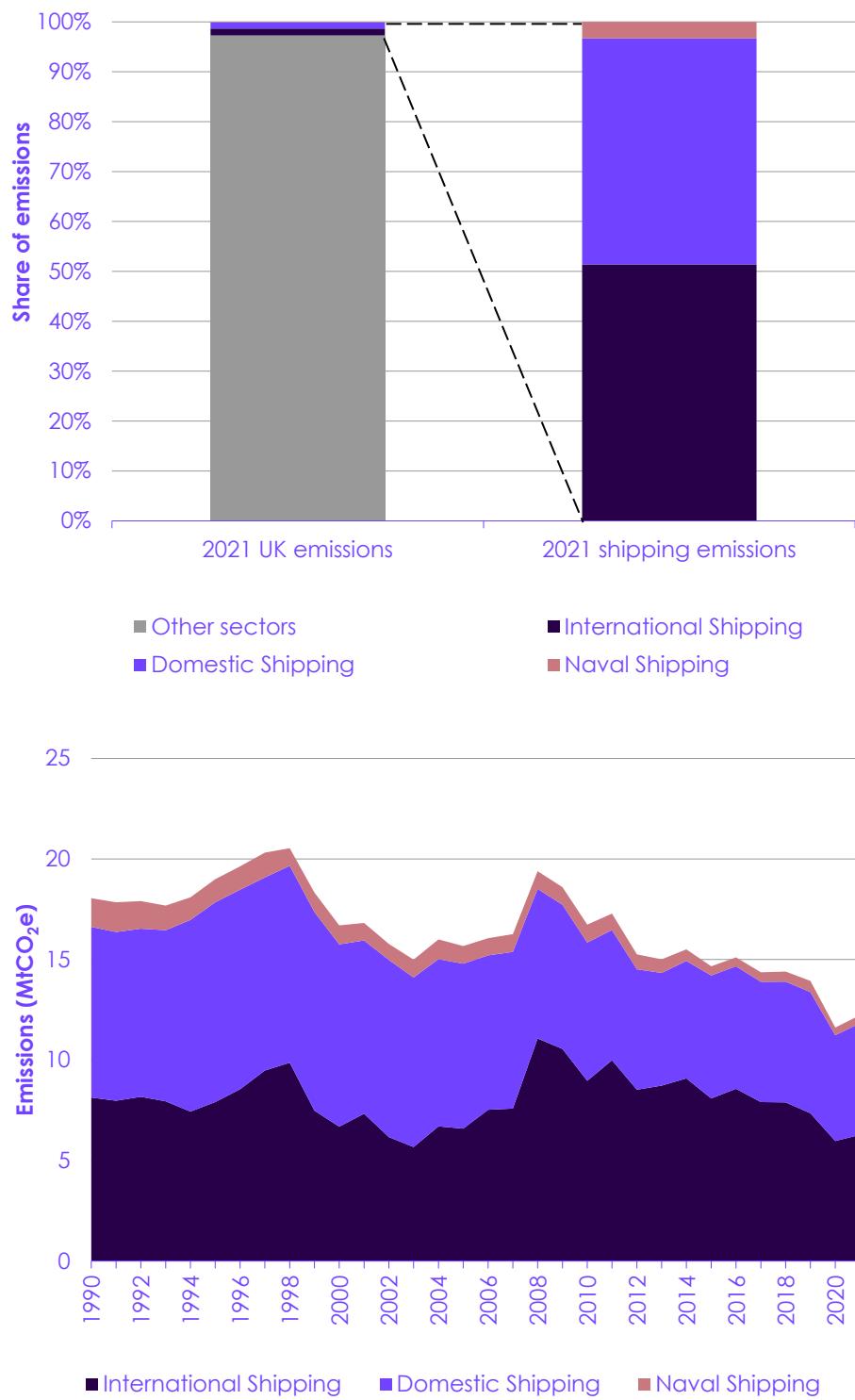
Shipping emissions fell by 16% in 2020 due to pandemic responses. In 2021 emissions rebounded by 4%.

Our provisional estimates suggest that the shipping sector contributed around 3% of total UK emissions in 2021. Just over half of this came from international shipping, with the remainder from the domestic sector.

- Emissions had fallen by around 2% per year over the past decade, before a 16% reduction in 2020 (Figure 10.1). Our estimates suggest that they rebounded by 4% in 2021 but remained 13% below 2019 levels.
 - The 2020 fall was due to reductions in global shipping demand, with overall freight tonnages moved through UK ports 9% lower than in 2019. These were caused by responses to the pandemic, and provisional statistics¹ show that this disruption continued into 2021 with total freight rebounding only 2%.
 - The emissions savings over the preceding decade were driven in part by a 26% fall in domestic shipping activity and a 7% reduction in outbound international freight shipping, due largely to significant reductions in the quantities of oil and coal being transported. In addition, global vessel carbon intensities improved by around 30% between 2008 and 2018.

Over half of total UK shipping emissions in 2021 came from international shipping.

Figure 10.1 Shipping emissions by sub-sector as a share of UK total



Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics 2021; BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.
Notes: Global warming potentials from IPCC AR5 without feedback are used.

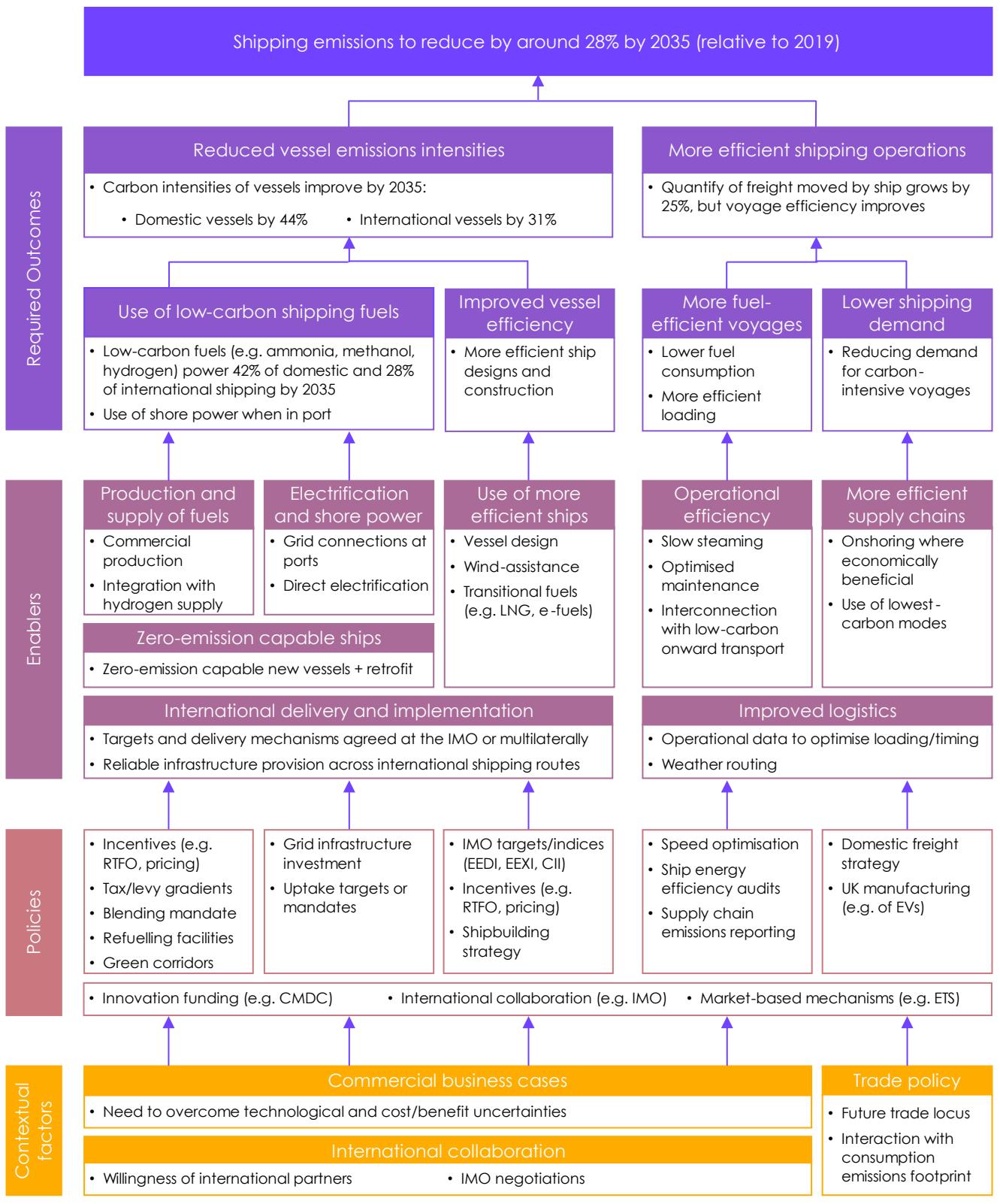
2. Indicators of progress

The range of actions and conditions that combine to enable decarbonisation of shipping is summarised in Figure 10.2. The details of how these work together to deliver the sector's decarbonisation pathway are introduced in our accompanying Monitoring Framework.

We hope to update our indicators to allow more granular monitoring of the enablers that will deliver the key decarbonisation outcomes for the sector, such as the uptake of low-carbon fuels and the availability of shore-side electrification infrastructure, based on the approach set out in the Course to Zero strategy expected later in the year. For now, we monitor a subset of indicators. Progress this year on these indicators is shown in Table 10.1.

At present, take-up of both low-carbon fuels and electrification are essentially zero. They are not yet reported in regular publications, and should be in future.

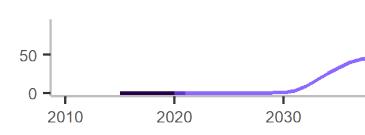
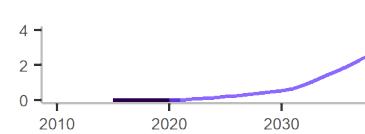
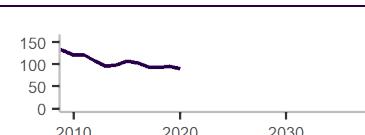
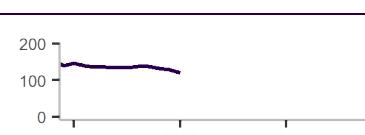
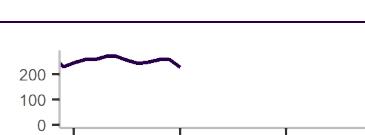
Figure 10.2 Monitoring map for shipping



Source: CCC analysis; milestones based on Net Zero Strategy and CCC pathways.

Table 10.1

Key indicators for the shipping sector

Shipping indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Low-carbon fuels	Use of low-carbon fuels	2021	0%; CCC benchmark: 0%	0% from 2020	
Electrification	Use of electricity	2021	0%; CCC benchmark: 0.0036%	0% from 2020	
Demand	Domestic freight moved	2020	90 Mt	-6% from 2019	
	International freight moved - exports	2020	120 Mt	-6% from 2019	
	International freight moved - imports	2020	230 Mt	-11% from 2019	

Notes: All values are rounded to two significant figures; solid lines represent pathways; all indicators are UK wide unless otherwise stated.
Source: Refer to our website for accompanying data and more details on our indicators, including sources and units use.

3. Policy progress, assessment and next steps

The Transport Decarbonisation Plan (TDP), published in July 2021, included a chapter on accelerating maritime decarbonisation. This included eight commitments outlining how the Government intends to approach decarbonising the sector.

The Government has committed to consulting later in 2022 on a Course to Zero for the maritime sector (i.e. a strategy to reach the Government's ambition for Net Zero shipping by 2050 at the latest) and embedding this within its Clean Maritime Plan.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

UK policy

Decarbonisation of the shipping sector will require innovation in fuel and engine technologies. The Government is supporting early-stage innovation in these spaces through innovation competition funding and production incentives.

Government funding is supporting feasibility studies to investigate the viability of various low-carbon technologies.

UK-SHORE will take responsibility for delivering interventions and overcoming market failures to drive forward decarbonisation of the sector.

The RTFO has been extended to include renewable fuels of non-biological origin for maritime uses.

- The first tranches of funding through the Clean Maritime Demonstration Competition (CMDC) were announced in September 2021.
 - This has provided £23 million to 55 green innovation projects, for a series of feasibility studies to investigate the viability of technologies including shore power, ammonia fuel cells, and wind-power assistance.
 - A second round of funding is expected to build upon these initial projects in 2022.
- DfT has recently launched the new UK Shipping Office for Reducing Emissions (UK-SHORE). This office will take responsibility for delivering interventions and overcoming market failures to drive forward decarbonisation of the sector.
 - The Government is investing a further £206 million in the sector through UK-SHORE. As part of this, a new multi-year expansion of the CMDC will be launched, aiming to support projects including on ammonia, hydrogen, and battery technologies.
- A significant step forward in support for production of low-carbon shipping fuels was the extension of the Renewable Transport Fuels Obligation (RTFO) to include renewable fuels of non-biological origin for maritime uses, which commenced at the beginning of 2022. It will cover fuels such as ammonia, methanol, and hydrogen.

- The potential for producing low-carbon shipping fuels, such as ammonia and methanol, from hydrogen was also covered in the Government's Hydrogen Strategy, which was published in August 2021. This emphasised the potential value of these fuels in allowing energy from hydrogen to be stored at higher density, but also the need to ensure that production and usage are aligned to wider emissions standards.

Electrification, particularly for vessels at berth in ports, can also play an important role. DfT launched a call-for-evidence on shore power in early 2022.

- This sought evidence on a variety of potential options, including Government mandates and market-based measures, for encouraging provision and use of shore power infrastructure.

The Government has stated its ambition to achieve Net Zero emissions in the domestic shipping sector by 2050 at the latest. The Course to Zero strategy, due to be published later in 2022, will consult on options for achieving this.

- This will be supported by indicative emissions targets from 2030.
- The new National Shipbuilding Strategy includes a welcome focus on harnessing the opportunities of the transition to green shipping. This includes commitments that all new UK-built vessels for use in UK waters must be designed with zero-emission capabilities by 2025, and that zero-emission fuel bunkering will be widely available across the UK by 2035.
 - This included promising consideration of key enablers, including skills, timelines, and a mapping of the viable technologies and potential market sizing.
 - DfT will also consult later in 2022 on a phase-out date for ending the sale of new non-zero-emission domestic vessels.
 - At the same time, investment in the development of competitive retrofit solutions will also be necessary to allow existing ships to be updated to use zero-emission fuels. Major marine engine manufacturers are beginning to develop these options.²

The Course to Zero strategy will consult on options to achieve Net Zero shipping emissions by 2050 and will include indicative emissions targets from 2030. A phase-out date for ending the sale of new non-zero-emission domestic vehicles will also be consulted on in late 2022.

A recent consultation proposed extending the UK ETS to cover parts of the domestic maritime sector.

The UK ETS Authority's March 2022 consultation on developing the UK's Emissions Trading Scheme (ETS) proposed extending the scheme's scope to cover parts of the domestic maritime sector.

- The Authority's preferred option is to apply this on an activity basis, based on fuel consumed multiplied by the carbon intensity of the fuel.
- This will build upon the MRV requirements within the Merchant Shipping regulations, which came into force at the beginning of 2022 and require operators of ships with gross tonnage over 5,000 to report these data.

Various maritime operations in the UK are beginning to take steps towards trialling low-carbon fuel and vessel technologies in commercial operation.

- At COP26, DfT launched Operation Zero, an agreement between the maritime and offshore wind sectors to deploy zero-emission vessels for wind turbine servicing by 2025.

- The HySeas 3 project aims to deploy a ferry powered by hydrogen fuel-cells in the Orkney Islands.

International policy

Shipping is an inherently global sector, so effective decarbonisation action requires joined-up international action. The International Maritime Organisation is the organisation responsible for agreeing global action.

Just targets and global mechanisms are required to deliver decarbonisation at the necessary pace.

However, the IMO's current targets are insufficient and progress to update these has been slow. This is despite the shipping industry backing a Net Zero target. Beyond just targets, global mechanisms to deliver decarbonisation are also required.

- The 77th session of the IMO's Marine Environment Protection Committee declined to commit to the sector achieving Net Zero by 2050. Instead, emissions reduction plans and potential targets will be considered in the update of the IMO's initial GHG strategy due in 2023.
 - As global shipping emissions continue to rise,³ the IMO's existing targets are clearly insufficient and such delays to updating these are detrimental to the sector's ability to decarbonise.
 - Proposals to introduce a Net Zero target are backed by a majority of the shipping industry.⁴
- The IMO's current efficiency target is for a 40% reduction in carbon intensity by 2030 (relative to 2008 levels), pursuing efforts towards 70% by 2050. This target is unlikely to drive sufficient progress, as over 30% improvement has already been delivered.
 - Since 2013, the main mechanism to deliver this has been the Energy Efficiency Design Index, requiring minimum energy efficiency standards for new ships.
 - From 2023, this will be supplemented by a similar Energy Efficiency Existing Ship Index for existing vessels and a new A-E-rated Carbon Intensity Indicator. Port authorities will be encouraged to offer incentives to high-performing vessels.
 - Delivery mechanisms for a Net Zero target will need to extend beyond these indices to provide a comprehensive package of measures, comprising also agreed taxes and levies, efficient redistribution mechanisms, and minimum national regulation requirements.

Current IMO efficiency targets are unlikely to drive sufficient progress.

The Fit for 55 package introduced measures to support decarbonisation of the EU maritime sector.

In July 2021, the EU introduced a reasonably comprehensive package of measures to support decarbonisation of the region's maritime sector, as part of the "Fit for 55" legislative package.

- This included market-based mechanisms backed by regulation, tax incentives, and infrastructure provision:
 - The EU ETS will be extended to cover ships above 5,000 gross tonnes. This establishes a market-based mechanism to cap emissions from the sector and incentivise operators to make their vessels more efficient.

- New FuelEU Maritime mandates will require ship operators to meet targets on reducing their fleetwide GHG intensity, rising to a 75% reduction by 2050.
- Subject to approval by all member states, a tax levy on bunker fuels will be introduced, including differential rates and exemptions for low-carbon fuels.
- These measures will be supported by regulations requiring member states to provide refuelling infrastructure for clean fuels and shore power connections.
- The Fit for 55 package also proposed a change from the accounting of international emissions based on bunker fuel sales to counting 50% of all inbound and outbound journeys towards the EU's emissions account. This portion of such journeys will also be captured under the EU ETS.
 - This could be increased further to 100% if a global market-based mechanism for driving decarbonisation is not implemented.
 - The UK Government should explore making a similar accounting change to ensure that emissions from international voyages to and from the UK are accurately reflected in emissions inventories in future. Otherwise, there is a risk that vessels will increasingly choose to refuel at ports in less ambitious countries that allow continued use of higher-carbon fuel sources.

There are targets to create at least six green corridors by the mid-2020s and many more by the 2030s.

The Clydebank Declaration, signed at COP26, recognised concerns around increasing global shipping emissions and the need for action to go further and faster than has currently been agreed at the IMO. There were 24 nations party to this agreement, aiming to establish green shipping corridors.

- The Declaration aims to support the establishment of at least six green corridors by the mid-2020s, and many more by the 2030s. Signatories have pledged to facilitate partnerships across the sector and explore inclusion of enabling actions in national strategies.
- This is a good example showing how UK leadership can enable multilateral agreements with willing partners that extend beyond globally agreed plans. It will be important for the UK to continue to show leadership in driving forward these agreements and the implementation of corridors.

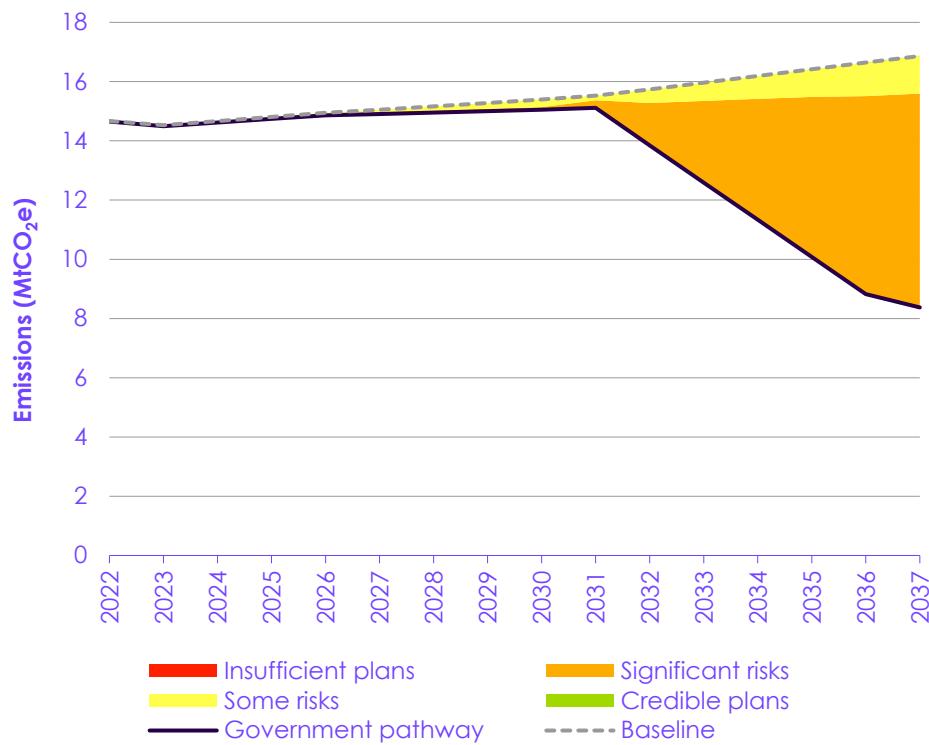
(b) Assessment of policies and plans

UK policy has shown positive steps in supporting early innovation for shipping, but slow international progress represents a significant delivery risk.

Most of the abatement required in the Net Zero delivery pathway for shipping is driven by uptake of low-carbon fuels from the 2030s onwards. While UK policy is showing positive steps in supporting early innovation in this market, the slow nature of current international progress represents a significant delivery risk (Figure 10.3 and Table 10.2).

Through the policy measures outlined in the previous section, we assess that the Government and the devolved administrations have achieved one, partly achieved one, and not achieved one of the recommendations for the shipping sector in our 2021 Progress Report. A further four recommendations were of a more ongoing nature, and of these one is showing clear signs of positive progress, two have seen some but insufficient progress, and one has shown no progress.

Figure 10.3 Assessment of policies and plans for shipping



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: The levels of global shipping demand are identical across the Government's modelled delivery pathway and baseline. This means that the potential for abatement due to reductions in overall demand are not quantified within this analysis.

Table 10.2

Policy scorecard for shipping

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Low-carbon fuels 85% of 2035 abatement	O	Y	O	Y	O
		<ul style="list-style-type: none"> The launch of UK-SHORE, the extension of the CMDC, the expansion of the RTFO to cover hydrogen-based fuels, and the proposal to include domestic shipping in the UK ETS are all positive steps. The upcoming Course to Zero strategy and the refreshed Clean Maritime Plan now need to set out more detail on roles and responsibilities and what will be delivered when. The 2023 refresh of the IMO's GHG strategy must include a Net Zero goal for 2050 (at the latest). This will need to be supported by international mechanisms that ensure operators are incentivised to transition to low-carbon fuels and nations are required to make appropriate refuelling infrastructure available at ports. 			
Efficiency and electrification 15% of 2035 abatement	O	Y	Y	Y	Y
		<ul style="list-style-type: none"> The recent call for evidence on potential options for providing shore power at UK ports signals an intent to make this widely available, including the possibility of mandation. This needs to be developed into a credible delivery plan. Greater ambition on efficiency measures is needed at both UK and international level. 			
Demand management No quantified abatement in Net Zero Strategy pathway	R	O	O	O	O
		<ul style="list-style-type: none"> The proposed extension of the UK ETS to cover a portion of domestic shipping could provide price incentives to reduce unnecessary demand. However, there is not yet a comprehensive strategy for how to manage demand. This should be embedded within plans to lower the UK's consumption emissions. 			
Overall sector assessment	O	Y	O	Y	O

(c) Recommendations

Increased ambition and credible plans are needed in the shipping sector, at both a domestic and international level.

The coming year is a crucial time for the shipping sector, as it presents opportunities at both a domestic and an international level to increase ambition and set out credible plans to deliver on this.

- Our priority recommendation for the sector is for the UK to take a leadership role in pushing for inclusion of a Net Zero 2050 target within the 2023 update of the IMO's initial greenhouse gas strategy.
 - This is vital to ensure that global action is aligned towards a Paris-compliant level of ambition. The IMO should then build upon this by developing and agreeing a package of measures to deliver.
 - If this does not occur, then the Government will have to think carefully about how to drive genuine emissions reductions in international shipping routes to/from the UK without risking carbon leakage. Consideration of an activity-based measure of shipping emissions could be a useful starting point in this regard.
- The UK Government must also continue to show international leadership by ensuring that the UK and partners are proactive at taking the voluntary actions agreed within the Clydebank Declaration, and should report on progress in identifying routes and the actions to implement them ahead of COP28 in 2023.
- The establishment of UK-SHORE and the commitment to set out a Course to Zero also present an opportunity to drive investment in decarbonising UK shipping.
 - The Course to Zero should set an ambitious trajectory, supported by measurable interim targets. It must then be embedded within the upcoming updated Clean Maritime Plan, providing a credible plan for how this trajectory will be delivered. This should include a comprehensive range of measures similar to those recently proposed by the EU.
 - This delivery plan should include support and incentives for development of low-carbon fuels and engine technologies, as well as solutions such as route and speed optimisation that can deliver emissions savings in the short term.
- Mechanisms for ensuring the widespread availability of low-carbon fuel bunkering and refuelling facilities and shore power infrastructure will also be important.
 - Committing to development of a commercial-scale clean maritime cluster in the UK would support development and testing of these facilities and build confidence in the viability of the sector's transition.
 - The Government should build on the recent call for evidence to develop a full delivery plan for deploying shore power and electric recharging infrastructure across all major ports and requiring its use when at berth.
 - The Government currently has an opportunity to embed these requirements into agreements with operators to establish freeports.

The UK Government must continue to show international leadership in the shipping sector.

Endnotes

¹ DfT (2022), *Port freight statistics (Table PORT0502)*, <https://www.gov.uk/government/statistical-data-sets/port-and-domestic-waterborne-freight-statistics-port>

² MAN Energy Solutions (2021), *Unlocking ammonia's potential for shipping*, <https://www.manes.com/discover/two-stroke-ammonia-engine>

³ IMO (2020), *Fourth greenhouse gas study*,
<https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx>

⁴ International Chamber of Shipping (2021), *Shipping industry sets out bold plan to global regulator to deliver Net Zero by 2050*, [https://www.ics-shipping.org/press-release/shipping-industry-sets-out-bold-plan-to-global-regulator-to-deliver-netzero-by-2050/](https://www.ics-shipping.org/press-release/shipping-industry-sets-out-bold-plan-to-global-regulator-to-deliver-net-zero-by-2050/)



Chapter 11: Waste

25 MtCO₂e, 6% of UK emissions, in 2020

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Introduction and key messages

Progress in reducing emissions from landfill has recently been undermined by increased incineration. Tackling these dual challenges requires a step change in waste reduction and recycling, as part of a holistic plan to decarbonise the sector.

Historically, the UK has made good progress in reducing emissions from the waste sector, as the Landfill Tax reduced the amount of waste being landfilled. The key challenge now is to end the landfilling of biodegradable waste and reduce reliance on incineration by delivering a step-change in recycling, re-use and waste prevention. This will need the Government to implement, and go beyond, its planned waste management reforms. This Chapter reviews progress in reducing emissions from waste (including Energy from Waste)* and outlines priority actions for the sector to support delivery of future carbon budgets and Net Zero.

Our key messages are:

- **Emissions.** Overall waste emissions declined 5% in 2020 compared to 2019. The Landfill Tax continues to be effective in diverting waste from landfill, reducing methane emissions as a result. It remains to be seen if emissions will continue to decline following the COVID-19 pandemic.
- **Underlying Progress.** However, waste is increasingly being diverted to incinerators and Energy from Waste plants - from which emissions continue to rise, whilst recycling rates declined in England and Scotland – partly due to the pandemic affecting services. Wales, and increasingly Northern Ireland, show it is possible to achieve higher recycling and minimise incineration.
- **Policy assessment.** The Net Zero Strategy provided limited detail on how emissions from waste will be reduced but did announce a new intention to prevent bio-degradable waste from going to landfill by 2028. Empowered by the Environment Bill, Government is bringing in a series of reforms to waste collection and treatment. These will be key to meeting the landfill commitment and future waste reduction and recycling targets.
- **Recommendations.** Timely and effective implementation of the forthcoming waste reforms is a key priority for the sector, but further action is needed. Notable priorities include to limit continued growth in incineration, publish a sector plan for Net Zero and ensure the right incentives and regulations are in place to facilitate decarbonisation.

The rest of this chapter is laid out as follows:

1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps
4. Major risks

* The CCC considers the waste sector to include emissions from Energy from Waste (EfW), which the Government includes within the 'Energy Supply'/power sector. We may refer to Energy from Waste and incineration interchangeably and/or consider them together.

1. Emissions trends and drivers

Waste emissions declined 5% between 2019 and 2020, due to the continued effectiveness of the Landfill Tax at diverting residual waste elsewhere. Increased incineration of waste had seen emissions rising prior to the pandemic.

Waste emissions in 2020 were around 25 MtCO₂e, almost 6% of UK emissions (Figure 11.1). Emissions from waste reduced by about 5% in 2020 from 2019 levels.

- This was driven principally by a 9% reduction in methane emissions from landfill, which accounts for over half of the emissions from the sector.
- Energy from Waste plants and incineration is responsible for about a quarter of the sectors emissions and increased by 3% from 2019.
- Emissions from wastewater treatment, for which estimated emissions were revised down in 2021, are responsible for around 10% of emissions in the sector.

The Landfill Tax came into force in 1996 and has been effective in diverting waste to alternative treatment methods, resulting in sustained emissions reductions (Figure 11.1). This has been driven principally by reductions in biodegradable waste being landfilled, which produces methane when decomposing.

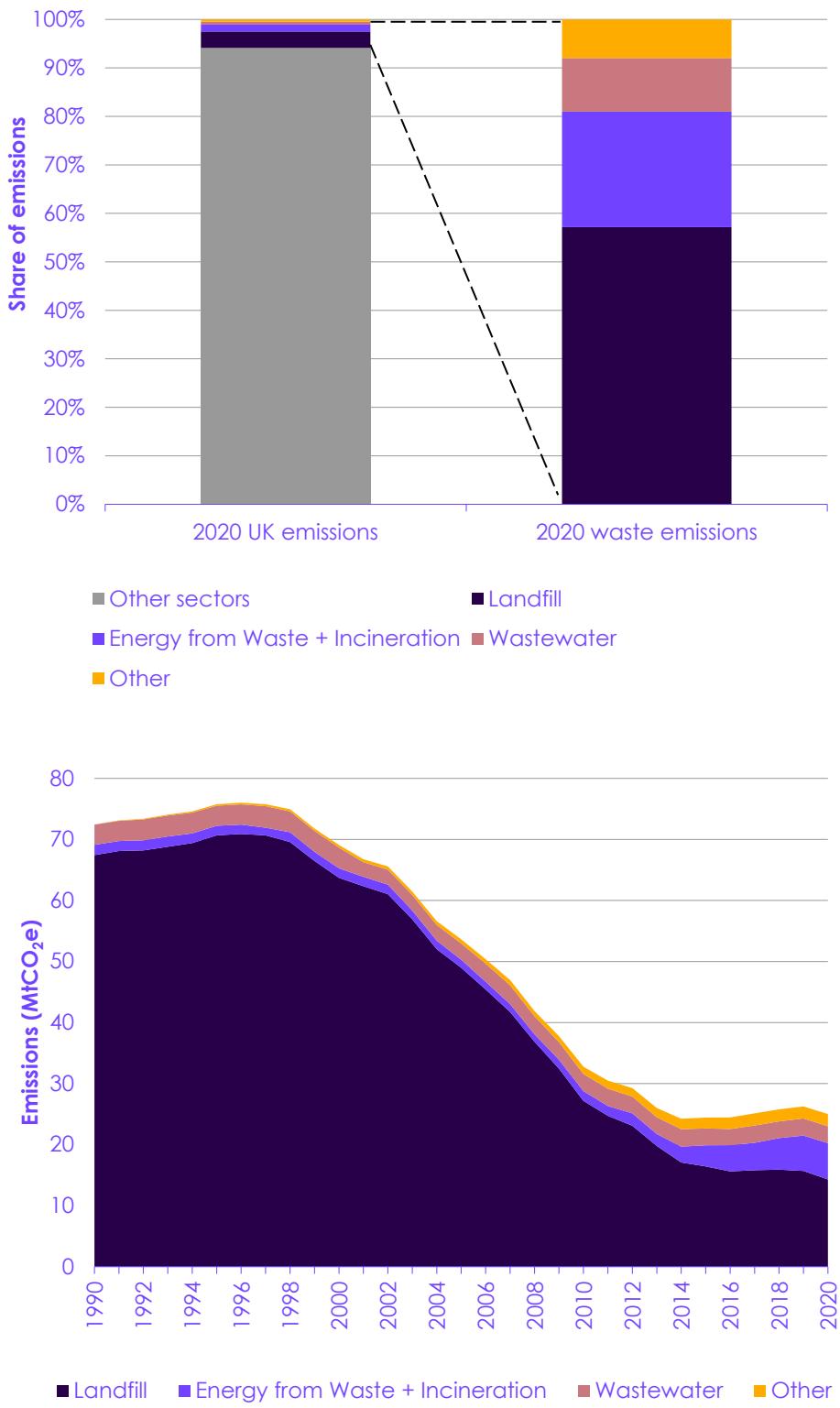
More recently, increasing amounts of waste have ended up being incinerated which had led to growing waste emissions in the years prior to the COVID-19 pandemic. However, methane reductions from landfill outweighed the increase in incineration emissions in 2020.

The pandemic is believed to have affected the sector in the following ways:

- The pandemic led to increases in household and municipal waste in England as people spent more time at home, alongside disruptions to recycling services which saw recycling rates decline and the proportion of waste sent to incinerators increase.¹
- On the other hand, research from WRAP suggested the pandemic saw short-lived positive changes in people's behaviours regarding food waste, as people had more time to plan and prepare food.² Studies by Resource London found that commercial waste arisings in the capital fell substantially during 2020.³

Half of waste emissions are caused by biodegradable waste decomposing in landfill, 25% is from Energy from Waste/incineration, and 10% from wastewater treatment. Waste emissions in 2020 are 65% lower than in 1990.

Figure 11.1 Waste emissions by sub-sector as a share of UK total



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.
Notes: 'Other' includes emissions from composting, mechanical biological treatment and anaerobic digestion; Global warming potentials from IPCC AR5 without feedback are used.

2. Indicators of progress

Our indicator framework for waste suggests that efforts to reduce emissions are being stymied by a lack of progress in reducing waste arisings and improving re-use and recycling, coupled with increasing incineration of waste.

The range of actions and conditions that combine to enable decarbonisation of the waste sector is summarised in Figure 11.2. The details of how these work together to deliver the sector's decarbonisation pathway, along with a full set of data indicators designed to track each of these elements, are introduced in our accompanying Monitoring Framework. Progress this year on the key indicators is shown in Table 11.1 and Figures 11.3 -11.9. Progress on the full set of indicators is shown in the supporting data to this report.

Our key messages on indicator progress are:

- Prior to the pandemic, waste arisings before treatment or recycling were increasing from commercial sources, whilst waste from households remained broadly flat (Figure 11.3).
- Meanwhile municipal residual waste (after treatment, recycling) had been increasing, and although the amount being sent to landfill has been decreasing, the use of incineration has been growing (Figure 11.4).
- This is due to a lack of progress in preventing waste and improving recycling rates (Figure 11.5), particularly in England, where incineration is now more widespread than recycling (Figure 11.6), and Scotland (Figure 11.7) – with Northern Ireland (Figure 11.9) performing better. Wales has shown that it is possible to reduce landfill whilst limiting incineration by achieving higher recycling rates (Figure 11.8 and Box 11.1).
- Progress in tracking reductions in food waste and improving resource efficiency are covered in Chapter 8 on Agriculture and Land Use, and Chapter 5 on Manufacturing and Construction respectively. WRAP's latest food waste survey suggests good progress against the target to reduce waste by 50% in 2030 (against 2007 levels), but it's unclear to what extent this has been driven by policy.

Wales has demonstrated that higher recycling rates are possible, and that incineration can play a limited role whilst reducing the use of landfill.

Box 11.1

Focusing on Reduction, Re-use and Recycling to limit role of incineration

There are several factors behind the rising use of incineration as an alternative to landfill, in the context of stalling recycling rates:

- Incineration is considered to have a lower overall environmental impact compared to landfill – including in terms of emissions, whilst Energy from Waste plants offer an opportunity to recover value from waste feedstocks by generating power and sometimes providing heat.
- Energy from Waste plants have benefitted from a supportive planning and investment policy regime, including Defra's Waste Infrastructure Delivery Programme, which has seen the number of plants grow from 37 in 2016 to 54 by the end of 2020 (not including Incinerators without energy recovery).⁴
- Increasing recycling requires coordinated action across a range complex factors, including public engagement and service provision to improve behaviours, whereas incineration offers a relatively simple disposal option to Local Authorities or businesses. Higher incineration coupled with lower recycling rates can often be observed in urban areas⁵ where there might be higher levels of deprivation and more limited access to recycling facilities or services.⁶

However, Wales – which has one the highest recycling rates in the world⁷ has – shown that higher rates of recycling are possible alongside a minimal role for incineration, provided the right policy framework and funding mechanisms. We presented a summary of key learnings from the Welsh Government's approach⁸ in our 2021 Progress Report, which noted:

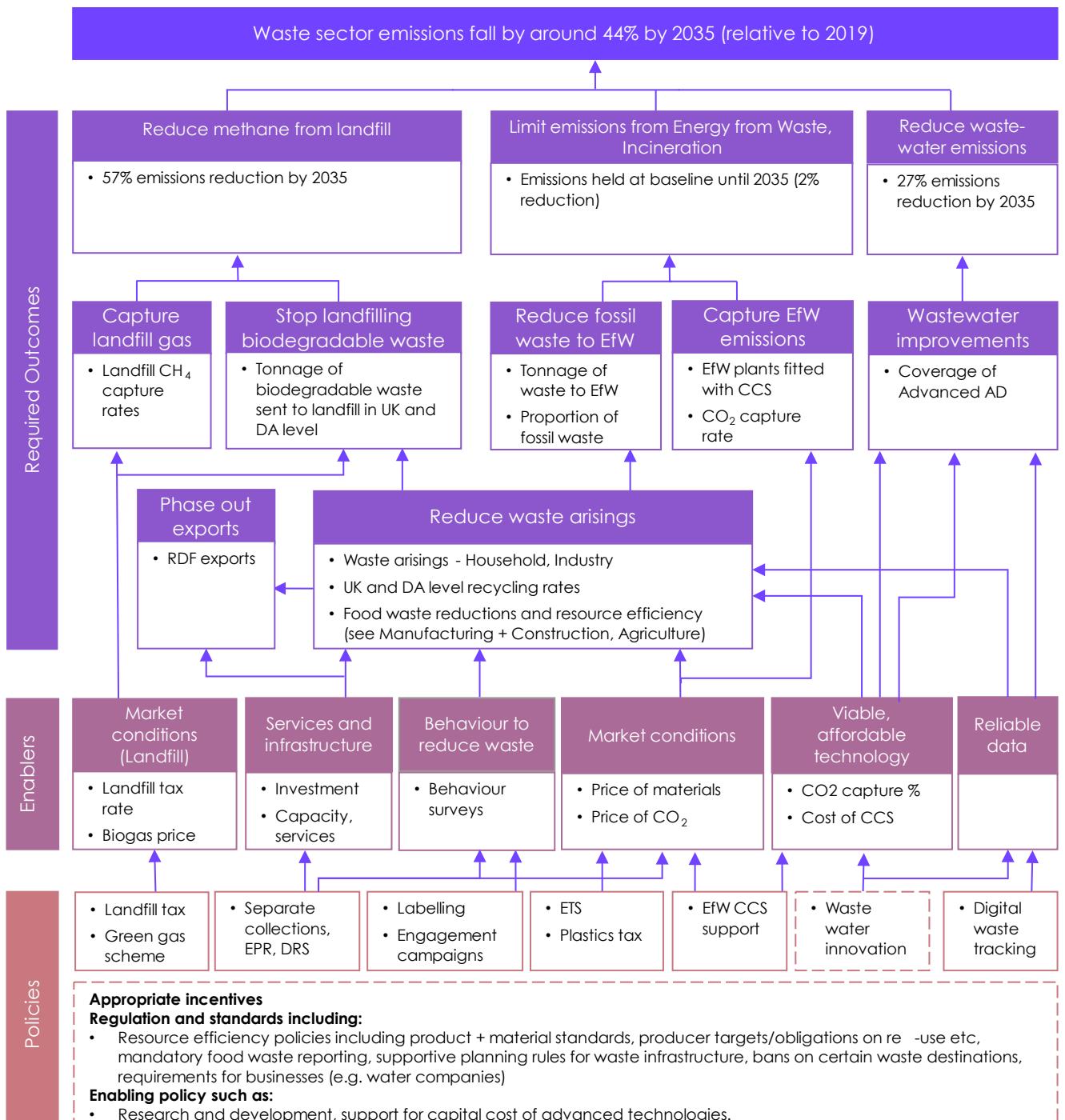
- The setting of statutory recycling targets for Local Authorities provided an incentive for action (although these may be more challenging to implement across England).
- Promotion of positive recycling and waste prevention behaviours to the point of being considered an important part of Welsh culture.
- Investment in services and facilities to support recycling and re-use, with dedicated resources available for Local Authorities to audit and support their waste management practices.
- Consistent recycling and weekly food waste collections, with reduced collections for general rubbish.

Scotland recently completed an independent review into the role of incineration and the Scottish Government has subsequently placed a moratorium on new planning permissions for incinerators beyond those already planned.

- We will report fully on this development in our Scottish Progress Report later this year, but the Review made a range of recommendations to minimise the role of incineration whilst ensuring Scotland fulfils its commitment to prevent biodegradable waste from going to landfill from 2025, including calling for an indicative cap on the level of residual waste treatment which reduces over time.

The planned reforms to waste management, including Extended Producer Responsibility and consistent collections, should help to enable higher recycling rates in England and across the UK but these alone won't be sufficient. Greater focus is needed to unlock long-term investment into recycling and drive behaviour change, to avoid waste in the first place, including through prevention, efficiency, re-use and extending product lifetimes. At the same time, action is required to avoid an over-reliance or over-capacity of incineration.

Figure 11.2 Monitoring map for waste

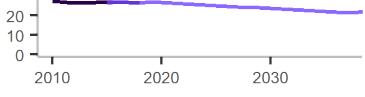
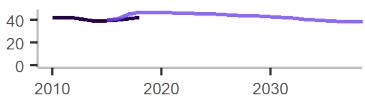
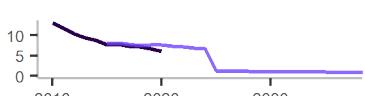
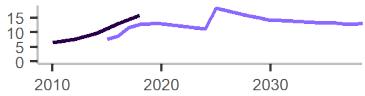
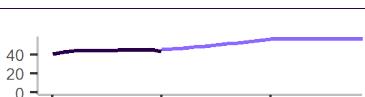
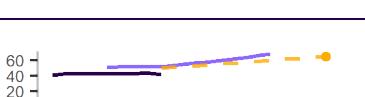
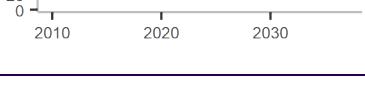
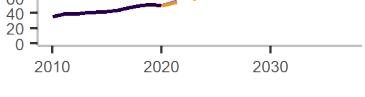


Source: CCC analysis.

Notes: Policy boxes with a dashed line indicate areas not yet addressed by the Government's plans.

Table 11.1

Key indicators for the waste sector

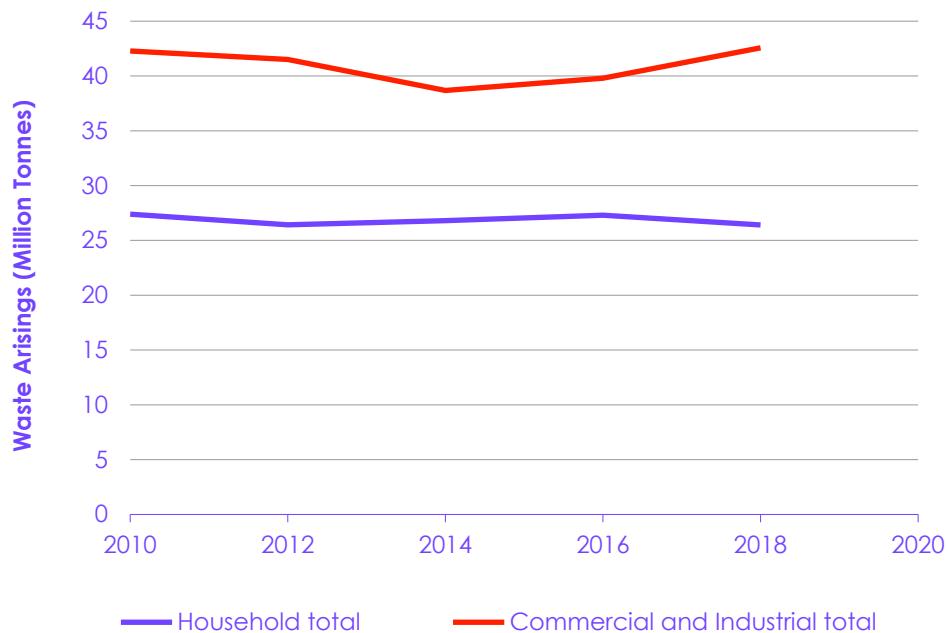
Waste indicators		Most recent value & benchmark			Trend
Group	Name	Year	Value	Change	Key: Historical - CCC - Gov
Reduce waste arisings (Waste arisings)	Household Waste Arisings	2018	26 million tonnes (Mt); CCC benchmark: 26	-3% from 2016	
	Commercial and Industrial Waste Arisings	2018	43 million tonnes (Mt); CCC benchmark: 47	+7% from 2016	
Stop landfilling biodegradable waste	Biodegradable Municipal waste to landfill	2020	6.1 million tonnes (Mt); CCC benchmark: 7.6	-8% from 2019	
Reduce fossil waste to EfW (Tonnes of residual waste to EfW)	Waste Incinerated (including EfW)	2018	16 million tonnes (Mt); CCC benchmark: 13	+21% from 2016	
Reduced waste arisings (Recycling)	Waste from Households (WfH) Recycling Rate	2020	44%; CCC benchmark: 45%	-4% from 2019	
	Proportion of municipal/LA waste recycled or composted, England	2020	41%; CCC benchmark: 52%; Gov benchmark: 50%	-3% from 2019	
	Proportion of municipal/LA waste recycled or composted, Wales	2020	65%	+0% from 2019	
	Proportion of household waste recycled or composted, Scotland	2020	42%	-6% from 2019	
	Proportion of Local Authority-collected municipal waste recycled or composted, NI	2020	50%; Gov benchmark: 50%	-2% from 2019	
Wastewater improvements	Wastewater handling emissions	2020	2.8 MtCO2e	-1% from 2019	

Source: Refer to our website for accompanying data and more details on our indicators, including sources and units used.

Notes: All values are rounded to 2 significant figures; solid lines represent pathways; points represent in-year benchmarks; dotted lines show the linear rate of change required to meet in-year benchmarks.

The years before the pandemic saw increases in commercial waste whilst household waste arisings have stayed reasonably flat.

Figure 11.3 UK Household and commercial waste arisings (prior to treatment, recycling, disposal)

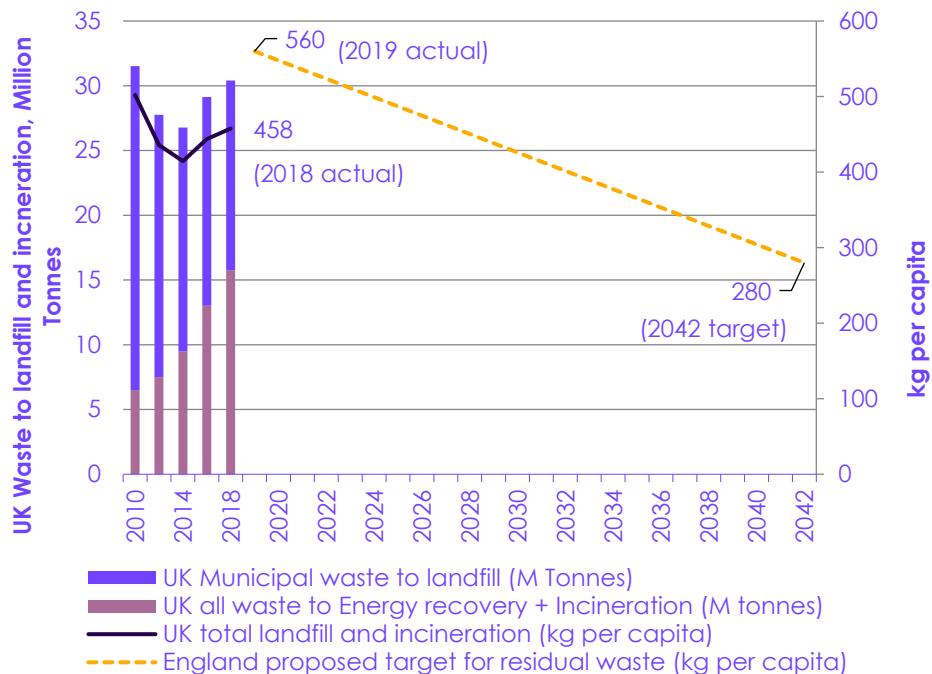


Source: Defra (2020) UK Statistics on Waste Dataset.

Notes: Construction waste makes up 60% of all waste arisings but is not shown as it is less significant when considering waste emissions due to being largely inert. We track construction waste arisings in our full monitoring framework.

Residual municipal waste being landfilled or incinerated in the UK increased from 2014 to 2018, following a strong decline from 2010. Recent increases have been driven by rising incineration/EFW, as landfilling has continued to decline.

Figure 11.4 Residual waste treatment in the UK

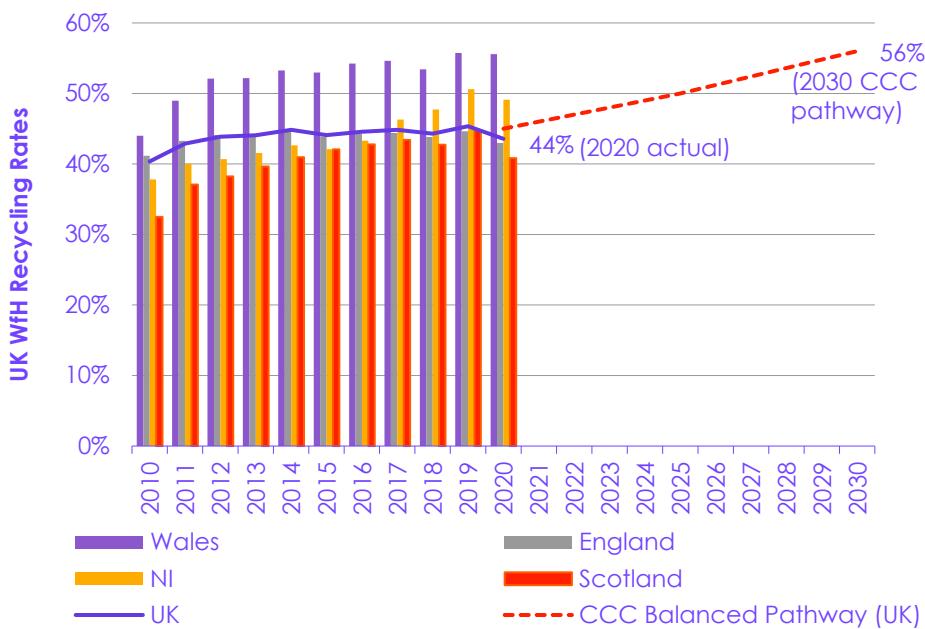


Source: Defra (2022) UK Statistics on Waste Data Set.

Notes: Residual waste refers to the waste remaining after treatment, recycling and other recovery. England's residual waste per capita measure covers a wider definition of waste than the UK measures on this chart. We will report on a consistent dataset against the target when the Government publishes this data.

Household recycling in England has stalled at about 45% with Scotland performing slightly worse. Northern Ireland has shown strong improvements in recent years while Wales continues to outperform the rest of the UK.

Figure 11.5 Waste from Household's recycling rates across the UK

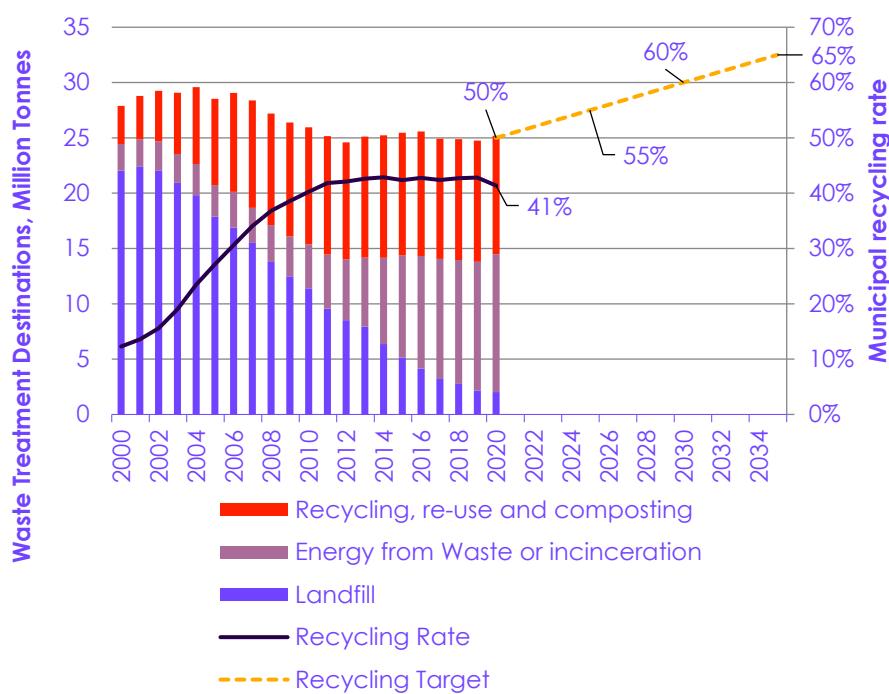


Source: Defra (2022) UK Statistics on Waste Dataset; CCC analysis.

Note: Waste from Household is the agreed definition for comparison of recycling rates across nations of the UK.

In England more municipal waste is now incinerated than recycled, but landfilling has reduced significantly since 2000. Municipal recycling rates have stalled since 2010 at just over 40% and the 2020 statutory target of reaching 50% has been missed. There is much to do to meet the future targets through to 65% for 2035.

Figure 11.6 Local Authority waste treatment, England

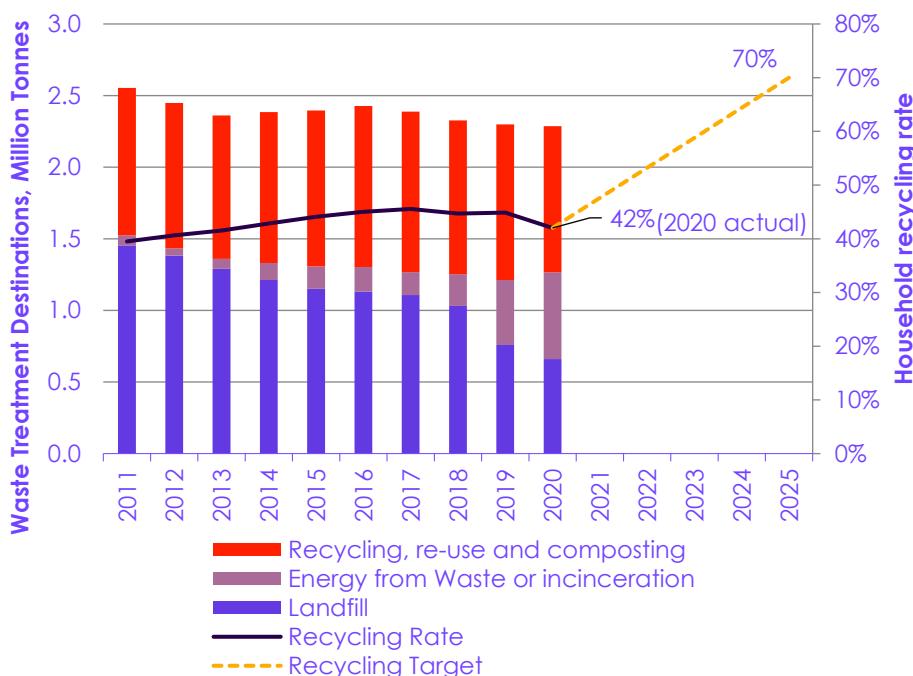


Source: Defra (2021) Local Authority Collected Waste Statistics for England.

Notes: England's statutory recycling target is for municipal waste, which is a slightly broader definition than Local Authority Collected Waste, which is the basis of historical statistics. Defra is in the process of developing a new indicator to track against the statutory target but LACW is a reasonable proxy in the meantime.

Household waste in Scotland follows a similar trend to England – with increasing incineration and recycling stuck at around 40%. Major effort is needed to get on track for meeting Scotland's 70% recycling target for 2025.

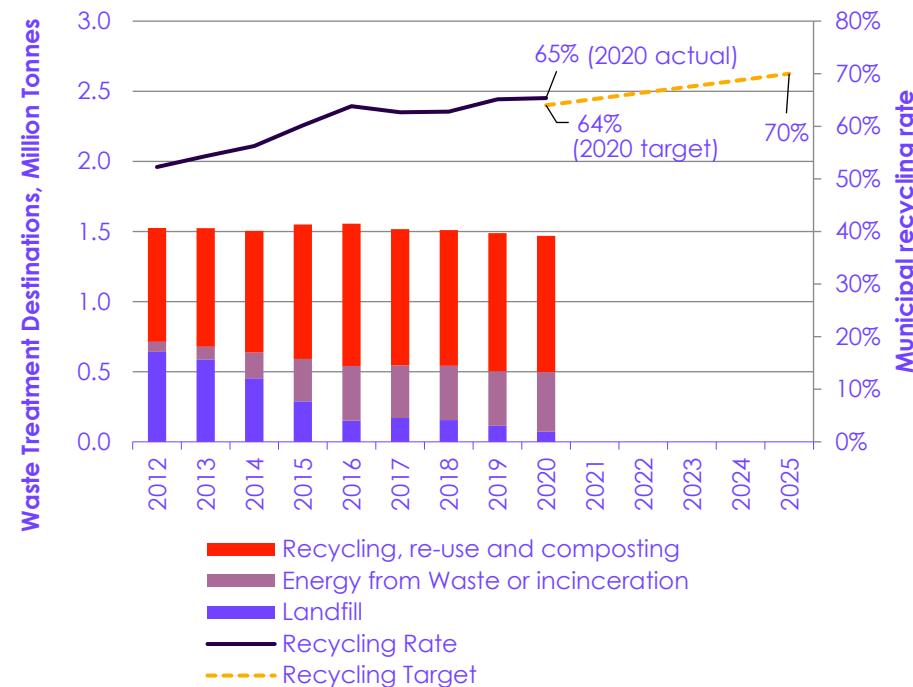
Figure 11.7 Household waste treatment, Scotland



Source: SEPA (2020) Household Waste Statistics.

In 2020, Wales overachieved its statutory recycling target of 64% and is on track to meet its 2030 target of 70%. Wales sends the least amount of waste to landfill out of any nation in the UK, and sends a third of waste to incineration, compared to half in England.

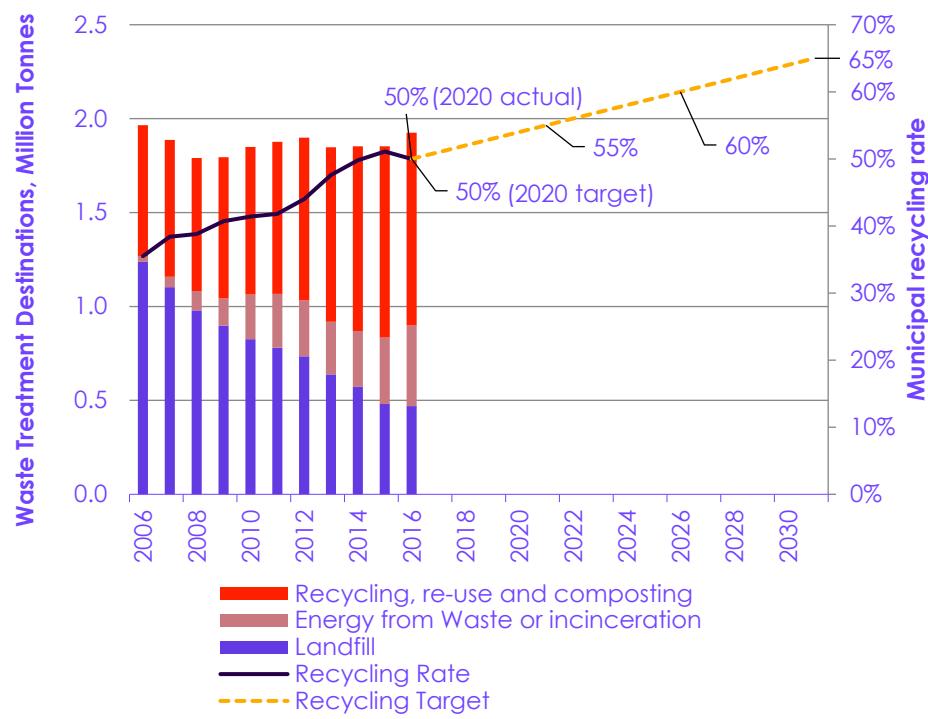
Figure 11.8 Local Authority waste treatment, Wales



Source: Statistics Wales (2021) Local Authority Municipal Waste Data.

Northern Ireland has seen strong improvements to municipal recycling rates in recent years, rising from 40% in 2012 to 53% in 2020, beating the statutory target of 50% and on track to meet future recycling targets.

Figure 11.9 Local Authority waste treatment, Northern Ireland



Source: Northern Ireland local authority collected municipal waste management statistics 2020/21 annual report.

3. Policy progress, assessment and next steps

The Net Zero Strategy provides limited detail on plans to decarbonise waste. From what we know, the Government's emissions pathway broadly aligns with our ambition for meeting the Sixth Carbon Budget but policies to reduce emissions from waste do not go as far as we have previously called for. Progress has been made in developing key reforms to waste management, empowered by the Environment Bill.

Priorities for the sector are to ensure successful and timely implementation of the planned waste management reforms, whilst taking action to prevent over-reliance on incineration, as part of a dedicated plan for decarbonising the sector.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

Waste policy is highly devolved across the UK. This chapter mainly focuses on UK Government actions given its overall responsibility for meeting carbon budgets, however a summary of policy progress across the UK Government and devolved administrations is set out in Table 11.2.

Table 11.2

Comparison of policies in England, Scotland, Wales and Northern Ireland

Policy progress	
England	<ul style="list-style-type: none">• New intention to stop landfilling biodegradable municipal waste by 2028 and will explore policies to achieve this. £295 million of capital funding to be made available for Councils to implement free separate food waste collections.• Confirmation of existing target to achieve 65% municipal recycling rate by 2035. Existing target to cut food waste by 50% by 2030.• Delayed introduction of Extended Producer Responsibility, Deposit Return Scheme and consistent collections of recycling and food waste from 2024/2025
Scotland	<ul style="list-style-type: none">• Existing commitment to ban biodegradable municipal waste from landfill by 2025 and is considering extending to non-municipal sources. Following an independent review into the role of incineration, the Scottish Government has introduced a moratorium on new incineration plants being built (beyond those currently planned).• Existing target to achieve 70% recycling rate for all wastes by 2025 – developing a Route Map to achieve targets in 2025 as well as ambition beyond that. Target to cut food waste by a third by 2025.• In November 2021 the Scottish Government announced the first round of funding for the £70 million Recycling Improvement Fund. £7 million was awarded to local authorities to increase recycling and prepare for future developments.

	<ul style="list-style-type: none"> • Scotland is aiming to be first nation to implement the Deposit Return Scheme by August 2023, delayed from 2022 due to the COVID-19 pandemic. A ban on certain single-use plastic items will come into force in June 2022. Scotland also intends to introduce Extended Producer Responsibility. Most Local Authorities in Scotland already benefit from consistent collections of recycling and food waste. • In May 2022 the Scottish Government launched a consultation on the delayed Circular Economy Bill, outlining several new measures to reduce waste, embed circular economy principles and promote responsible production, consumption, and re-use. The draft Fourth National Planning Framework includes several proposals to support a circular economy and waste prevention.
Wales	<ul style="list-style-type: none"> • Existing commitment to prevent all waste from going to landfill from 2025 whilst a memorandum on new large-scale Energy from Waste plants has come into effect. • Existing target to achieve a 70% municipal recycling rate by 2025, with statutory recycling targets set for each Local Authority in Wales. Target to cut food waste by 50% by 2025. • Wales are also introducing Extended Producer Responsibility and a Deposit Return Scheme. Most Local Authorities in Wales already benefit from weekly collections of recycling and food waste. • Through the Transforming Towns 'Place Making' grant, Wales Programme for Government commits to implementing novel solutions to improve resource efficiency, such as creating a place-based zero-waste challenge network of organisations to support cultural change in businesses and communities and supporting 80 re-use and repairs hubs in town centres.
Northern Ireland	<ul style="list-style-type: none"> • Existing target to achieve 65% recycling rate by 2035. • Draft Green Growth Strategy includes Principle to reduce wasteful use of resources through greater efficiency and an increasingly circular economy but lacks detail. • A strategic environmental outcome of Northern Ireland's draft Environment Strategy is zero waste and a highly developed circular economy. This commits government to publishing the Circular Economy Strategic Framework for public consultation in Autumn 2022; appointing members to an NI Circular Economy Coalition; and a policy review to embed circular practices in current planned policy. • The strategy also reaffirms Northern Ireland's commitment to implementing future waste reforms in line with UK Government timelines, including the Deposit Return Scheme and Extended Producer Responsibility. • In June 2021 a call for evidence on the plan to eliminate plastic pollution in Northern Ireland was published. The plan will be consulted on in 2022. A consultation was also closed in January 2022 on the reduction of single-use beverage cups and food containers.

Waste in the Net Zero Strategy

The Government's plans to reduce emissions from waste are not as ambitious as we called for in our advice on the Sixth Carbon Budget.

According to the Net Zero Strategy, emissions from waste need to fall by about 40% by 2035 compared to 2020.* We understand that the abatement within the sector pathway is mainly associated with reducing biodegradable waste going to landfill and through improvements to wastewater. No abatement is associated with emissions from Energy from Waste plants (although the Government's baseline for EfW emissions is lower than we would expect). It is unclear as to whether ambitions to improve waste prevention are considered to reduce emissions.

We have compared the Government's pathway for the waste sector with our own Balanced Pathway (Figure 11.10). In 2037, the Government's pathway brings emissions to a similar level as our Balanced Pathway. However, the Government has used a more optimistic baseline for future emissions than used in our Sixth Carbon Budget analysis.

* This figure includes Energy from Waste which the CCC considers within the waste sector but was included in the electricity sector in the Net Zero Strategy.

When adjusting for this difference, it is evident that the level of abatement delivered within the Government's pathway is much lower than that of our Balanced Pathway. This reflects several points of difference in key assumptions within our respective pathways, summarised in Table 11.3.

Limited progress in policy implementation in recent years and consequently compressed timelines, has made it increasingly unfeasible to strengthen targets set by the Government for eliminating biodegradable waste to landfill and improving recycling. This raises the importance of addressing policy gaps and ensuring timely implementation of the Government's stated ambition. If reported emissions in the next few years suggest that the Government's baseline was overly optimistic, then greater effort to reduce emissions will be needed.

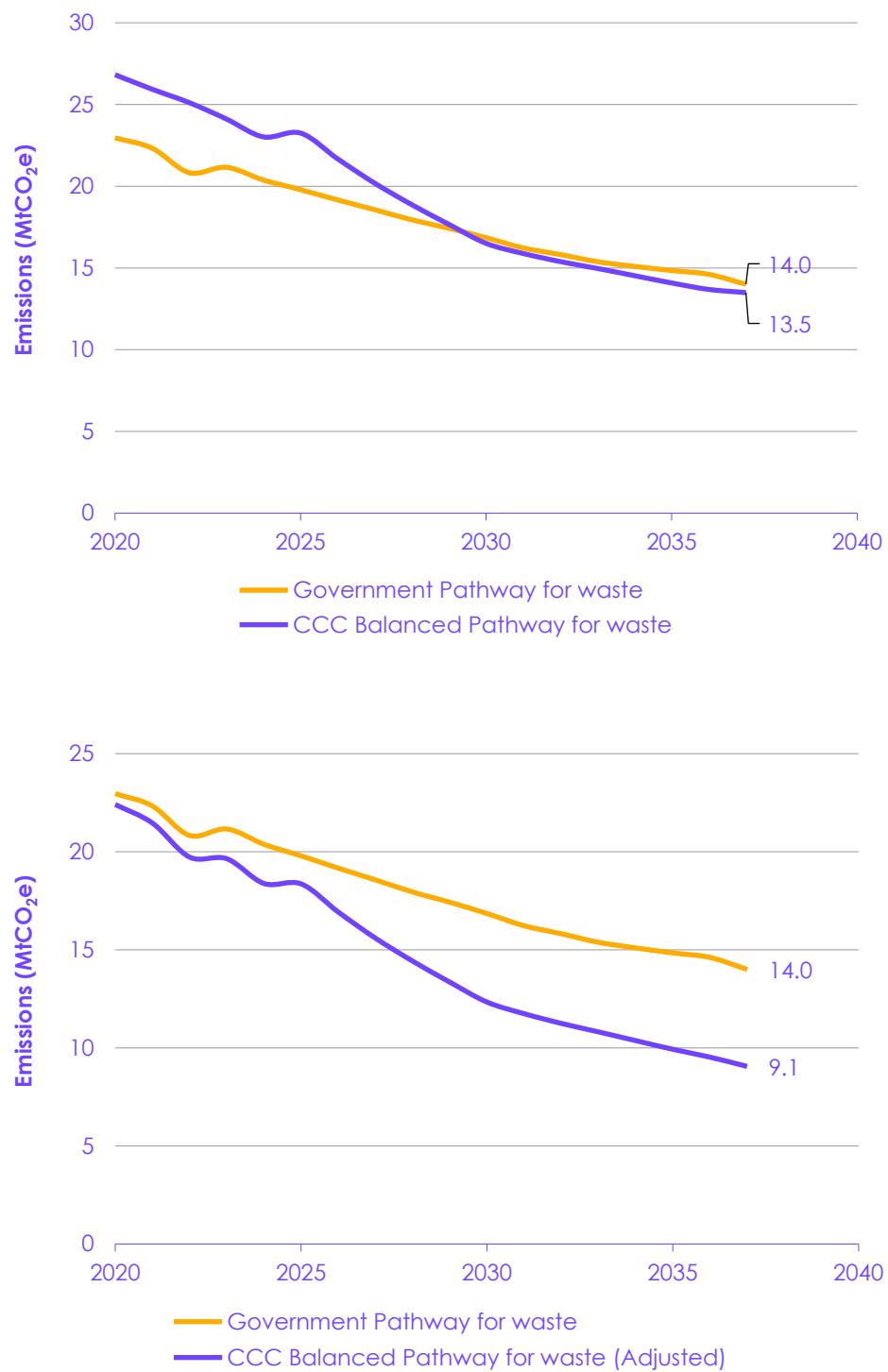
Table 11.3

Comparison of key differences between Government pathway and CCC Balanced Pathway for Waste (with Energy from Waste)

	Government Pathway	CCC Balanced Pathway
Landfill	<p>Aim to eliminate municipal biodegradable waste from going to landfill from 2028, assuming:</p> <ul style="list-style-type: none"> • 50% reduction in food waste by 2030 • 65% recycling by 2035 <p>Assume no improvement to methane capture rates.</p>	<p>Ban municipal and non-municipal waste from going to landfill from 2025, enabled by:</p> <ul style="list-style-type: none"> • 51% reduction in food waste by 2030 • 68% recycling rate by 2030 <p>Ambition to capture 80% landfill methane by 2050.</p>
Energy from Waste	<p>No abatement through to 2037, unclear whether potential for resource efficiency to reduce waste arisings and inputs to EfW has been considered.</p> <p>No clarity on timeline for installing CCS to EfW plants.</p>	<p>50 Mt CO₂e abatement through to 2037, accounting for resource efficiency which reduces waste arisings by 33% by 2037.</p> <p>CCS fitted to EfW plants from 2040 with full coverage by 2050.</p>
Wastewater	5.2 MtCO ₂ e abatement from wastewater improvements through to 2037.	10 MtCO ₂ e abatement from wastewater improvements through to 2037 – although not reflective of 2021 inventory change which revised down wastewater emissions estimates.



Figure 11.10 Comparison of Government and CCC pathways for waste, before (top) and after (bottom) adjusting for different baselines



Source: BEIS (2021) Net Zero Strategy and subsequent communications.

Notes: Considers CCC definition of waste sector (i.e. including Energy from Waste). In bottom chart CCC Balanced Pathway has been scaled to the Net Zero Strategy baseline. This might not fully account for differences in baseline assumptions.

Empowered by the Environment Act, Defra is bringing in a raft of reforms designed to boost recycling and is setting a new target to reduce waste.

Waste prevention

The passage of the Environment Act in November 2021 has given the Government powers to establish new targets and policies to reduce waste. Defra is currently finalising consultations on a package of waste management reforms intended to boost recycling rates.

- The Government is consulting on setting a target for reducing residual waste per capita by 50% by 2042 from 2019 levels (approximately 560 kg per capita), but this will not cover construction or mineral waste.
- Key reforms – including Extended Producer Responsibility, the Deposit Return Scheme and consistent recycling collections – should improve recycling behaviours across England (with similar schemes brought in by the devolved administrations), but delays and a lack of detail pose a major risk to delivery. A delayed consultation on mandatory food waste reporting (originally promised by 2019) has only recently been published, while we are waiting for a response to the Waste Prevention Programme consultation which closed in 2021.
- As of 1st April 2022, a new tax is payable by manufacturers and importers of plastic packaging containing less than 30% recycled plastic content, at a rate of £200 per tonne. Certain single-use plastic items are also to be banned.

Landfill

Eliminating biodegradable waste from landfill is the number one priority to reduce emissions in the sector. The Net Zero Strategy stated the Government's intention to achieve this by 2028 for municipal waste.

The Government's Net Zero Strategy included a tentative commitment to "explore policies to work towards the near elimination of biodegradable municipal waste to landfill from 2028". To help achieve this aim, the Government has announced £295 million of capital funding for free separate food waste collections from 2025 but Local Authorities need more detail on how this will be spent, as well as detail on the additional policies needed to meet the aim. The Government is also consulting on a review of the role of the Landfill Tax in supporting wider environmental objectives, including Net Zero.

Energy from Waste

BEIS has made good progress in developing plans to support Energy from Waste plants to install CCS from the end of the decade and are consulting on bringing EfW into scope of the UKETS. However more decisive action is needed to stem the growth in incineration.

There have been several promising policy developments related to Energy from Waste (EfW) in the last year.

- The Government confirmed in November 2021 that EfW plants will be eligible for support under the Industrial CCUS business model, intended to bring forward CCUS at scale in the UK. It will be initially focused on two clusters in the North-West and Humber regions and BEIS is currently considering specific challenges around enabling CCS at EfW facilities, such as ensuring that the waste hierarchy is not undermined.
- As we recommended last year, the Government is consulting on expanding the scope of the UK ETS to include Energy from Waste plants as part of a wider review of changes to the regime.
- The draft National Planning Statement for renewables⁹ sets out new requirements for future Energy from Waste plants so that they demonstrate alignment with the waste hierarchy and do not result in EfW over-capacity at a national or local level.

However, no detail has been provided as to how developers might demonstrate compliance with these requirements, and an updated assessment of waste treatment capacity is yet to be published.

Wastewater

The Government is relying on industry to reduce emissions from wastewater but has provided no significant policy to enable this.

The Net Zero Strategy assumes that industry will reduce emissions from wastewater treatment. Some innovation funding to address wastewater emissions has been announced¹⁰, however, Defra has not specified delivering Net Zero as an explicit strategic priority for OFWAT, whose role has been limited to scrutinising water companies' business plans - stopping short of a mandate to enable decarbonisation. Meanwhile there is no detail on how industrial wastewater emissions will be addressed.

(b) Assessment of policies and plans

The Government has made some progress on our recommendations from last year, but none have been achieved in full and important risks and gaps remain.

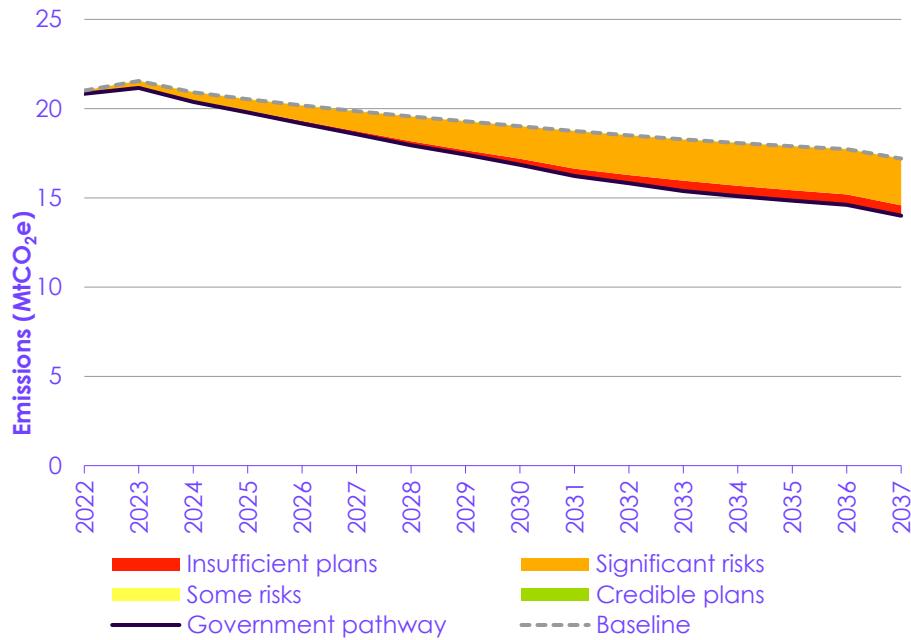
- While the Government has made some progress against the recommendations we made in last year's Progress Report, there are still significant risks to delivering the emissions pathway for waste set out in the Government's Net Zero Strategy (Figure 11.11, Table 11.3). Out of 24 recommendations to the UK Government and devolved administrations, no recommendations were judged as having been achieved in full.* 13 are assessed as either being partly achieved or underway, whilst 11 are assessed as having not been achieved.
- The Net Zero Strategy identifies eliminating biodegradable waste from landfill as the key action to reduce emissions from waste. Despite identifying a date for this to be achieved, alongside the promise of funding and service reforms to food waste and recycling collections, there are still significant risks due to the lack of policy detail and the risk of delay to implementation.
- The other measure to reduce emissions identified in the Government's pathway is improvements to wastewater handling but the Government is yet to set out any notable policy to support this ambition.
- Last year we highlighted growing emissions from Energy from Waste as an issue to address with urgency and called on Government to justify the need for any additional EfW plants, alongside policy to reduce their emissions. Despite welcome progress in developing CCS support for EfW plants, and consulting on inclusion within the UK ETS, there is still no clear plan to limit or reduce EfW emissions.
- We have limited information on the Government's plan to decarbonise the waste sector more broadly, with minimal detail provided in the Net Zero Strategy on important questions such as the effort from different parts of the UK and how key assumptions around waste reduction will support the transition. We've also seen limited new ambition - with recycling targets unchanged, delayed implementation of key waste management reforms, and policy gaps in areas such as resource efficiency.

* This count only includes recommendations where Waste is identified as the lead sector.

- Of all the devolved administrations, Scotland has made most progress in bringing forward new policies and initiatives to address emissions from waste, but UK wide implementation of the planned waste collection reforms has been subject to delays.

We consider there to be significant risks around reducing emissions from landfill, and consider wastewater emissions to be a policy gap which needs addressing. Although there is no abatement associated with Energy from Waste in the Government's pathway, we also consider this to be an area of significant risk.

Figure 11.11 Assessment of policies and plans for waste



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Table 11.4

Policy scorecard for waste

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Landfill 83% of emissions reduction through to 2037	O	O	O	O	O
	<ul style="list-style-type: none"> Aim to eliminate biodegradable municipal waste from landfill by 2028 provides signal and funding has been announced to improve food waste collections and treatment, whilst the Landfill Tax continues to divert waste elsewhere. Forthcoming reforms to recycling collections and EPR should help to increase recycling and reduce biogenic inputs to landfill. Local Authorities and industry urgently need detail on arrangements for EPR, recycling and food waste collections. Policies (such as mandatory food waste reporting) needed to drive better behaviour are either delayed or absent. Implementation of the Waste Prevention Plan has been delayed and the timeline for bringing forward additional policies is unclear. 				
Energy from Waste, incineration 0% of emissions reduction through to 2037	O	O	R	R	O
	<ul style="list-style-type: none"> Good progress has been made in developing proposals to support CCS at Energy from Waste (EfW) plants in clusters and consulting on the inclusion of EfW plants in the UK ETS, but more work is needed to develop these policies. Currently there is no direction from Government as to how or when it intends to decarbonise the UK's EfW fleet, noting that not all locations will be viable for CCS. There is no policy to prevent continued expansion of EfW capacity and usage. 				
Wastewater 17% of emissions reduction through to 2037	O	O	R	R	R
	<ul style="list-style-type: none"> Government is relying on the water industry to deliver emissions reductions, but has provided no meaningful mandate, policies, or incentives to enable them. It has however identified reducing emissions from wastewater as a key need in the Net Zero Research and Innovation Framework. 				
Devolved-level efforts No emissions reduction scored.	Y	O	Y	O	Y
	<ul style="list-style-type: none"> Wales and Scotland are implementing a range of policy interventions to increase resource efficiency and reduce waste, such as through redesigning planning frameworks, providing funding for novel solutions and passing legislation in anticipation of future waste reforms. Northern Ireland has taken positive steps towards producing plans for the waste sector but must spell out a legislative plan for future waste reforms and ensure attention is not solely on eliminating plastics. Implementation of some key reforms are dependent on UK wide policy and are at risk of delay. 				
Overall sector assessment	O	O	O	O	O

(c) Recommendations

The recommendations for the waste sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department.

We call on the Government to implement planned waste reforms without delay, and to set out additional policies to reduce waste and boost recycling.

Further action is needed to stem emissions from Energy from Waste, including by clarifying requirements to demonstrate compatibility of any new plants with treatment capacity needs.

We also recommend that the Government publishes a detailed plan dedicated to decarbonising the waste sector in line with delivering Net Zero alongside waste prevention objectives.

- The most pressing priority for the waste sector is successfully implementing forthcoming waste management reforms to consistent collections for recycling and food waste, Extended Producer Responsibility and Deposit Return Schemes.
 - Doing so will help to deliver key outcomes eliminate biodegradable waste from landfill by no later than 2028, improve recycling rates and reduce fossil inputs to Energy from Waste plants.
 - However, further action is likely to be needed, so we recommend that the Government brings forward additional detailed policies to unlock long-term investment into recycling infrastructure and services, and to drive behaviour change to reduce waste arisings in the first place.
- To address continued growth in Energy from Waste/incineration we call for an urgent assessment of residual waste capacity to inform decisions about the need for additional Energy from Waste plants.
 - The Evidence Annex for England's 2018 Resources and Waste Strategy suggested that further increases in Energy from Waste capacity beyond that planned at the time would be unnecessary to meet committed targets to reduce waste to landfill, if the 65% recycling target for 2035 was met.¹¹
 - We agree with the draft National Planning Statement for renewables that further Energy from Waste plants should not be built unless they can demonstrate consistency with residual waste capacity needs and alignment to the waste hierarchy. We therefore call for Government to confirm how such assessments will be made. Any new EfW plants should also be required to demonstrate readiness for installing carbon capture technology.
- More broadly, Defra, alongside the devolved administrations, should publish a detailed plan for decarbonising the waste sector (including Energy from Waste and wastewater) in line with the UK's Carbon Budgets and Net Zero.
 - Such a plan should set out details of what the path to decarbonising the sector to 2050 will involve, and explain how Government and the devolved administrations will facilitate the transition.
 - It should include a holistic review of the incentives for the sector to achieve the dual aims of reducing emissions and waste, including by driving long term investment into recycling.
- The Government should also set out how the water industry will be supported to deliver the wastewater emissions reductions identified within the Net Zero Strategy. This requires a clear mandate for OFWAT to enable this work and a requirement for companies to measure and report on emissions.

We have set out a high-level policy and implementation timeline covering the priority actions in the waste sector over the next decade and beyond. The government should set out an ambitious implementation timeline for waste as part of the decarbonisation plan we have asked for.

Figure 11.12 Waste policy and implementation timeline



Planning and decisions		Implementation				Outcomes
H1 2022	H2 2022	2023	2024	2025	2026	2030
Landfill						
	Consult on mandatory business food waste reporting	Introduce mandatory business food waste reporting				2035: Landfill methane emissions reduced by 57% (relative to 2019)
	Confirm details of £295m funding for food waste collections and develop further policies required to end landfilling of biodegradable waste	Implement policies to end landfilling of biodegradable waste, including food waste collections.				Key biodegradable waste streams are prevented from going to landfill (2028 at the latest)
Energy from Waste (EfW)						
	Continue to develop plans for supporting EfW plants to install CCS	Decision on first EfW plants to receive CCS support				2030: CCS coverage expanded to further EfW plants
	Develop plans to expand CCS coverage to wider EfW fleet and clarify role of sites where CCS not viable	Siting requirements and planning guidance developed for EfW plants to enable decarbonisation		Decision on CCS and decarb of wider EfW fleet		
	Confirm the requirement of the draft National Planning Statement for Renewables for any new EfW plants to demonstrate compatibility with waste capacity needs and the waste hierarchy. Clarify how such an assessment would be made.	First EfW plants install CCS				
Cross-cutting						
	Finalise and provide detail on plans for introducing Extended Producer Responsibility, Deposit Return, and consistent collections	Implement EPR, DRS and collections	Develop further EPR and waste reduction policies including those set out in WPP	Implement further EPR and other waste reduction, resource efficiency policies		2030 Recycling and waste targets met
	Review incentives for waste sector to drive decarbonisation and waste reduction					
	Review planning policies for waste infrastructure to ensure they enable delivery of recycling targets, support future residual waste needs and consider decarbonisation requirements					
	Publish an assessment of residual waste treatment capacity needs through to 2050, consistent with meeting committed and prospective recycling and waste reduction targets, except for resource efficiency improvements and the stated goal to end the landfilling of biodegradable waste by 2028.	Publish a sector plan for decarbonising the waste sector in line with the UK's emissions targets.				
		Legislate targets for reducing waste and improving resource efficiency				
		Waste exports phased out				
Wastewater						
		Companies' business plans set out steps to effectively monitor and reduce emissions from wastewater	Ofwat supports company plans to effectively monitor and reduce emissions from wastewater			2035: Wastewater emissions reduced by 27% by 2035 (relative to 2019)

Key

Planning Research, consultations, pilot schemes	Decisions Consultation responses, concrete policy plans	Legislation Legislation, updating regulations	Implementation Legislation into force, funding starts, deployment starts	Outcomes
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Source: CCC analysis.

4. Major risks

Table 11.4

Major risks and required mitigating actions for waste

Risk Category	Description	Mitigation actions	
		Details	In place?
Implementation of key waste reforms and delivery of targets waste reduction, landfill and recycling.	The sector is set to implement a series of significant waste management reforms, but a lack of clarity and numerous delays poses a risk to delivery. Failure could undermine key outcomes to eliminate biodegradable waste from landfill, improve recycling rates and reduce fossil inputs to Energy from Waste plants.	<p>Defra should provide detail urgently on the implementation and administration of these reforms and prevent further delay. If one aspect is delayed do not allow the whole package of reforms to be affected.</p> <p>Defra should review the impact of the schemes once implemented to ensure they are delivering the intended outcomes and consider whether additional policy is needed.</p>	Partially – Defra has provided limited information on EPR implementation, but this is not sufficient. Details of consistent collections, DRS and additional policies is needed.
Significant growth in the use of Energy from Waste / incineration	The use of Energy from Waste / incineration is now more prevalent than recycling in England, and has driven an increase in waste emissions in the years before the COVID-19 Pandemic. Continued, unchecked growth could undermine the sector's contribution to UK emissions targets and efforts.	<p>Defra should urgently complete and publish an up-to-date assessment of residual waste treatment capacity needs for the UK out to 2050, consistent with committed and proposed targets to improve recycling, reduce waste and reduce waste being landfilled. This review should also look at the feasibility of phasing out waste exports by 2030.</p> <p>In line with the requirements set out in the draft National Planning Statement for Renewables, new EfW should not be built unless they can demonstrate compatibility with waste treatment capacity needs and the waste hierarchy, as well as readiness to install carbon capture technology.</p>	Partially – Defra is understood to be undertaking an assessment of residual waste capacity needs but an updated assessment is yet to be published. The draft National Planning Statement for renewables states that new Energy from Waste plants will be required to prove alignment to the waste hierarchy and residual waste capacity needs – however no details as to how these requirements will be met have yet been published.

Endnotes

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Chapter 12: F-gases

12 MtCO₂e, 3% of UK emissions, in 2020

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Introduction and key messages

Fluorinated gases (F-gases) are potent greenhouse gases (GHGs), used in a range of applications including refrigeration, air conditioning, heat pumps and inhalers. The Government's Net Zero Strategy plans to reduce F-gas emissions to less than 2 MtCO₂e by 2035, from 12 Mt in 2020, with most of the planned reduction coming from requirements in the F-gas Regulation. This regulation mandates a large reduction in the consumption of most hydrofluorocarbons (HFCs) by 2030, bans the use of F-gases in certain applications and mandates various emission reduction measures.

This Chapter reviews progress in reducing emissions from the UK F-gas sector and outlines the required next steps.

Our key messages are:

- **Emission trends.** F-gas emissions have fallen over the last few years but are still higher than levels in the early 2000s. There is also a risk that emissions may increase with the roll-out of heat pumps, which currently use F-gas refrigerants.
- **Planned emissions reductions.** Of the 10 MtCO₂e emissions reduction expected by 2035 in the Government's Net Zero Strategy, 87% will be via the existing F-gas Regulation.
- **Review of the F-gas Regulation.** The Government has committed to reviewing their F-gas Regulation, and we recommend that they match or exceed any increase in ambition in the EU F-gas Regulation, which is currently also being reviewed and the European Commission has proposed to increase its ambition.
- **Low-GHG asthma treatment.** NHS England has committed to rewarding Primary Care Networks (PCNs) for increasing prescriptions of lower-GHG treatments for asthma patients than Metered Dose Inhalers (MDIs).

Due to the relatively small emissions from this sector, and the fact that we expect most emissions to be addressed by the existing F-gas regulation, this is a short chapter without any indicators at this stage.

The rest of this chapter is laid out as follows:

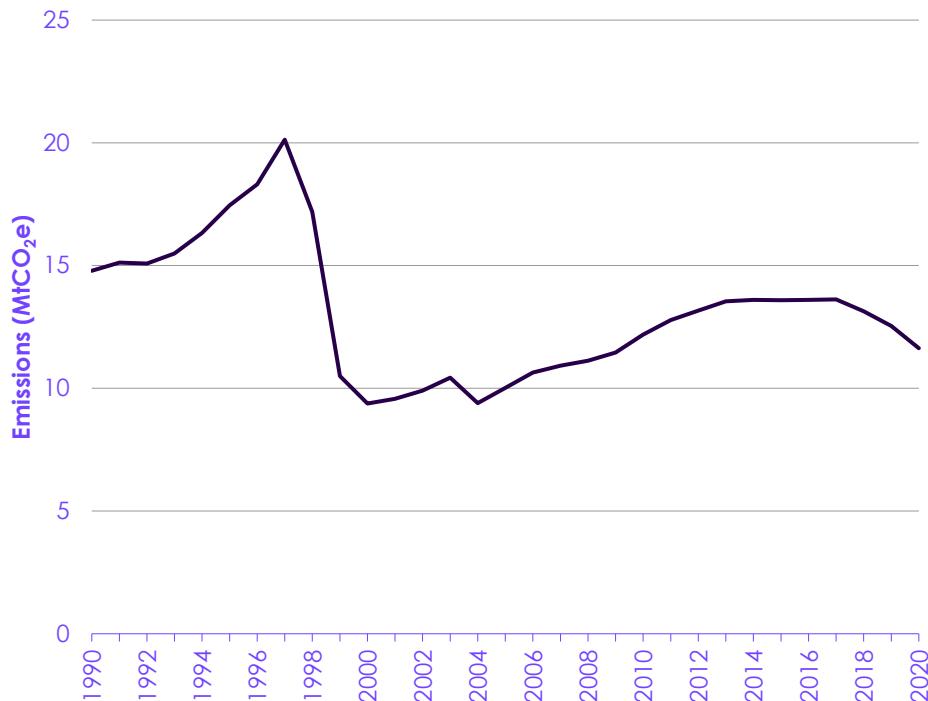
1. Emissions trends and drivers
2. Indicators of progress
3. Policy progress, assessment and next steps

1. Emissions trends and drivers

With emissions of 12 MtCO₂e, the F-gas sector contributed to 3% of total UK emissions in 2020 (Figure 12.1). Emissions have decreased slightly in recent years due to the F-gas Regulation taking effect, although they are still higher than levels seen in the early 2000s. Historically, emissions saw a sharp decrease in the late 1990s due to the fitting of abatement equipment to plants producing F-gases. Emissions then increased until the mid-2010s, mainly due to increasing use in air conditioning and refrigeration appliances. Most heat pumps use F-gas refrigerants, which could become a significant source of F-gas emissions as heat pumps get rolled out across the UK, unless the Government takes action to ensure that they shift to using non-F-gas refrigerants.

F-gas emissions have been decreasing over the last few years, but they have not yet fallen back to the levels of the early 2000s.

Figure 12.1 F-gas emissions in the UK



Source: BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020.
Notes: Global warming potentials from IPCC AR5 without feedback are used.

2. Indicators of progress

We do not have any F-gas indicators at this stage. We are hoping to develop these for our next UK Progress Report.

3. Policy progress, assessment and next steps

There has been no major policy progress in the last year, but here we highlight a couple of minor developments, one of which is NHS England providing financial incentives for PCNs to reduce inhaler emissions.

The existing F-gas Regulation (which mandates a 79% reduction in the consumption of most HFCs by 2030 relative to the average between 2015 and 2019), accounts for 87% of the emissions abatement in 2035 given in the Net Zero Strategy, with 6% from Defra's new target to reduce HFC consumption by 85% by 2036, and 6% from NHS England's plan to reduce inhaler emissions.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

NHS England has started incentivising prescriptions of lower-GHG treatments for asthma patients, and BEIS has launched a programme to fund heat pump innovation research.

NHS England has begun rewarding PCNs for increasing prescriptions of lower-GHG treatments for asthma patients.¹ This will support their plan to reduce the number of prescriptions of MDIs, which generally use F-gases as a propellant and so cause significant GHG emissions.

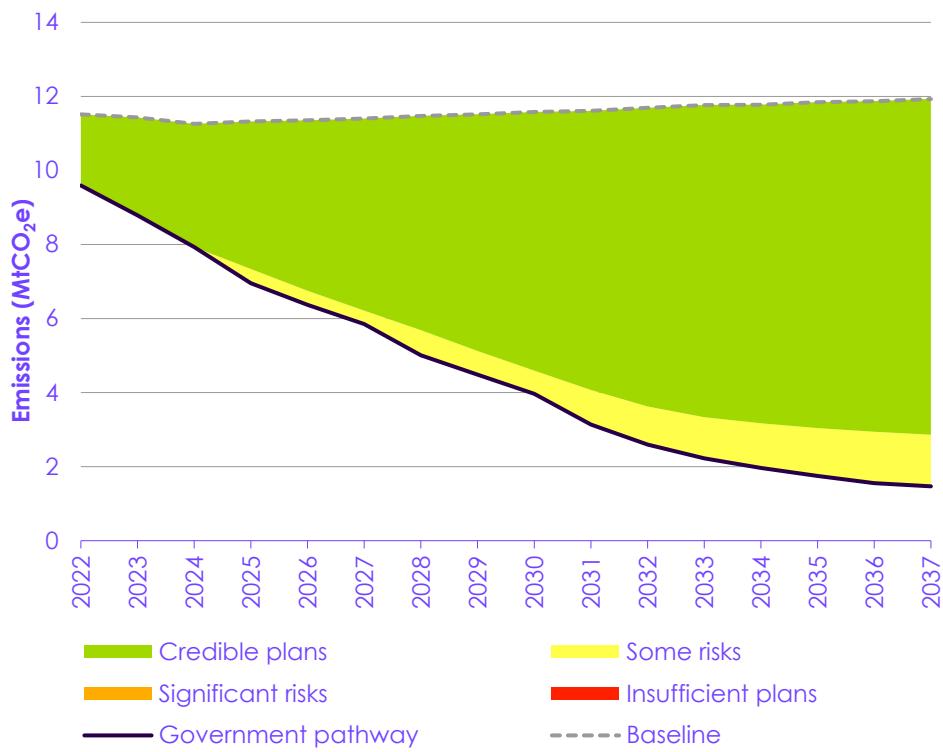
BEIS has launched the Heat Pump Ready Programme² to award up to £60m funding to heat pump innovation research. This may include improving the performance of heat pumps with low-GHG refrigerants, which may lead to reductions in F-gas emissions in this sector, as most heat pumps currently being installed use F-gases as a refrigerant. Potential replacement refrigerants include propane and CO₂.

(b) Assessment of policies and plans

While the existing F-gas Regulation is credible and likely to lead to the intended emissions reductions for this, the additional abatement expected from the Net Zero Strategy contains some risks (Figure 12.2 and Table 12.1).

Most of the planned F-gas emissions reductions are credible, with a small amount having some risks.

Figure 12.2 Assessment of policies and plans for F-gases



Source: CCC (2020) *The Sixth Carbon Budget*; BEIS (2021) *Net Zero Strategy: Build Back Greener*; BEIS (2021) *Energy and emissions projections: Net Zero Strategy baseline*; CCC analysis.

Notes: We have adjusted the baseline from that published in the Net Zero Strategy to exclude the impact of the existing F-gas regulation, and we have scaled the resulting baseline to match the 2020 historical emissions. This allows us to assess the impact of this regulation in delivering the emissions reductions required.

Table 12.1

Policy scoreboard for F-gases

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
Emissions reduction expected under existing F-gas regulation 87% of 2035 abatement	G	G	G	G	G
	<ul style="list-style-type: none"> These emissions reductions are included in the baseline given in the Government's Net Zero Strategy analysis. 				
85% phasedown of HFC consumption by 2036 relative to 2011-2013 6% of 2035 abatement	G	G	G	O	Y
	<ul style="list-style-type: none"> This policy is an extension of the existing 79% phasedown target in the F-gas Regulation, so can use the same delivery mechanism. No funding or financial incentives are necessary. The enablers and barriers should be the same as for the existing phasedown target. It is unclear when further details behind this target will be published, or when it will be put into UK law. 				
Reduction of MDI prescriptions in England 6% of 2035 abatement	Y	Y	Y	O	Y
	<ul style="list-style-type: none"> NHS England has published a list of planned actions to encourage a reduction in MDI prescriptions, but an assessment of the expected impact of each action has not been published. NHS England has started rewarding PCNs for increasing prescriptions of lower-GHG treatments for asthma patients, but the total cost of their MDI reduction targets has not been assessed publicly and no funding has been committed beyond 2023. NHS England has considered the barriers to the uptake of lower-GHG asthma treatments and is taking some action to address them. Neither NHS England nor the Department for Health and Social Care have provided much indication of timelines for future policies. 				
Overall sector assessment	G	G	G	G	G

(c) Recommendations

We recommend increasing the ambition of HFC consumption reduction targets, publishing targets and plans on heat pumps that do not use F-gases, reducing inhaler emissions and pushing for stronger international action on reducing emissions.

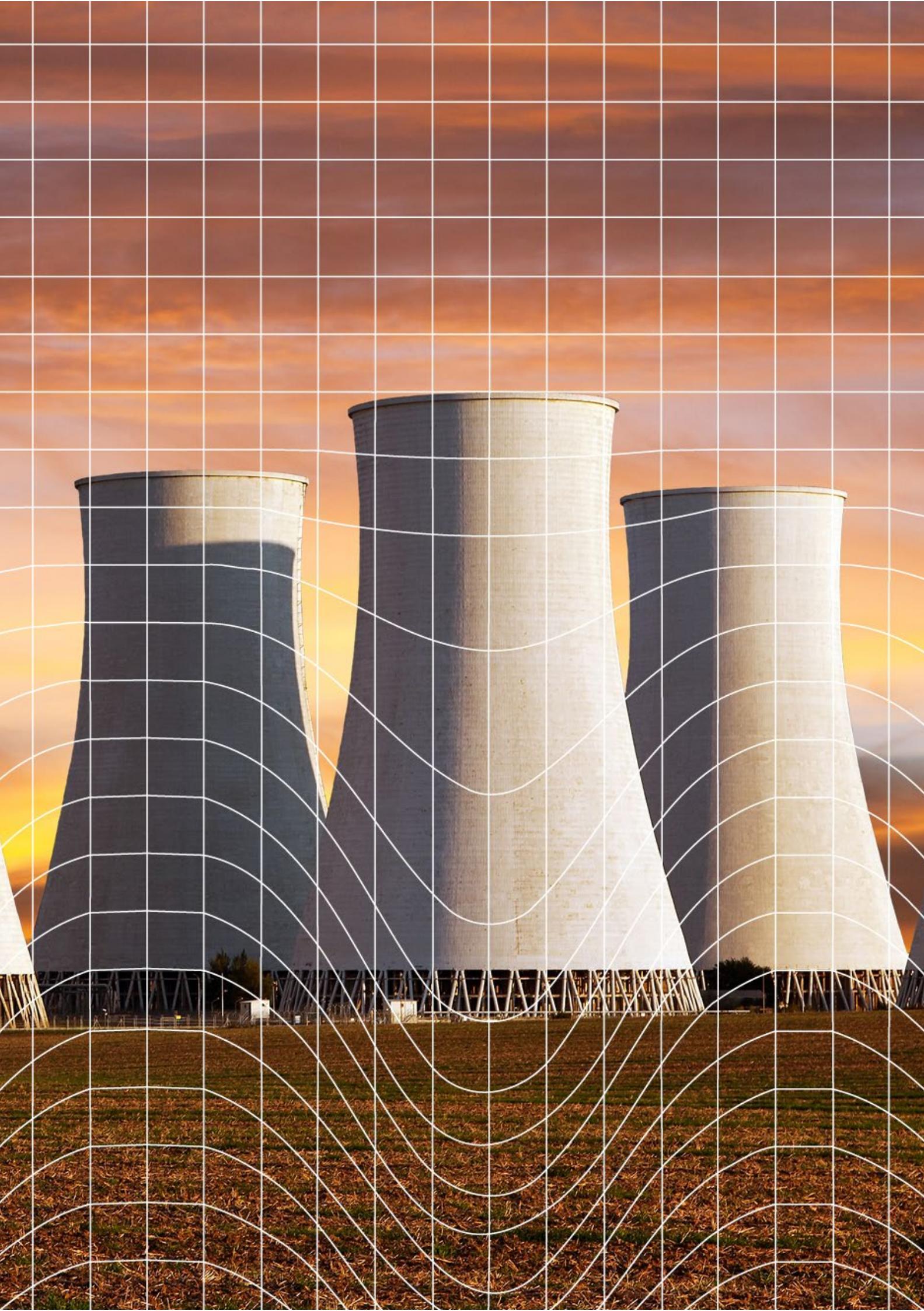
The recommendations for the F-gas sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department. Here we provide a brief summary. The Government should:

- In its upcoming review of the F-gas Regulation, match or exceed any increase in ambition in the EU F-gas Regulation.
- Pass legislation on its plan to reduce HFC consumption by 85% by 2036.
- Publish targets and plans for the roll-out of heat pumps that do not use F-gases as a refrigerant.
- Set a target and make a plan to end the use of MDIs that use high-GWP F-gases by the mid-2020s. Extend this to all NHS and private services, including those of the devolved administrations.
- Push for stronger international action on reducing F-gas emissions, including health services in other countries.

Endnotes

¹ NHS (2022) *Network Contract Directed Enhanced Service, Investment and Impact Fund 2022/23: Updated Guidance*, <https://www.england.nhs.uk/wp-content/uploads/2022/03/B1357-investment-and-impact-fund-2022-23-updated-guidance-march-2022.pdf>.

² BEIS (2022) *Heat Pump Ready Programme*, <https://www.gov.uk/government/publications/heat-pump-ready-programme>.



Chapter 13: Engineered removals

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Introduction and key messages

Engineered removals, such as Bioenergy with Carbon Capture and Storage (BECCS), Direct Air Capture with Carbon Capture and Storage (DACCs) and wood in construction, provide an important contribution to reaching Net Zero by complementing, rather than replacing, emissions reduction across all sectors. Engineered removals supplement natural carbon storage measures such as peatland and forest restoration and new woodland creation.

The IPCC Working Group III report finds that the deployment of removals will be ‘unavoidable’ in counterbalancing residual emissions from hard-to-abate sectors to reach Net Zero emissions.¹ In delivering this, both nature-based and engineered removals will be important.

Key policy decisions on engineered removals are required this year and over the period to 2025 to enable their scale up in the second half of the 2020s, as set out in the Government’s Net Zero Strategy.² This policy framework must sit alongside continued investment in research and development and Carbon Capture and Storage (CCS) infrastructure.

Our key messages are:

- **Ambition.** The UK Government’s Net Zero Strategy’s target of 5 MtCO₂/year of engineered removals by 2030 is aligned to the CCC’s Balanced Net Zero Pathway. Full and timely implementation of the other Net Zero Strategy commitments on engineered removals and strong follow-up policies on financial support are required to enable this scale of deployment by 2030.
- **Deployment leadership.** Engineered removals technologies are undergoing increased research and development, but current projects are operating at a small scale. The need for rapid international upscaling provides the UK with the opportunity to play a leading role in establishing monitoring, reporting and verification (MRV) frameworks, including considering the permanence of engineered removals, and financial support mechanisms to enable their large-scale deployment.
- **Pathway dependence and need for contingency measures.** The Government’s Net Zero Strategy pathway has a relatively high dependence on engineered removals, with all scenarios for 2050 assuming more CO₂ removed a year than the CCC’s Balanced Pathway. This higher dependence on engineered removals creates risk around the increased need for contingency emissions reductions from other sectors if deployment of engineered removals goes off-track.
- **Sustainability.** Engineered removals are resource-intensive, so their sustainability must be carefully assessed and monitored. In addition to the materials needed for large-scale facility construction, BECCS requires bioenergy feedstocks, and DACCs requires considerable energy input.
 - In the upcoming Biomass Strategy, the Government must set out how it will ensure the sustainability of the full amount of bioenergy feedstock needed for BECCS. This should set out how domestic biomass feedstock supplies can be expanded to avoid overreliance on imported biomass, for example through policies on diet change to make more UK land available.

- Should the Biomass Strategy find that insufficient quantities of sustainable biomass feedstock will be available, Government should plan how this shortfall can be made up through either, or a combination of, other engineered removal approaches and deeper emissions reductions.
- **Infrastructure.** Delivery of BECCS and DACCS relies on appropriately located and sized CO₂ transport and storage infrastructures. Coordination of CCS requirements must be facilitated across sectors and the sequencing of anchor and follow-on projects for planned clusters must be set out. Wider infrastructure implications of engineered removals, such as the energy network reinforcements that may be needed to service DACCS energy demand, should also be considered in future planning decisions.
- **Coordination across the UK.** Alongside the UK the devolved administrations, particularly Scotland, also have ambitious targets on engineered removals and greenhouse gas removals more generally. The UK Government and devolved administrations should improve coordination on deployment planning and discuss the implications for each nations' pathways if initial deployment of engineered removals is concentrated in only a small number of sites in one part of the UK.
- **Public engagement.** Public engagement on engineered removals is needed to improve understanding and address concerns around sustainability of technologies such as BECCS. Public consultation can benefit delivery in this area, with the required scale-up this decade offering good opportunities for co-designing solutions with UK citizens. A programme of engagement should be carried out in advance of large-scale deployment later this decade.

The rest of this chapter is laid out as follows:

1. Indicators of progress
2. Policy progress, assessment and next steps
3. Major risks

1. Indicators of progress

This section sets out key indicators of progress within the engineered removals sector (Table 13.1).

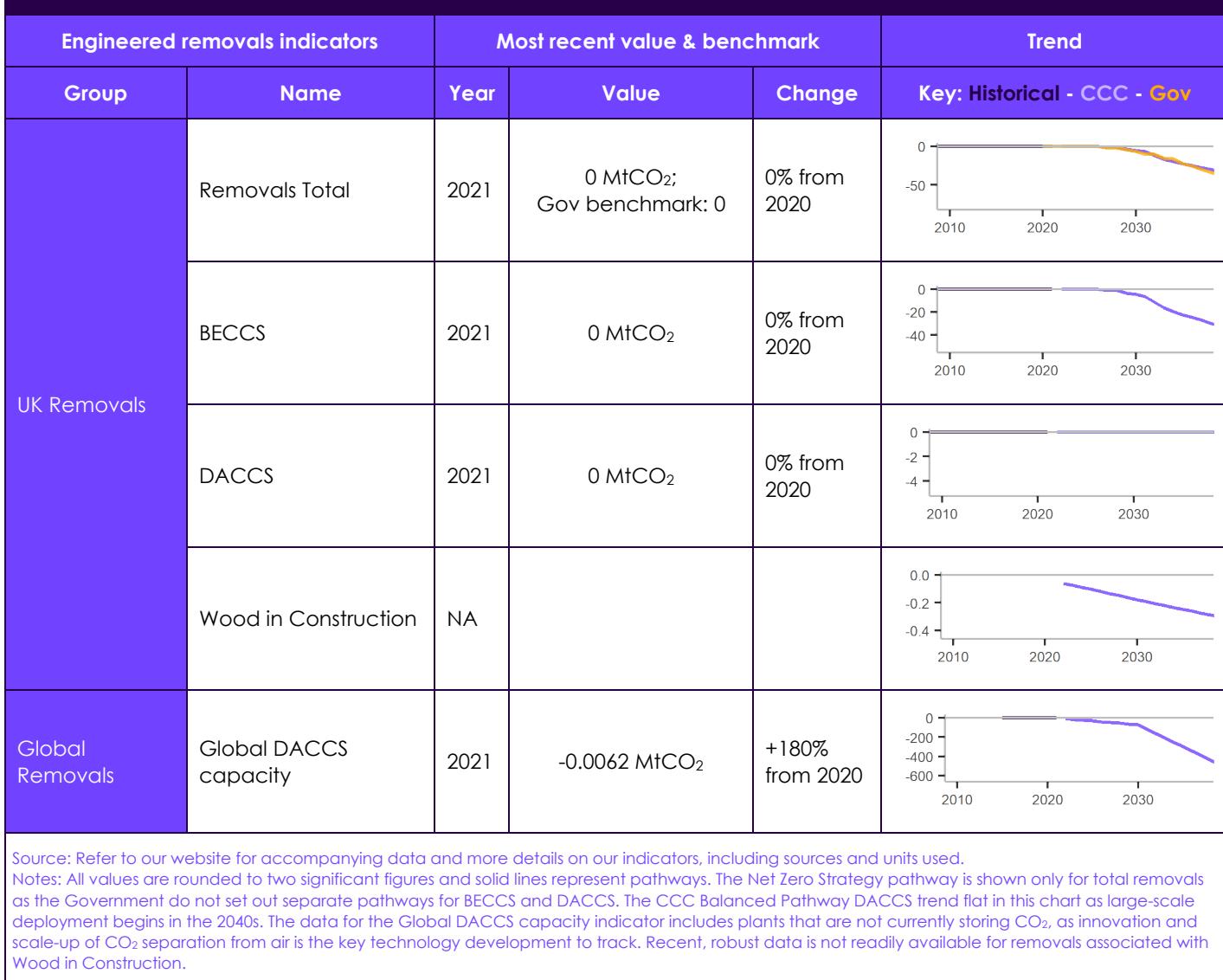
Developments in CCS networks inform our tracking of progress in engineered removals.

Progress in DACCS abroad can influence deployment timelines in the UK.

- Indicators for the UK are the total deployment of engineered removals, and of the contributions to this total from BECCS, DACCS and Wood in Construction (WiC). BECCS, DACCS, or a combination of the two, are expected in the Net Zero Strategy to start removing CO₂ in the late 2020s. Underpinning developments in CCS infrastructure need to be scaled up this year and are being tracked through the indicator on industrial CCS candidate projects in Chapter 5 and the indicator on CO₂ storage licences in Chapter 14.
- In addition to UK-located deployment, international progress on DACCS capacity is an important indicator to track as scale-up experience and shared lessons from international projects could allow the UK's take up of DACCS to happen more rapidly and cost effectively.
- Following the setting out of market support mechanisms for engineered removals (see Policy Progress below), we may in future introduce indicators tracking progress on candidate UK engineered removals projects.

Table 13.1

Key indicators for the engineered removals sector



2. Policy progress, assessment and next steps

Engineered removals build on developed CCS technology, namely CO₂ capture and permanent geological CO₂ storage. Large-scale CO₂ capture from combustion, in a manner similar to that which would be applied to combustion of biomass for BECCS, is in operation at a small number of plants worldwide.

In 2021 a full-chain DACCS plant opened in Iceland, capturing and geologically storing up to 4,000 tCO₂/year. Large-scale DACCS plants capturing up to 1 Mt CO₂/year are presently proposed in the United States, Norway and Scotland.

In the UK there is currently no deployment of full-chain BECCS or DACCS, although Drax is testing CO₂ capture from biomass at its North Yorkshire power plant. The UK Government's Net Zero Strategy set out plans for the initial development of engineered removals to achieve 5 MtCO₂/year of sequestration by 2030.

Early clarity on market design for engineered removals is needed to enable large-scale deployment by 2030.

The UK Government will need to move at pace to reach its 2030 ambition. The evidence-gathering committed to in the Net Zero Strategy must be completed on time and swiftly followed by policy development and implementation to avoid delays in deployment. Early clarity on business models, MRV including sustainability, and legal treatment of engineered removals is needed to secure business confidence and incentivise investment.

This section is in three parts:

- (a) Policy progress
- (b) Assessment of policies and plans
- (c) Recommendations

(a) Policy progress

Net Zero Strategy

The UK Government's Net Zero Strategy set out plans for the initial development of engineered removals in the UK as follows:

The Net Zero Strategy set out important initial steps towards tackling legal and financial barriers for engineered removals deployment in the UK.

- Deployment of at least 5 MtCO₂/year of engineered removals by 2030, in line with the CCC's Balanced Net Zero pathway. This is expected to be realised via a scale-up in the second half of the 2020s, with the UK Government allowing for 0-4 MtCO₂ of removals in 2027.
- A consultation on business models for the incentivisation of early investment in engineered removals in Spring 2022.
- A Call for Evidence on the potential role of the UK Emissions Trading Scheme (UK ETS) as a long-term market for engineered removals – published in March 2022.
- Exploring options for regulatory oversight to provide robust monitoring, reporting and verification (MRV) of engineered removals and greenhouse gas removals more generally, following the recommendations of the BEIS-led MRV Task & Finish Group (Box 13.1).

- Amending the Climate Change Act to enable the contribution of engineered removals to UK carbon budgets as recommended in the Committee's 2021 Progress Report.

Research and Development (R&D)

The Net Zero Strategy also committed to delivering £100 million innovation funding for engineered removals. This is an important contribution to international R&D efforts, which will be critical to rapidly advancing engineered removals technologies.

BEIS and UKRI-funded R&D projects on engineered removals are underway.

- The BEIS Direct Air Capture and Greenhouse Gas Removals programme has committed up to £70 million towards funding pilots and demonstrator projects to identify MtCO₂-scale solutions at a cost of less than £200 per tonne of CO₂ removed. Phase I (now completed) funded 15 projects to establish pilot designs and will inform the selection of projects moving to Phase II to receive support towards demonstration level by mid-2025 (status in May 2022).
- The International Energy Agency's 2022 report on Direct Air Capture (DAC) highlights the importance of innovation and demonstration to enabling DAC technologies to contribute to reaching Net Zero emissions (Box 13.2).
- UKRI funding of £30 million from the Strategic Priorities Fund is supporting four-and-a-half-year test projects on enhanced weathering and biochar, as well as projects on natural carbon storage in peatlands and forests.

Robust rules and guidance are needed to enable transparent MRV around the volume and permanency of all greenhouse gas removals.

Box 13.1

Monitoring, Reporting and Verification of Greenhouse Gas Removals – Task and Finish Report

In 2020 BEIS convened the Monitoring, Reporting and Verification (MRV) of Greenhouse Gas Removals (GGR)* Task and Finish Group to assess existing regulatory frameworks and standards and identify gaps to develop a comprehensive and robust MRV approach to UK GGR development. This Group assessed MRV needs and options for both engineered removals and land-based removals such as afforestation and reforestation.

The Group's 2021 report examined the steps that would need to be taken to ensure that the volumes of CO₂ removed through GGR and the permanency of the removals are quantified in a robust and transparent way. The report provides suggestions for incentivising and accurately capturing the permanency of removals. This includes recommending that credits for tonnes of GGR should correspond to the CO₂ store's expected longevity and risk of leakage and that provision for recovery of potential post-removal CO₂ release is made at the start of the projects.

The Group's other recommended actions for Government include:

- Explicitly identifying any gaps in the science in MRV capabilities for each GGR approach (within 1-2 years).
- Engaging with relevant international stakeholders to share knowledge and understanding, and to collaborate on addressing the governance and accounting challenges relevant to GGR (within 1-2 years).
- Establishing an independent function responsible for the MRV regime that sits between project developers and HMG, to ensure that the amount and permanence of removals are quantified robustly and transparently (within 2-4 years).

* Greenhouse Gas Removals (GGRs) are methods and processes that remove greenhouse gases, predominantly CO₂, from the atmosphere. GGRs include nature-based removals, such as afforestation, or engineered removals, such as BECCS. This chapter focuses on engineered removals.

- Developing detailed MRV protocols for all non-geological storage GGR approaches. This should be done in parallel with initial commercial demonstration (within 2-4 years).
- Considering developing a regulatory framework to enable the participation of GGR in a potential Emissions Trading Scheme and in international carbon markets (by the mid-late 2020s). This report preceded the UK ETS Call for Evidence.

Source: BEIS (2021) *Monitoring, Reporting and Verification of Greenhouse Gas Removals Task and Finish Group Report*.

The IEA finds that at-scale deployment, innovation and international co-operation have potential to bring down costs for DAC technologies.

Box 13.2

International Energy Agency Report on Direct Air Capture

In April 2022 the International Energy Agency (IEA) published an assessment of Direct Air Capture (DAC) technologies. This finds that while present facilities are small-scale (capturing up to 4,000 tCO₂/year) momentum is growing. Innovation and deployment could reduce current high costs enabling DAC to play a key role in reaching Net Zero emissions. The IEA global Net Zero Emissions by 2050 for energy and industry scenario includes over 85 MtCO₂ captured by DAC in 2030, and around 980 MtCO₂ in 2050 (the scenario includes captured CO₂ being both geologically stored and used as a feedstock to create carbon neutral synthetic fuels).

The report makes the following recommendations for accelerating DAC deployment to support Net Zero.

- **Demonstrate DAC at scale as a priority.** Demonstration of DAC at scale is needed as soon as possible to reduce uncertainties about deployment potential, lower costs and provide lessons for future projects. Targeted policies should be introduced to support early investment in DAC projects, with policy design taking into account the early stage of commercialisation of these technologies.
- **Foster innovation across the DAC value chain.** Innovation along different parts of the DAC process has high potential to reduce manufacturing and operational costs. Increased research, development and deployment (RD&D) spending is required at the national and global level.
- **Identify and develop CO₂ storage.** Increased investment is needed in the development of CO₂ storage and CCS infrastructure to avoid lack of availability of developed storage sites acting as a bottleneck for DAC deployment. Governments should be proactive in identifying and developing CO₂ storage in appropriate regions and consider introducing policies to accelerate commercial development of CCS networks.
- **Develop internationally agreed approaches to DAC certification and accounting.** A robust and transparent set of international rules on accounting and certification for DAC-based removals is needed to facilitate their integration into carbon markets and provide confidence in the validity of the emissions reductions.
- **Assess the role of DAC and other Carbon Dioxide Removal (CDR) approaches in Net Zero strategies.** Governments should engage in early planning on the future role of DAC and other removals options in their pathways, noting that these technologies and processes do not provide an alternative to ambitious early action on emissions reduction.
- **Build international co-operation for accelerated deployment.** International co-operation can lead to faster deployment and lower costs through shared lessons from early projects and reduced duplication of research efforts. Co-operation across countries can also help to harmonise monitoring, accounting and certification approaches, creating international consistency and improving confidence in DAC and DAC-based removals.

Source: International Energy Agency (2022) *Direct Air Capture 2022 – A key technology for net zero*.

(b) Assessment of policies and plans

Recent policy progress in this sector is focused on gathering evidence and developing support policies following the setting out of high-level ambition in the Net Zero Strategy. All recommendations from the CCC's June 2021 Progress Report are now underway.

An ambitious and decisive Biomass Strategy and a timely response to the upcoming business models consultation are essential in continuing initial Government progress on engineered removals.

- The Government's position on market design, support mechanisms and governance must now be set out and clearly communicated to industry and investors in a timely manner.
- The Government's upcoming Biomass Strategy must include robust plans on sustainability frameworks and increased domestic biomass production to underpin the role of BECCS in future UK decarbonisation. The Biomass Strategy should address the findings of the IPCC Working Group III Report on the risks of biomass demand to biodiversity and land carbon stocks.

Table 13.2

Policy scorecard for engineered removals

Sub-sector	Delivery mechanism and responsibilities	Funding and other financial incentives	Enablers in place and barriers overcome	Timeline for future policies	Overall sub-sector assessment
BECCS	N/A	Y	O	O	O
<ul style="list-style-type: none"> Establishment of governance and delivery mechanism pending various evidence-gathering exercises. Ratings not provided as fully-formed structures are not expected at this time. The BEIS consultation on engineered removals business models is due in the first half of 2022. This will start to establish a picture of the future market for commercial deployment of BECCS. Delays to this timeline risk undermining business confidence and delivery. Proposals for BECCS funding models should be published over the next year to improve business confidence. The Government's upcoming Bioenergy Strategy should clearly explain how sustainability of BECCS feedstocks will be secured and how overreliance on imported feedstocks will be avoided. When considering the balance between imported and domestically produced feedstocks, the Strategy should take into account the land use constraints implied by the lack of provision for diet change in the Government's Net Zero Strategy. Risks to delivery if appropriately located CCS infrastructure and sufficient storage capacity are not developed during this decade. Timeline on future policies is unclear. The Government is taking steps to gather the evidence to support decisions but there is presently no clear indication of when firm conclusions will be reached on market design, funding and governance. 					
DACCS	N/A	Y	O	O	O
<ul style="list-style-type: none"> Establishment of governance and delivery mechanism pending various evidence-gathering exercises. Ratings not provided as fully-formed structures are not expected at this time. BEIS consultation on engineered removals business models is due in the first half of 2022. Delays to this timeline or exclusion of DACCS from this consultation could risk undermining business confidence. Small-scale projects (located outside the UK) are demonstrating technical feasibility and informing cost assessment. Deployment timeline is subject to further scaling of test projects and specific assessment of locating DACCS in the UK including the provision of energy input and CO₂ transport and storage infrastructure. Plans to address sustainability considerations, including around energy use, should be developed by the middle of this decade and be incorporated into public engagement to help avoid possible issues around public acceptability. Timeline on future policies is highly uncertain. The Government is supporting R&D and gathering evidence but there is no clear indication of expected DACCS deployment or when firm conclusions will be reached on expected market design, funding and governance. 					
Overall sector assessment	N/A	Y	O	O	O

(c) Recommendations

The recommendations for this sector are available in the accompanying tables in the Annex (grouped by department) and on our website. The latter are filterable by sector and by department.

To date, the UK Government has undertaken evidence-gathering on the role of engineered removals in reaching Net Zero and provided ongoing support for R&D. Targeted dates for scale up of engineered removals are now fast approaching.

Decisions on market structure and design are needed in 2022 and 2023 to enable deployment of 5 MtCO₂/year by 2030.

- Experience with similar facilities suggests it is likely to take around four to six years for the UK's first large-scale engineered removals facilities to become operational covering design engineering, full planning and consenting, contract negotiations, final investment decision, and build and commissioning.
 - Government must therefore use 2022 and the start of 2023 to make rapid progress towards setting in place a comprehensive delivery package comprising financial, technical and institutional (MRV) policies and setting out clear timelines for decisions.
 - Hard-to-abate sectors may rely on the reductions in emissions from engineered removals for offsetting their residual emissions in the 2030s and 2040s. These interactions between sectors should be considered when allocating the burden of financial support for engineered removals between different actors in upcoming business model decisions.
- The Net Zero Strategy allows for 11-34 MtCO₂ of engineered removals annually by 2035. This speed of scale-up in the early 2030s means that Government policies around funding, MRV and biomass use must be ready to support 5 MtCO₂ of removals as a minimum, not a maximum, in 2030.
 - This step change in scale-up in the 2030s must also be considered in ensuring that energy system and CCS networks around potential BECCS or DACCS sites have sufficient capacity.
 - Consideration should also be given to measures that might be taken to further reduce emissions in other sectors should such rapid scale-up in engineered removals prove too technically challenging, expensive, or sustainability criteria are not met (see Table 13.3).
 - Growing activity on DACCS internationally suggests potential for DACCS to contribute to UK engineered removals deployment this decade (Box 14.2). Subject to sufficient support, this might result in different relative scales and timings of contributions from BECCS and DACCS than suggested in the CCC Balanced Pathway where large-scale (1Mt CO₂) DACCS deployment occurs in the 2040s.
 - Government should also continue to support R&D and monitor developments across other engineered removals technologies such as enhanced weathering and biochar to assess if they might contribute to the overall UK deployment of engineered removals.

International progress across engineered removals technologies must be closely monitored and considered in decisions on Government support.

Strong MRV frameworks are required to address sustainability concerns and secure public acceptance.

- Alongside market establishment, Government must be proactive in ensuring that all removals are sustainable and that the MRV systems that measure net CO₂ removed and the permanency of storage are set out in a transparent and robust way that are understood and accepted by the public.
 - Comprehensive MRV frameworks for feedstock sustainability and encouraging diet change to free up land for domestic feedstock production are both important steps towards establishing BECCS as a viable long-term decarbonisation option for the UK.
 - The Government's upcoming Biomass Strategy should set out best-use hierarchies for biomass, how sustainability requirements for feedstocks will be met, and demonstrate how these align with plans for BECCS deployment.
 - Addressing sustainability concerns and improving public understanding around the underpinning science and emissions reduction potential of different engineered removals technologies is a key step in securing public acceptance ahead of large-scale deployment.
- Engineered removals are expected to contribute to medium-term emissions reduction targets and Net Zero targets both for UK-wide, and in the UK constituent nations. However, initial UK deployment of engineered removals is likely to be operating in just a handful of sites (e.g. as part of CCS clusters), which might be located in just one part of the UK, particularly in the 2030s. In the next year, HMG and the devolved administrations should work together to publish a joint position on the allocation of engineered and other removals towards contributing to UK-wide and devolved administration targets.

3. Major risks

Table 13.3

Major risks and required mitigating actions for engineered removals

Risk category	Description	Mitigating actions	In place?
		Details	
Delayed policy	Key policies such as establishing market mechanisms and MRV not delivered to schedule.	<ul style="list-style-type: none"> Ensure adequate Government focus on coordinating across relevant policy areas including power, CCS and bioenergy to deliver a clear policy timeline. 	Partly
Sustainability	<p>BECCS deployment is unsustainable and/or has an over-reliance on imported feedstocks.</p> <p>DACCS energy and materials requirements are not met sustainably.</p>	<ul style="list-style-type: none"> Implementing measures to encourage diet change, using freed-up land from resulting changes in land use for sustainable feedstock growth and afforestation. Potential DACCS energy requirements built into future planning for UK energy system. Additional emissions reduction action in other sectors (see 'Abatement from other sectors' below). 	No
Technology	Engineered removals technology scale-up proves more technically challenging than envisaged.	<ul style="list-style-type: none"> International collaboration in early projects. Continue R&D into alternative engineered removals approaches such as enhanced weathering and biochar. Additional emissions reduction action in other sectors (abatement from other sectors see below). 	Partly
Costs	Costs prove higher than estimated/Government finance allocation insufficient to deliver investment.	<ul style="list-style-type: none"> International collaboration in early projects. Explore funding models that can reduce the cost of capital. Additional emissions reduction action in other sectors (abatement from other sectors see below). 	Partly
Infrastructure	Underpinning CCS infrastructure not available on time.	<ul style="list-style-type: none"> Ensure that infrastructure development is not reliant on a single anchor project. Explore funding models that can reduce cost of capital. Additional emissions reduction action in other sectors (abatement from other sectors see below). 	Partly
Abatement from other sectors	Combination of realised risks in sustainability, technology, cost and infrastructure results in inability to deploy the levels of engineered removals in the Net Zero Strategy, requiring additional effort from other sectors.	<ul style="list-style-type: none"> Ensure delivery of emissions reductions across the economy is on track, so that an undue reliance is not placed on engineered removals. Develop measures to bring about additional demand-side emissions reductions in case required, for example in areas such as diet change and aviation. 	Partly

Public attitudes	<p>Development of engineered removals receives significant public opposition.</p> <ul style="list-style-type: none"> • Establish transparent and robust sustainability criteria and MRV. • Timely integration of engineered removals into the Government's Net Zero communications, emphasising that removal capacity does not negate the need for deep decarbonisation across sectors. • Ensure delivery of emissions reductions across the economy are on track, so that an undue reliance is not placed on engineered removals. • Disseminate evidence from trial projects in an open and accessible way. • Public consultation on co-designed policy solutions. 	Partly
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Endnotes

¹ Intergovernmental Panel on Climate Change (2021) *Climate Change 2021: The Physical Science Basis*, <https://www.ipcc.ch/report/ar6/wg1/>.

² Department of Business, Energy and Industrial Strategy (2021) *Net Zero Strategy: Build Back Greener*, <https://www.gov.uk/government/publications/net-zero-strategy>.



Chapter 14: Cross-cutting issues

Progress on cross-cutting issues

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Introduction and key messages

As well as assessing progress towards Net Zero through a sectoral lens, it is important to look at key enablers that cut across the economy. The Government's Net Zero Strategy recognised the importance of these and initiated plans to strengthen them. At present, the implementation of many of those plans has only progressed partially.

Our key messages on enablers are:

- **Governance.** Good governance structures and processes are essential to the delivery of the Net Zero transition. The Net Zero Strategy has identified what needs to be done. Now the Government needs to set out who is responsible for which parts and how delivery as a whole will be coordinated, particularly between central, devolved, and local government. These roles should be backed up with accountability mechanisms, overarching policies and funding that empower departments, public bodies, and local government to deliver on their responsibilities in the short, medium and long term.
- **Public engagement.** People are central to meeting Net Zero, whether as investors making upstream investment decisions, in businesses manufacturing and adopting low-carbon technologies, or as consumers and households choosing lower-carbon goods and services. While support for climate action remains high, people often do not have a clear view of what actions are needed or what their roles are, both for mitigation and for adaptation. The Government needs to set out an overall strategy for public and business engagement which includes participatory and deliberative processes, awareness-raising communications and integration of social and behavioural science in policy design. The promised energy advice service, and the supply chains and skills needed to allow their advice to be followed, is a clear priority given the cost-of-living crisis and continued slow progress in decarbonising buildings.
- **Fair funding and affordability.** In the past year, spiking fossil fuel prices have pushed the relative costs of decarbonisation downward. However, they have also fuelled the cost-of-living crisis by increasing households' bills and expenses. The Government has put forward policies that will support households in the short term. The Treasury must make decisions that address how the funding of Net Zero will impact households and the Exchequer in the long-term, and how the distribution of both costs and opportunities will be made fair.
- **Workers and skills.** The Government has put in place a series of policies to identify skills needs for Net Zero and to support both the existing workforce and new entrants through reskilling and training. These policies signal an important role for local authorities, education providers and businesses; however, the Government has not provided a strategic framework. This will be needed to support those most at risk of a sudden and localised transition away from high-carbon sectors, but also to maximise economic opportunities for high quality domestic job creation.
- **Business and investment.** This year has seen a flurry of ambitious commitments from private sector coalitions at COP26 and from the Government, who announced aspirations for the UK to be home to the world's first Net Zero-aligned Financial Centre.

The Government now needs to translate ambition into action, developing policies for the Sustainability Disclosure Requirement (SDR), publishing a comprehensive Green Finance Strategy and holding businesses to account for their Net Zero commitments. To effectively harness corporate Net Zero ambition, the Government should publish an outline for a robust transition plan standard, regulate the use of voluntary carbon offsets and increase its engagement with small and medium-size enterprises (SMEs).

- **Innovation.** The UK's Net Zero Research & Innovation Framework appropriately prioritises innovation funding and is backed by at least £1.5 billion up to 2024. The Government now needs to take steps to ensure transparency in research processes and results, so that knowledge is built on and not lost. System-level interdependencies of novel methods, products and processes should be appropriately addressed. The Government should consider whether the timescales of funding cycles are appropriate for all projects and ensure the availability of clear pathways for successful research to application.
- **Infrastructure.** The path to Net Zero requires major upgrades and investments in the UK's existing infrastructure (such as the electricity networks and the housing stock) as well as development of vital new infrastructures (such as for carbon capture and storage, electric vehicle charging and district heating). The Government has made some progress with firming up its plans on CCS and launching the UK Investment Bank (UKIB). We recommend that the UKIB introduces a Net Zero test, possibly informed by the green UK taxonomy under development (see the business and investment section), on its investments and outlines how it will incorporate non-financial benefits into its investment decisions. The significant investment in new infrastructure for Net Zero must be designed with high levels of climate resilience from the outset, to avoid locking in future climate impacts or additional costs due to changes in the UK's climate over its lifetime.
- **Trade, carbon leakage and reducing consumption emissions.** Following small steps towards developing its medium-long-term approach to managing carbon leakage risk, the Government should prioritise two steps. First, consult on plans to implement by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy. Second, develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application via due diligence or at the border.

We also cover the integration of **adaptation** and climate resilience within the transition towards Net Zero in this chapter. Overall, there is a significant gap between current policy ambition and delivery across the Government on building climate resilience, including related to Net Zero. There has been minimal policy progress over the last year on adaptation. It is vital that the next National Adaptation Programme (NAP) – which will be published over the next year – provides a genuine step-change in the UK's approach to climate change adaptation. Without adequate consideration of a changing climate across the Government and across sectors there are significant risks to the delivery of the UK's greenhouse gas reduction targets.

1. Governance

Introduction and key messages

Good governance – with clear roles and effective coordination – will be needed to deliver the Net Zero Strategy.

Meeting Carbon Budgets and reaching Net Zero will require significant changes across all sectors of our economy. While the responsibility for delivering much of this is shared between the Government (across all levels), private business, and the public, central Government has a clear role in leading and coordinating this change in order to ensure that these commitments are realised. The challenges associated with coordinating and delivering such a cross-cutting and transformational transition are significant and will require effective organisation of and collaboration between all levels and localities of government. Overall good governance gives the Net Zero Strategy credibility and is vital to delivering its vision.

The importance of governance was recognised in the Net Zero Strategy, including in sections on ‘Embedding Net Zero in Government’ and ‘Local Climate Action’. More is needed to put these good intentions into practice.

- **The Government needs to agree, define and publish clear roles and responsibilities** for the actions and interactions on the path to Net Zero, with effective accountability mechanisms to translate these into practice. DfT’s recent EV Infrastructure Strategy provides a useful example (see Box 14.1 below).
- **Net Zero (and climate adaptation) should be more integrated throughout Government policy**, having been largely missing from key documents such as the Levelling Up White Paper. Embedding this properly across the policy landscape is vital to the credibility of the Government’s Net Zero Strategy.
- **The UK Government’s monitoring of the delivery of the Net Zero Strategy should be a transparent and comprehensive exercise** that draws on and complements the Committee’s progress monitoring. It should learn from this and be prepared to change approaches and push through barriers while considering trade-offs and co-benefits.
- **The UK Government needs to work better with local and devolved government.** It should use the Local Net Zero Forum and the renewed Net Zero Hubs to learn from local best practice, to set clearer expectations across local government around what steps they should be taking, and to communicate how these actions are to be coordinated. The Committee’s previous recommendations still stand in this area: there needs to be an agreed delivery framework with local flexibility, more strategic and longer-term funding mechanisms, and better facilitation of delivery.¹

The Committee is not currently planning to publish a standalone report on the governance of Net Zero but will instead monitor progress and make recommendations through these annual Progress Reports. Therefore, this section includes more detail than the others in this chapter.

We set out our assessment on governance in four parts:

- (a) Indicators
- (b) Policy progress
- (c) Next steps
- (d) Key risks

(a) Indicators

Most of the indicators of progress towards good governance are inherently policy based and covered in the next section.

Most of the progress in Net Zero governance is inherently related to policy, which we cover in the next section. In this section, we present a small number of indicators that give a sense of the current state-of-play in certain areas.

- **Department plans.** Outcome Delivery Plans set out departments' priority outcomes and strategy for achieving these. While it is not necessary for every department to have a priority outcome linked to delivering Net Zero and adapting to climate change, departments should use their plans to set out clear actions and measurable targets to deliver the required contributions in their policy areas. Many, but not all, departments have done this in the first iteration of these plans (Figure 14.1).
- **Estates and operations.** The Greening Government Commitments have been successful in driving departments to decarbonise their estates and operations (Figure 14.2). This will need to continue to meet and exceed the emissions targets for 2025.
- **Local government.** There is considerable momentum at local government level (Figure 14.3). However, there is currently a lack of shared understanding of where these good intentions would be most effectively directed. Good governance would allow for better data collection and learning, efficiency in the scaling of delivery and longer-term strategic investment.
 - As of 2021, 335 councils have a Climate Action Plan, while 74 do not.
 - In 2021, Climate Emergency UK conducted an exercise to score the quality of these plans across nine areas. This assessment found an average quality rating of only 50%. For many councils, scores fell short across all areas, including the presence of appropriate governance, development, and funding. Manchester City Council's was the highest-scoring plan, achieving 87%.

Net Zero in department planning

Outcome Delivery Plans set out departments' priority outcomes and strategy for achieving them. Some departments have used these to identify clear actions and measurable targets to deliver their contributions to Net Zero.



Figure 14.1 Net Zero in departments' Outcome Delivery Plans

Priority outcome linked to Net Zero	Actions linked to cross-cutting Net Zero outcome	No Net Zero outcome, but specific actions identified	Minimal specific content relating to Net Zero
Department for Business, Energy and Industrial Strategy	Her Majesty's Treasury	Ministry of Defence	Ministry of Justice
Department for Environment, Food and Rural Affairs	Department for Levelling-Up, Housing and Communities	Department for Work and Pensions	Department of Health and Social Care
Department for Transport		Her Majesty's Revenue and Customs	Cabinet Office
		Department for International Trade	Department for Digital, Culture, Media and Sport
		Home Office	Department for Education
		Foreign, Commonwealth and Development Office	

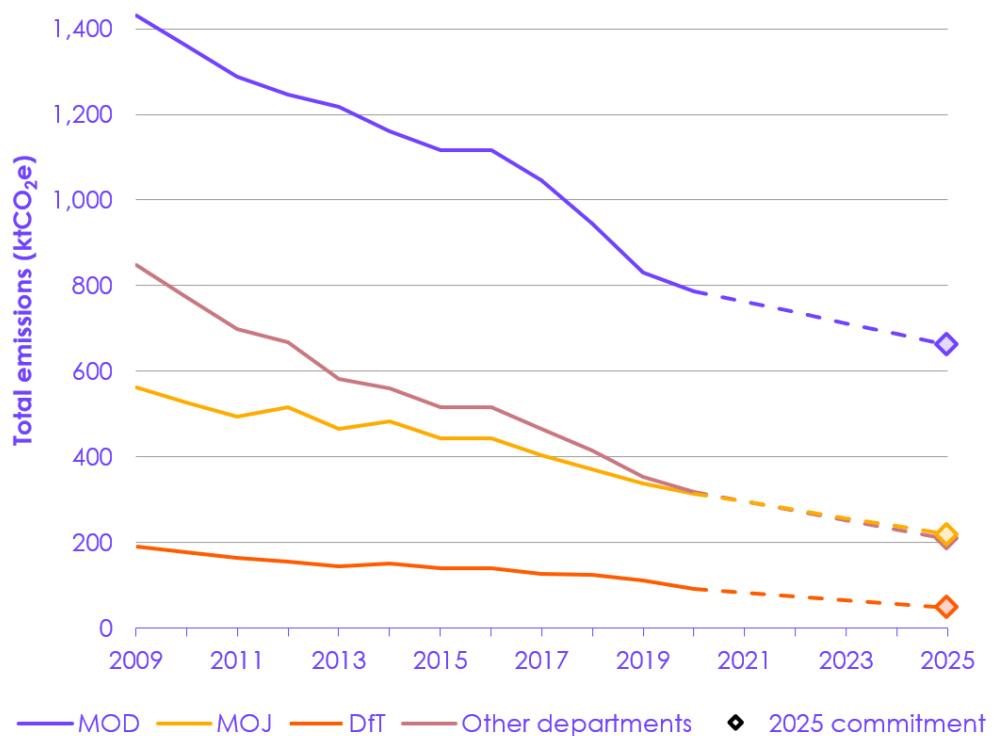
Source: Cabinet Office (2021) Outcome delivery plans; CCC analysis.

Notes: This chart summarises the extent to which Net Zero is reflected within departments' 2021 Outcome Delivery Plans. All plans contain a section on sustainability, but whether this contains specific actions and commitments, or just general observations varies by department. While Net Zero is not expected to be a top priority for all departments, the actions that are required cut across all departments' remits. This will need to be reflected in all departments' delivery planning. Departments should also consider how they can ensure that their policies help the country adapt to climate change and deliver other positive environmental outcomes.

Departmental emissions footprints

Emissions from the Government estate have been falling, and the pace of delivery is on track to meet the 2025 commitments.

Figure 14.2 Emissions from central Government department estates



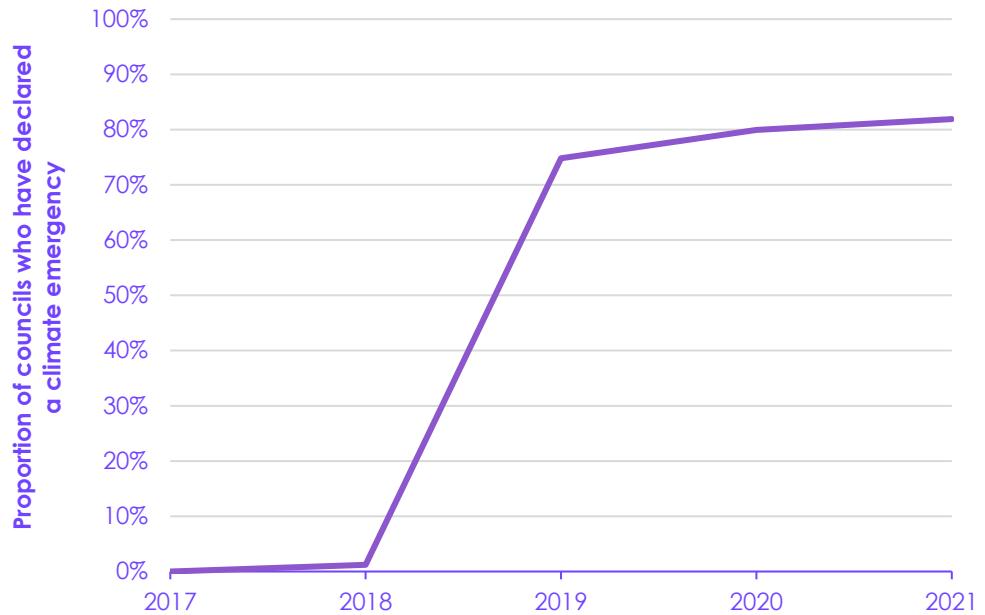
Source: Defra (2021); CCC analysis.

Notes: This chart shows the emissions performance of Government departments as reported in the Greening Government Commitments annual reports. The points on the right-hand side of the graph show the department's 2025 emissions target under the most recent Greening Government Commitments. The three highest-emitting departments (MOD, MOJ, DfT) are shown individually, with the emissions from the remaining 16 departments shown in aggregate. Emissions from hospitals and schools are not included within the figures and targets for DHSC and DfE.

Climate emergency declarations and plans

Over 80% of local authorities have now declared a climate emergency, and a similar proportion have a climate action plan.

Figure 14.3 Local authority climate emergency declarations and climate action plans (2021)



Source: Climate Emergency UK (2022) *List of Councils who have declared a climate emergency*; CCC analysis.
Notes: This chart captures all climate emergency declarations and climate action plans, irrespective of the target date or the quality of the plan.

(b) Policy progress

The Net Zero Strategy recognised the importance of good governance.

The Government recognised the importance of good governance within the Net Zero Strategy. This included acknowledgement of the importance of getting the right oversight structures in place within individual sectors (notably in the power sector).

- Three cross-cutting sections were of particular relevance:
 - The first relevant section emphasised the importance of taking a whole-system approach to Net Zero. This highlighted the need for contributions from all areas of Government and the importance of effective collaboration and communication.²
 - The second relevant section looked at embedding Net Zero across Government activity.³ So that sustainability is built into key policy-making processes and all decisions consider how they contribute to meeting the Net Zero pathway. Further, it introduced a series of key targets and ambitions that the Government will monitor and report on.
 - The third relevant section discussed the role of local action in delivering Net Zero.⁴ The Strategy recognised the need for clearer expectations on the role of local government in Net Zero delivery, supported by better resourcing and capability- and capacity-building.

- However, Net Zero and climate adaptation were largely absent from the Levelling-Up White Paper. Omitting consideration of interactions between environmental actions and the Government's other major objectives risks missing key synergies that could facilitate delivery of cross-cutting benefits.

While some progress has been made, the Government has not yet introduced a Net Zero test.

In our 2021 Progress Report, the Committee made a number of recommendations relating to the governance theme. Our priority recommendation, to implement a Net Zero Test, has not yet been achieved, although the Government has made some progress towards embedding environmental principles and emissions assessments within some areas of policy- and decision-making.

- Of the five recommendations that are not ongoing in nature, we assess one as having been achieved in full, two as having been partly achieved, and two as having not been achieved.
- There were also fourteen ongoing recommendations, relating to the need to embed Net Zero within departmental processes across a variety of departments. While some departments are making progress, further action will continue to be needed through the coming years.
 - To enable more effective monitoring of this, all departments should ensure that both Net Zero and climate resilience are reflected within their Outcome Delivery Plans in a manner commensurate with the actions required from their areas of responsibility.

The rest of this section on policy progress considers progress in specific areas of Net Zero governance.

Coordination and accountability

There are two Cabinet committees focused on climate action, supported by a range of groups at official level.

The pathways and delivery outcomes required for Net Zero cut across all areas of society, the economy and the Government and involve many interdependencies. The Net Zero Strategy recognised that policy development and implementation therefore need to be well coordinated to ensure that actions reinforce each other and avoid mixed messages. The key current structures in place to support this are:

- Two Cabinet sub-committees – Climate Action Strategy (chaired by the Prime Minister) and Climate Action Implementation (chaired by the COP26 President). The fact that Cabinet committee meetings are not publicly disclosed makes it difficult for us to monitor progress through these groups.
 - Collectively, the Cabinet are responsible for delivering Net Zero (along with other key strategic goals), while BEIS as a department holds the lead on implementing this.
- In 2021, Number 10 set up the Prime Minister's Delivery Unit, which is designed to implement the core objectives of the Government as identified by the Cabinet. Net Zero is one of these objectives.⁵ It sits alongside four other major ambitions, which will stretch the resource and expertise of the Unit.
 - The Government should explore opportunities for synergies between these ambitions and should make clear how any conflicts will be managed.

- A variety of cross-Whitehall and internal departmental official-level boards support collaboration and coordination between policy areas. As identified by the NAO, these include a senior-level Climate Change Integrated Review Implementation Group chaired by BEIS, along with various inter-departmental subgroups.⁶
- In April 2022, the Government launched the new Future System Operator.⁷ This independent public body will have a remit to take a strategic whole-system view of how Great Britain's energy system should develop.
 - The Government will need to ensure that the roles and relationships between this organisation, other new bodies such as Great British Nuclear, and existing entities are clear. This organisations mandate needs to ensure that the energy system develops high levels of resilience to climate and weather hazards.

Net Zero has been established as a core objective across the public sector.

The Net Zero Strategy set out the contribution required from each sector to deliver the overall pathway. It has established Net Zero as a core objective across the public sector. In most sectors, this is backed by an underpinning sectoral strategy.

- In some cases, these sectoral strategies lack sufficient joined-up thinking and a consideration of dependencies and co-benefits between policies in their areas. For example, on synergies between transport and buildings policy and demand in the energy system. The Government needs to ensure that there is stronger alignment between new and existing strategies, and any related plans being developed by business and local authorities.
- Some sectors (e.g. land use) still lack strategies. The Government needs to urgently fill these gaps.
- Some recent strategies, for example the UK electric vehicle infrastructure strategy, have begun to include credible plans for implementing the Government's vision (Box 14.1).⁸ This approach should provide a blueprint for future policy papers.
- During 2021, the Chancellor wrote to the Bank of England, the National Infrastructure Commission, and the principal financial regulators to add Net Zero and climate resilience objectives to their statutory remits.^{9,10,11,12,13} The UK Infrastructure Bank was also launched with supporting projects that tackle climate change as one of its core objectives.¹⁴

The EV Infrastructure Strategy gives a good example of how roles and responsibilities should be set out.

Box 14.1

Clarifying roles and responsibilities for Net Zero

DfT's recent UK electric vehicle infrastructure strategy included an annex that clearly set out the roles and responsibilities for delivering the scale-up of charge points required. This table is reproduced below:

Table B14.1

Responsibilities table reproduced from the EV Infrastructure Strategy

Organisation	Summary of role and responsibilities
Central government	<ul style="list-style-type: none">Set the overall vision for the UK's electric vehicle charging infrastructure network.Define outcomes and measure and monitor progress.Provide the legislative, regulatory, funding and support frameworks to deliver a well-functioning, competitive market with targeted interventions where required.
Devolved administrations	<ul style="list-style-type: none">Set out the strategy and policy for the charging infrastructure network in their devolved area.Define outcomes and monitor progress.Engage with UK Government to promote collaboration and best practice sharing to create a cohesive UK network.
Local and Mayoral authorities	<ul style="list-style-type: none">Develop and deliver ambitious tailored local EV charging infrastructure strategies that provide scaled, commercially sustainable public charging provision. They should align with wider local transport and energy decarbonisation policies.Ensure clear ownership and resourcing of the planning and delivery of EV charging infrastructure rollout.Ensure local chargepoints are inclusively designed and accessible for residents, businesses, and visitors, and in line with local authorities' legal obligations.Ensure internal processes for the installation of chargepoints (for example grant permissions) are efficient, fast and easy to navigate for those working with local authorities.
Sub-national transport bodies	<ul style="list-style-type: none">Lead assessments of demand across their regions to assist local authorities and electricity network operators in the planning of chargepoint rollout.
Ofgem	<ul style="list-style-type: none">Ensure the electricity network is ready for the transition to EVs.More widely, regulate the energy industry to support delivery of decarbonisation of the energy system.
Electricity network operators	<ul style="list-style-type: none">Facilitate fast and efficient connections of EV charging infrastructure to the grid.Support local authorities in planning chargepoint delivery and chargepoint operators in delivering projects.
Chargepoint operators	<ul style="list-style-type: none">Provide convenient, reliable and affordable charging infrastructure that meets all legal and regulatory requirements.Collaborate with local governments to help develop appropriate local charging strategies and solutions, and bid into tenders.

	<ul style="list-style-type: none"> Develop and innovate, supporting long term growth of the sector and creating jobs across the UK.
Operators of motorway service areas	<ul style="list-style-type: none"> Plan and deliver the ambitious rollout of charging infrastructure at motorway service areas. Work closely with chargepoint operators to ensure that there are enough chargepoints at services across the UK.
Fleet operators and businesses	<ul style="list-style-type: none"> Develop and deliver plans to transition fleets to electric vehicles, including putting in place the appropriate supporting infrastructure. Share plans and data with local authorities to enable local authorities to understand wider charging provision within their areas.
Investors	<ul style="list-style-type: none"> Work with the stakeholders set out in this chapter to increasingly understand and invest in this growing sector.

Building on this table, the annex also discussed in detail the priority actions required from each group of organisations and identified funding, guidance, and policy that would be provided to aid delivery of these. This included £50 million of new funding to support local authorities in delivering their role, including resource funding where required.

In developing and implementing its Net Zero strategies and policies, the Government should provide similar clarifications of who will be responsible for delivering the actions required and which wider stakeholders need to be involved.

Source: DfT (March 2022) *Taking charge; the electric vehicle infrastructure strategy*.

Aligning policy and decision-making to Net Zero

Net Zero is increasingly embedded in other policy development and decisions, but this is not universal.

Through the Net Zero Strategy and the Environment Bill, the Government has acknowledged the need for policy across all areas to consider Net Zero in its formulation, although this is still not consistently and comprehensively dealt with.

- HM Treasury's Net Zero Review set out its intention to test spending decisions against the Government's Net Zero pathways, highlighting that this was done as part of the most recent Comprehensive Spending Review. This approach needs to extend to taxation and regulation.
- The Environment Act's five environmental principles are welcome as a qualitative and easily accessible guide for policymakers. But they are also vague, lack legislative power and focus on protection and prevention of damage rather than proactive actions. The Office for Environmental Protection identified eight specific areas that need to be strengthened.¹⁵
- In September 2021, the Government updated the Green Book guidance on how emissions impacts should be appraised in policymaking decisions, making it better aligned to Net Zero. But there are still issues around inconsistent adherence and capacity/resourcing, plus difficulties where certain co-benefits can be hard to quantify within existing frameworks.
- In some areas, notably the planning system, there remains a lack of clarity on how practitioners should balance conflicting objectives. This can present a barrier to delivery of the actions required to meet Net Zero as well as to building climate resilience.

The Government has committed to publish an updated Net Zero Strategy when the next Carbon Budget is set (in 2025). This is sensible, given the importance of being flexible to account for uncertain technological progress and react to unexpected changes.

Monitoring and evaluation

The Government has said it will report annually on progress with the Net Zero Strategy. This should build on the Committee's assessment.

The Net Zero Strategy committed the Government to publish an annual update on progress against the delivery pathway, including key indicators and discussion of contextual changes that might affect the pathway. This should be a comprehensive exercise that draws upon and complements the Committee's progress monitoring.

- In his letter to the Chair of the BEIS Committee in March 2022, The COP26 President confirmed that this will begin this year (i.e. 2022), and that the annual Energy and Emissions Projections will also continue to be published.¹⁶
 - The indicators that the update will assess are welcome in that they identify priority outcomes that need to be delivered, although the framework needs to be more comprehensive.
- Several sectoral strategies (e.g. the Transport Decarbonisation Plan and the Heat and Buildings Strategy) have also included sensible evaluation plans and commitments to regular updates based on their findings.
- In developing our Monitoring Framework for this report we have identified data gaps and shortcomings across the areas that we would ideally track. These range from fundamental indicators of actual progress (e.g. official data on the number of heat pump installations) to information on vital enablers (e.g. the number of people training to be heat pump installers). Government departments and the ONS should work together to address these gaps.

In October 2021, Defra published a new set of Greening Government Commitments, covering the period 2021-2025.¹⁷ These include targets for each department's emissions footprint in 2025 and plans for monitoring progress.

- They also give specific commitments to reduce emissions from travel by ministers, officials and other government personnel, to generate less waste, to consume less water and to procure products and services more sustainably.
- Departments are also asked to report on implementation and to produce climate adaptation action plans and nature recovery plans.

The role of local government and devolved administrations

The new Local Net Zero Forum will have a key role in strengthening local action on Net Zero.

Local government. The Net Zero Strategy recognised that 30% of abatement depends on local government action, and over 80% is within their scope of influence. The Strategy contained promising initial steps towards harnessing this ambition, including announcing the establishment of a Local Net Zero Forum and renewing the network of Net Zero Hubs. However, more clarity on the local role and how this will be coordinated is urgently needed.

- The Terms of Reference of the Local Net Zero Forum have yet to be published and its membership has not been determined. If done well, this Forum could improve policy development by allowing experience of what is practical and desirable on the ground to be fed in. The success of the Forum will be heavily influenced by its ability to synthesise useful lessons and socialise that information for the benefit of all local authorities.
- The supporting Local Net Zero Hubs will play an important role in providing guidance and coordination and sharing best practice. The Government needs to make sure they are accessible and relevant to all local authorities.

The Net Zero Strategy stated the intention to explore how local funding targeting Net Zero could be consolidated and simplified into longer-term packages that are accessible to all authorities, recognising that this could help unlock progress.

- The National Audit Office recently found that the current local authority funding landscape for Net Zero is highly fragmented and inconsistent.¹⁸
- The UK Infrastructure Bank will lend to local authorities to support high-value and strategic projects. It intends to develop an expert advisory service to offer guidance on how to develop and raise finance for projects.¹⁹
- To maximise value-for-money and deliver shared outcomes, the Government should embed synergies with local Net Zero delivery within Levelling Up funding streams and prioritise projects that can also reduce emissions.
 - The Levelling Up Fund and the Towns Fund together offer £8.4 billion in funding for projects that aim to deliver improvements in local connectivity, infrastructure and economic prosperity.
 - Seven city regions have been allocated £5.7 billion to improve their local transport schemes.²⁰ This scheme lists reducing emissions and delivering sustainable local transport systems as a core objective.

The Committee recently visited a number of local authorities across the UK, which highlighted a range of key challenges that need to be addressed and opportunities that could help in realising positive outcomes (Box 14.2).

The Committee has undertaken significant local engagement itself in the build up to this report.

Box 14.2

The Climate Conversation – Delivering a Net Zero, Climate Resilient UK

The CCC visited ten locations across the UK to get a better understanding of work taking place on the ground and the barriers to local delivery of climate action.

Ten local authorities hosted the Conversation and the CCC met leaders, mayors and officers. This included visits to business parks, innovation and training centres, new and retrofitted homes and adaptation projects. The Climate Conversation reached at least 480 people, providing valuable insights from climate partnerships, businesses, universities, community groups, school pupils, faith leaders and residents.

The findings are set out in a separate briefing, **Climate Conversation - Delivering a Net Zero, Climate Resilient UK**.

Each visit was different, but the common themes were:

- **Ambition** – local authorities have ambitious plans to deliver Net Zero and climate resilience, connected to delivering a fair transition and benefits to local people

- **Partnership** – there are strong climate leadership partnerships of key local organisations and project partnerships delivering innovation, adaptation, and training schemes locally
- **Place** – we found unique approaches and place-based schemes being designed for system-change, but every place was different with no apparent national strategy
- **Communities** – important community-based initiatives are generating the success stories, inspiration and positivity that maintain support for climate action
- **Capacity** – skilled teams are delivering locally, but overall capacity and skills in local authorities are insufficient to deliver at the necessary pace and scale to meet the UK Net Zero target, or improved climate resilience
- **Trust** – vital trusted people are key to implementation: experts are supporting the uptake of housing retrofit, nature-based flood solutions and business energy efficiency
- **Skills** – local initiatives are planned to develop the low carbon skills and knowledge for the Net Zero transition and to meet supply chain demands

However, the CCC heard about significant barriers to effective local delivery including:

- **Funding** – which is competitive, short notice, short term and narrowly defined – this prevents systemic change and the development of local skills, jobs and supply chains
- **Governance** – unclear roles and responsibilities for delivery at the national and local level and a lack of policy certainty; local authorities need a national framework for partnership with Government, national agencies and regional organisations
- **Planning** – The National Planning Policy Framework in England holds local planning authorities back from delivering Net Zero-ready new homes and homes are still being built that will need retrofitting later
- **Gaps in powers and perverse policies** – local authorities have incomplete powers to deliver, and national agencies do not align; some regulations disincentivise action
- **Capacity** – is insufficient at the local level to deliver at scale, local authorities are stretched despite some having experienced teams and investing in training
- **Data** – there is a lack of locally relevant, timely data to target interventions and monitor progress

The Climate Conversation reinforced the CCC's opinion that local authorities have a vital role to play in leveraging all their powers, assets and influence to deliver Net Zero and climate adaptation. The UK Government has recognised the role of local authorities in delivering Net Zero in its Net Zero Strategy, but now needs to work in partnership with them, through a framework to ensure local capacity is increased, that funding and policy are longer-term and more certain, and that policy contradictions are removed.

Source: Louise Marix Evans for the CCC (2022) *Climate Conversation - Delivering a Net Zero, Climate Resilient UK*.

Devolved Government. The Net Zero Strategy also recognised that achieving Net Zero will require joined-up action across the nations of the UK, acknowledging the need for a UK-wide approach and detailing sectoral collaboration arrangements.

- There is now a bimonthly Net Zero, Energy and Climate Change Inter-Ministerial Group that brings together ministers from the four nations to discuss emerging policies.
- This is supported by a cross-departmental official-level board as well as direct engagement between corresponding departmental officials.

While the UK Government has put these structural arrangements in place to provide the space for linking up with the devolved administrations, it is not clear that these are yet leading to effective engagement between the nations.

The UK Government and devolved administrations will need to work well together to succeed on Net Zero.

- It is unclear how far the devolved administrations were able to engage effectively with development of the UK Net Zero Strategy. There remains a misalignment of approaches in policy areas that are still reserved to the UK Government but will be critical in meeting devolved targets, such as the planning and delivery of engineered removals.
- The UK Government's Energy Security Strategy includes plans to ramp up onshore wind, with the implication that most of this will be located in Scotland. In order to deliver this, the UK Government relies on effective cooperation with the Scottish Government and should have undertaken extensive consultation with them during preparation of the Strategy.

(c) Next steps

Our full set of recommendations relating to governance is available in the accompanying tables in the Annex (grouped by department) and on our website. These apply both to the centre of Government (BEIS as the lead department on Net Zero, Defra as the lead department on adaptation, and the strategic centre of No 10/Treasury/Cabinet Office) and to the individual departments responsible for delivering the actions required to implement the Net Zero pathway.

Coordination and accountability

Having set out what is needed in the Net Zero transition, the Government should now be clearer on **how** it will be delivered.

The Government needs to build upon the progress made in setting out the Net Zero Strategy, to ensure that the policy landscape is complete, joined-up, and regularly updated. To achieve this, the Government must urgently set out its vision for how the Net Zero pathway will be delivered, including clarifying roles and responsibilities, how Net Zero interacts with other Government priorities, and how organisations should work together to deliver shared positive outcomes and realise co-benefits.

- Following the Net Zero Strategy setting out the Government's vision for what the transition will look like, the Government needs to produce a document making clear what needs to be done and by whom (Box 14.3). This should identify roles and responsibilities across central, devolved and local government, regulatory agencies, the wider public sector, and business.
 - Many interactions between policy areas will require joined-up action. The document should set out general principles on how these will be coordinated as they emerge and how lessons learned will be shared.
 - In some areas, international coordination is likely to be necessary to enable cost-effective and reliable delivery of the UK's Net Zero pathway. The UK should aim to take a leadership role in this.

Effective governance of this complex transition will need to balance centrally coordinated actions and effective delegation. This will require mechanisms that ensure that departments and delivery bodies are fully bought into the need for action and can be held accountable for delivery.

- The Government should set out ministers' latest expectations for the contributions from each sector and how these will be achieved. These expectations should be reflected through specific and measurable objectives within each department's Outcome Delivery Plan.

- By extending the remits of key financial bodies to specifically target Net Zero, the Government has begun to formally direct UK investment towards this goal. A similar approach could help build coherence and consistency in other key enabling sectors, such as planning and energy. Therefore, the Government should add Net Zero objectives to the remits of key regulatory and delivery bodies, including the Infrastructure and Projects Authority and Ofgem.

The Government needs to clearly map out the different roles and responsibilities in delivering Net Zero.

Box 14.3

Clarifying roles and responsibilities for delivering Net Zero

To deliver the Net Zero Strategy's vision, it is now vital for the Government to set out clearly how this will be achieved and by whom. Examples of good practice exist (e.g. in the EV Infrastructure Strategy, see Box 14.1), but these are not yet widespread. Cross-cutting guidance is required that sets out:

- **Roles and responsibilities.** The Government should set out an assessment of what each key actor's role is and who is responsible for what in delivering Net Zero. This must include not only a division between (and in some cases within) Government departments, but also a clear understanding for the role of local government, private sector, the public, and the international community.
- **Accountability.** Clear accountability mechanisms are needed for ensuring buy-in from those responsible for key actions and dependencies. Departments and delivery bodies should be given the space and flexibility to get on with delivering, supported by transparent reporting to enable effective progress monitoring.
- **Coordination.** The Government should clearly identify the unit within BEIS with responsibility for coordinating and monitoring delivery across Government, and how this interacts with cross-Government structures such as the Climate Action Implementation committee. This should abide by the following core principles:
 - It should focus on stewarding the system and aim to delegate as much as possible to those with clear accountability for delivering.
 - Its activity and skill-base should be focussed on coordinating actions that are more complex and require a whole-system approach, not on actual delivery. A small, agile, dedicated team could be helpful to achieve this.
 - It needs to have sufficient seniority/empowerment to be able to bring together and influence decision-makers across Government, the public sector, and business.
- **Monitoring and evaluation.** Robust monitoring and evaluation processes will be needed to identify potential barriers and understand delivery gaps at an early stage. These should be designed into policies from the outset, and the overall strategy should be agile to respond to emerging issues. The Government has made a good start on this through its commitment to review progress against the Net Zero Strategy annually and update the Strategy when setting the next Carbon Budget.

These proposals reflect the fact that Net Zero is a challenge unlike any other that Governments face – complexity, interdependency between a vast array of actors, long overall timescales, uncertainty, and the range of co-benefits and co-impacts. In recognition of these challenges, the Government's guidance will need to evolve over time, with reviews and updates based on experience of what is working effectively and what needs to improve. This aligns with the "living roadmap" that the Energy Systems Catapult have called for.²¹

Source: In March 2022, we held a roundtable discussion with a range of experts who have experience working with or across Government.

Notes: At this workshop, there was clear support for the importance of developing an agreed understanding of roles and responsibilities, as well as how these would be coordinated and monitored.

Aligning policy and decision-making to Net Zero

The Net Zero challenge has long timescales, is large in scale and relies upon delivery across the economy and society. It is therefore crucial that policies are properly aligned to the pace of transition required and work together constructively towards Net Zero. Policy coherence (ensuring that different policies all work towards the same end) is just as important as policy coordination (ensuring that policies are delivered in an organised and sequenced way).

The Committee continue to recommend introduction of a Net Zero Test.

We continue to recommend that introducing a Net Zero Test would be a good way to achieve this (Box 14.4). A recent Institute for Government report emphasised the importance of embedding Net Zero within policy and decision-making processes and set out how a usable and helpfully designed test could help achieve this.²² Other mechanisms may also be able to achieve the same goals, which would meet this recommendation.

The fundamental aim of such a test should be to identify policy areas or aspects of decisions that present risks or potential shortfalls relative to the Net Zero pathway, and then to consider alternative approaches, linked actions, or wider policies that can be used to mitigate or compensate for these. It should also identify opportunities for non-climate policies to contribute to Net Zero. There are two broad approaches that could be taken:

- Requiring an assessment of consistency with the Net Zero pathway to be conducted as part of all policy-making processes. This should assess whether schemes that lead to increased emissions are really essential and whether there are lower-carbon alternatives that could achieve similar objectives. It should also consider complementary actions that can improve benefits or reduce impacts. Given the cross-economy nature of adapting to a changing climate, this assessment should also extend to considering how policies help or hinder efforts to increase UK climate resilience.
- Publishing a regular assessment of how the aggregate emissions impact of all spending, taxation and regulation decisions taken over a specified period perform against what was expected in the Net Zero Strategy. This should identify actions required to compensate for any shortfall.

The key goals for a Net Zero Test are to ensure all policies and decisions appropriately consider Net Zero and to ensure that the sum of all Government policies is consistent with Net Zero.

Box 14.4

Options for developing a Net Zero test

Delivering the Net Zero pathway will require Government decisions across all areas to properly consider emissions impacts and wider environmental considerations. A Net Zero Test is one way to achieve this. The core aims of a Net Zero Test should be:

- To ensure adequate consideration within decision-making processes of how to avoid or mitigate negative climate impacts; and
- To ensure that helpful opportunities to deliver enhanced emissions reduction, better cost-effectiveness, or wider co-benefits are identified and exploited.

The aim is not to stop all emissions-creating policies from going ahead, but rather to ensure that lower-carbon alternatives that might give similar benefits are considered before the decision is made. And where such policies do go ahead, to ensure that due consideration is given to mitigating these negative effects as much as possible and to how other policies can help to compensate for them.

There are two broad approaches to such a test – either embedding Net Zero into individual policymaking decisions or assessing policy packages in aggregate. There could be value in a combination of both approaches.

Consideration of Net Zero alignment within policy appraisal

- Government policymaking processes already include a number of tests that need to be applied to ensure that proposals are compliant with specific duties or objectives, e.g. regulatory impact assessments and public sector equality duty tests.
- A similar test could be introduced for Net Zero, requiring policymakers to analyse emissions impacts of their proposals and to verify their compliance with their department's contribution to the Net Zero pathway.
 - To be useful, such a test should help policymakers understand the environmental impacts of their policy and guide them on the sort of actions that could be used to adapt the policy or mitigate damaging impacts.
 - Green Book appraisal guidance already includes advice on quantifying emissions savings, so this type of Net Zero Test could be designed as an extension of existing processes rather than introducing further bureaucratic steps.
- This sort of analysis could be beneficial for policies that appear to run contrary to Net Zero (e.g. coal mine, oil fields, roadbuilding, airport expansion), as it would require their emissions impacts and potential mitigating actions to be considered within the decision-making process.
 - If designed well and used early in the policy development process, this approach could prompt a rethink of such policy approaches, encouraging policy teams to pursue alternative options or put in place mitigation measures.
 - In practice, however, regulatory impact assessments are often viewed as simply a hurdle to be surmounted, rather than as a tool to shape policymaking. In that case, the ability of such a test to influence the approach taken would be reduced.
- The proposed Climate Compatibility Checkpoint for new North Sea licences can be seen as an example of this sort of test, although it will be important for it to set stringent limits if it is to align with the Net Zero pathway. Another example is the requirement under the Welsh Government's Well-being of Future Generations Act for public bodies to assess impacts of policies on people living in Wales in the future.

Aggregate assessment of policy packages

- Many of the policy areas that will have an impact on Net Zero are inherently interlinked, and the impacts of individual policy decisions may not always be clear. To account for this, policy alignment with Net Zero could be assessed in aggregate.
- Although the whole portfolio of departmental policy must align to the contribution required from that department, this does not mean that every policy needs to reduce emissions individually. Indeed, there may be some policies that increase emissions that are nonetheless desirable as they contribute to other important objectives. A test should allow these to proceed provided that they are part of a wider package of measures that still deliver the total emissions reductions required.
- This would require departments (or other bodies with oversight of full suites of policy) to conduct regular appraisals of the combined impacts of their decisions.
 - The basis for such an assessment should be the department's emissions reduction pathway to contribute to the overall Net Zero pathway. It must also identify any impacts on pathways owned by other departments (e.g. impacts on construction emissions from transport policy, transport/energy impacts from planning decisions).
 - Such an approach could be extended to cover not just new policies, but also revisions to assumptions or assessments around existing policies. As such, it would ensure that departments compensate for negative outcomes that have already been locked in through previous policy decisions.
 - Where the assessment identifies a shortfall relative to the required delivery, it should provide decision-makers with guidance on how this can be made up. This could include identifying mitigating actions to improve outcomes or advising on further savings that need to be delivered through additional policy.

- The Treasury applied a similar aggregate approach as part of the most recent Comprehensive Spending Review, where it required departments to quantify the expected emissions impacts of their proposed spending decisions as part of the allocation process.²³
 - This exercise applied only to spending and would need to be extended to cover regulation and taxation as well in order to provide a full picture of each department's compliance with the overall delivery required.
 - The Environmental Audit Committee has recommended that Government should work with the CCC and the ONS to publish forecasts of the environmental impacts of decisions taken at fiscal events, as well as applying an assessment of whether the full package of measures is compliant with the Net Zero pathway.²⁴
- WWF performed a similar appraisal for the recent Budget, in which they estimated the emissions impacts of each fiscal decision and compared the overall total against the Net Zero pathway.²⁵

Monitoring and evaluation

Monitoring and evaluation are vital to success and require that various evidence gaps are tackled.

Ensuring that evaluation mechanisms are designed into policies from the outset should be a key goal for BEIS and the Climate Action Implementation Cabinet committee, as the organisations with responsibility for coordinating Net Zero delivery. Only if they have confidence that robust processes for tracking progress and addressing problems are in place will they be able to delegate appropriately.

- To this end, there is a need for greater transparency on the assumptions underpinning the Net Zero Strategy, to enable effective scrutiny of these plans and progress against them.
- The Government should use its annual update on progress against the Net Zero Strategy (and its annual reports on the new set of Greening Government Commitments) to share lessons from effective progress (particularly those that are transferrable across departmental remits) and to set out plans for how barriers/issues will be resolved and shortfalls will be made up.
- The Government should build on the Committee's progress assessment in this report and begin to address the data gaps identified in the Monitoring Framework document accompanying this report.

The role of local government and devolved administrations

The Committee continues to identify a need for a strengthened approach to supporting local climate action.

Local government. One of our priority recommendations is the need for a clearer shared understanding of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. The Committee's previous recommendations still stand in this area: there needs to be an agreed delivery framework with local flexibility, more strategic and longer-term funding mechanisms, and better facilitation of delivery.¹

- **Framework and flexibility.** The Government has emphasised that it does not think that any new statutory duties are appropriate. However, it does need to use the Local Net Zero Forum and its wider engagement to agree and communicate a set of clearer expectations across local government on what steps they should be taking and how these actions are to be coordinated.

- This should be co-developed between central and local government and should form a core part of the overarching assessment of roles and responsibilities for delivering Net Zero described above.
- The purpose should be to develop a more effective partnership between central and local government for delivery of Net Zero. This will require a clearer shared understanding of how roles and responsibilities are divided, what outcomes local authorities are expected to deliver and how these will be supported by national decisions. UK100 recently published an example of what such a partnership framework could look like.²⁶
- The Net Zero Forum needs to be constituted in a way that allows local government to identify opportunities for collaboration and to feed experience of what works in practice into policy and strategy design.
- This clarity is equally important for the delivery of climate change adaptation, where it is often the case that more of the critical policy levers are at local government level than for Net Zero.
- The Government will need to consider how national policy, powers, and funding can best enable local government to deliver on these roles and responsibilities. A shift towards a more coordinated and strategic approach to funding, as opposed to short-term competitive allocations, should be a key part of this.
- **Facilitation.** We recommend that as part of this work the Government should assess local government's powers, capability/capacity and funding. This will help it to build a more detailed understanding of the potential barriers to delivery with a view to developing new policies which can address these gaps.
- **Funding.** Longer-term funding settlements should be linked to an understanding of roles and responsibilities and based upon the findings of the Local Net Zero Forum. This can help foster improved collaboration and allow local authorities to develop the resource required to implement their plans.

Similar actions are required from the devolved administrations, to unlock local delivery in all nations of the UK.

Devolved government. The UK Government and the devolved administrations have a shared interest in delivering ambitious emissions reductions. Better coordination and alignment of approaches are needed to achieve this.

- The forums and structures that are in place for collaboration between the nations are meant to be used for coordinating policy action across the UK. As the convenor of these forums and structures, the UK Government should review the process and identify the barriers to effective engagement, and then agree a joined-up approach to action. This is a pivotal step towards achieving the coordination and smooth cooperation necessary for the pace of delivery over the next decade.
- The Net Zero Strategy and important sectoral strategies should be regularly updated in consultation with the devolved administrations. These updates should be co-developed to enable identification of opportunities to increase ambition over time and synergies between nations' objectives.

Planning reforms should support the transition to Net Zero.

Spatial planning. Planning is a fundamental lever for local authorities to ensure that the long-term development of their communities is properly directed towards Net Zero. The Government should unlock this key enabler by making sure that the guidance available to local authorities is properly aligned to Net Zero.

- Net Zero and climate resilience should be embedded within the planning reforms that are expected as part of the Levelling Up and Regeneration Bill. These reforms should aim to ensure that key supporting documents (such as the National Planning Policy Framework) make clear the priority that should be placed on sustainability objectives and how these interact with other requirements.
 - The aim should be to require all developments to be built in a manner that ensures that the emissions they generate (both directly and indirectly) over their lifetimes are compatible with the Net Zero pathway. The Scottish Government's recent consultation on its fourth National Planning Framework showed welcome progress towards this aim, although the challenge will be in effective implementation.
 - Supporting guidance and appraisal methodologies should also be adapted to make it easier for practitioners to assess compatibility with the Net Zero pathway and realisation of co-benefits, and to enable decisions to be justified on these bases. Consideration should be given to how local plans can be extended to also cover existing buildings.

Local area energy plans can support the transition to Net Zero at least cost and disruption.

Energy planning. BEIS and DLUHC should formally adopt local area energy planning, providing clear guidance on who should be responsible for and involved in producing plans, along with support and funding for doing this.

- Although the recent Heat and Buildings Strategy was vague on this topic overall, the Government should build upon the approach it set out on zoning for heat networks, which identified clear actions and provided supporting funding. The Scottish Government's progress on Local Heat and Energy Efficiency Strategies could also provide a useful example.²⁷

(d) Key risks

Without effective governance, turning strong ambition and credible policy into tangible delivery becomes much harder. As such, any failure to establish good governance structures and processes poses a risk to the entire programme of Net Zero delivery. We have identified four specific risks:

Table 14.1
Major risks and required mitigating actions on Net Zero governance

Risk category	Description	Mitigation	
		Details	In place?
Credibility	The absence of clear agreement on who is responsible for delivering the actions required for Net Zero and effective mechanisms for ensuring this takes place could undermine the credibility of the Government's Net Zero Strategy.	Development of clear delivery plans for implementing sectoral strategies and managing cross-cutting interdependencies, backed by robust and transparent monitoring and evaluation.	No

Cross-government commitment	Inconsistent commitment between departments could place unreasonable abatement requirements onto those who are committed to Net Zero and would be likely to hinder progress in areas that require collaborative action.	Clearer roles and responsibilities for Net Zero delivery, backed by robust accountability mechanisms and effective coordination.	Partly
Policy alignment	Policy decisions that appear inconsistent with the Net Zero pathway pose a risk, both through their direct impacts and through the mixed signals they send about the UK's commitment to this transition, both to investors and the wider public.	A Net Zero Test that ensures that all decisions (either individually or in aggregate) are properly aligned with the Net Zero Strategy pathway.	No
Local government action	The strong commitment to Net Zero at a local level is currently at risk of being squandered. Without a clear framework setting out the roles and responsibilities for local government in the delivery of Net Zero, this momentum will not be harnessed and focussed on the actions that will make the most significant difference.	A clearer shared understanding of roles and responsibilities for delivery and how these will be coordinated between national and local government. Powers, capability, responsibilities, and funding will need to be aligned to this framework.	No

2. Public engagement and choices

Introduction and key messages

Public engagement will be vital for the next phase of the UK transition to Net Zero.

Meeting Net Zero will require the active involvement of people to make greener choices in a variety of roles and responsibilities (e.g. consumer, business owner). Effective public engagement is therefore essential to this transformation. To date, much of the success in reducing UK emissions has been on the supply-side, for example through switching from coal power to renewables in electricity supply. It has not therefore required the public to make low-carbon or green choices in what they purchase or what they use.

Involving people in the transition to Net Zero will bring benefits for people and for the climate. However, despite recognising this in its Net Zero Strategy, the Government has taken a light-touch approach to public engagement so far. This should now be strengthened with a clear long-term vision of how to engage people and businesses in delivering Net Zero, backed by actions to implement it.

Our key messages are:

- **People are vital to meeting Net Zero.** Around 60% of abatement by 2035 relies on consumer choices (Box 14.5). Beyond this, people can support the move to Net Zero in the additional roles they have in society. For example, a small business owner can change how they light their building, reducing emissions, saving money and possibly improving the quality of the indoor environment at the same time.
- **Public attitudes.** The public are increasingly concerned about climate change and supportive of the need to tackle it. However, there is lower public awareness of how individuals can most effectively support climate action and support has not translated into a complete understanding of what policies might be needed to reach Net Zero.
- **Policy strategy.** The Government's Net Zero Strategy recognised the need for public engagement in meeting Net Zero. The strategy makes commitments towards improving public facing advice, supporting businesses, increasing awareness and making green choices affordable and easy to make. This is positive, but the implementation of these commitments is unclear at this stage and risks losing the momentum and focus on climate change around COP26.*
- **Policy implementation.** Success is mixed in implementing this vision.
 - Positive progress around the choice to adopt electric vehicles (see the charts on the market share of electric vehicles in the surface transport chapter) is not yet being matched for home retrofits of energy efficiency and low-carbon heating (see the charts on these in the buildings chapter) or for public and active transport (see the charts on these in the surface transport chapter).

* COP26 was the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change. These latest UN climate talks were held in the UK in Glasgow in November 2021 and resulted in considerably increased media coverage and public interest in climate change.

- There have been a limited number of communications campaigns around climate change, for example ‘Together for our Planet’ around COP26, and a limited number of citizens assemblies and other deliberative processes. These need to be used more consistently, with deliberative and participatory processes embedded in policy making.
- **Next steps.** Delivering an effective energy advice service is a clear priority given the current energy bills crisis and continued slow progress on buildings decarbonisation. It should be ambitious and comprehensive (see Chapter 4 on buildings). There is also a wider opportunity for this advice service to encompass climate actions which, if taken, could save individuals and businesses money and provide advice on how to adapt energy systems to the impacts of climate change. The Government’s wider public engagement should include: participatory and deliberative processes, awareness raising communications, social research and reflecting behavioural science in policy design.

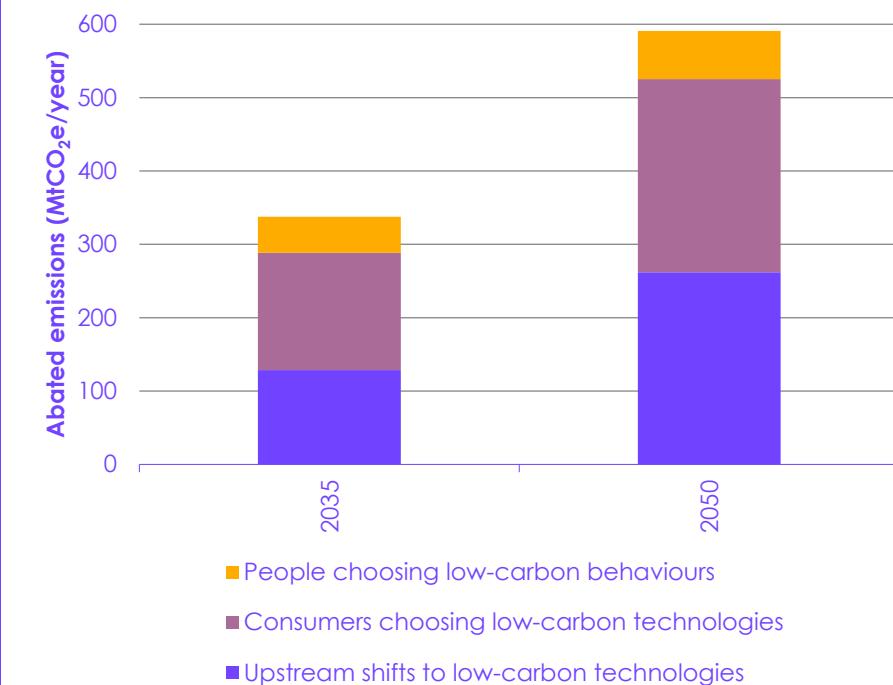
Box 14.5

The role of people in the Net Zero transition

The transition to Net Zero requires effective engagement from people in reducing emissions and making lower-carbon choices. Figure B14.5 shows the importance of low-carbon choices by splitting emissions reduction between three categories:

- **Upstream changes** to low-carbon options within the supply side (e.g. renewable electricity generation), which require investors and developers to change technologies but do not require changes by consumers. This category represents 38% of abatement in 2035 in our Balanced Pathway.
- **Choices that involve both the demand and supply sides:** consumers and businesses making lower-carbon choices that involve new low-carbon technology such as driving an electric car or installing a heat pump instead of a gas boiler. These choices comprise 47% of abatement in 2035 in our Balanced Pathway.
- **Primarily demand-side choices** that go beyond a switch to low-carbon technologies, such as shifting towards healthier and lower-carbon diets, reducing growth in aviation demand, shifting to lower-carbon goods and choosing products that last longer and therefore improve resource efficiency. This category contains 15% of abatement in 2035 in our Balanced Pathway.

Figure B14.5 Abatement from different types of measure in the Sixth Carbon Budget



Source: CCC analysis.



(a) Indicators

It would be useful to collate, streamline and strengthen data for monitoring public engagement.

The availability of data to monitor engagement comprehensively is limited with no one central organisation or place where this data is collated. There are a number of key attitude trackers from BEIS, DfT, Defra and DLUHC, as well as business and public surveys from the ONS. These provide useful data but there are gaps in, and limitations to, what is monitored.

Wider non-government led survey data tends to be one-off rather than allow for consistent monitoring over time. There are also issues around self-reporting bias and lack of transparency in how results from communications campaigns and participatory processes have been taken into account in policymaking.

We have used data from the BEIS Public Attitudes Tracker and other survey data to develop initial indicators for this theme.²⁸ We welcome input from others as we continue to develop our indicators. We split our initial indicators into the following categories:

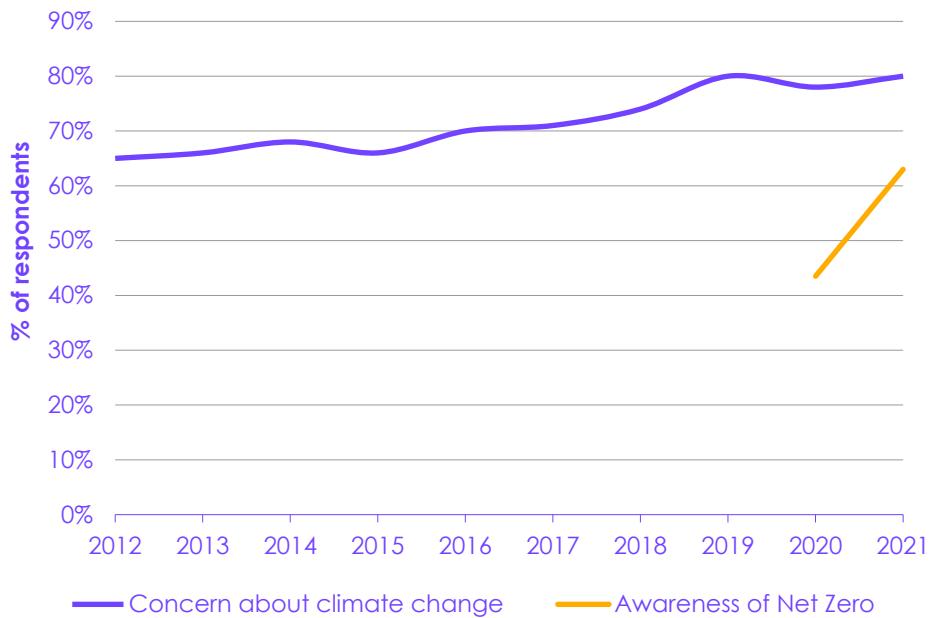
- **Public concern and awareness.** Public concern about climate change has generally seen an increase since 2012, with 80% of people surveyed in 2021 concerned about climate change (see Figure 14.4). People are also increasingly aware of the concept of Net Zero, with that proportion of people reaching 63% in 2021 compared to 44% in 2020, when data collection started.
- **Support for Government action on climate change.** There is limited data available on support for Government policies around tackling climate change. However, around 70% of people agree that if the 'Government does not act now to combat climate change, it will be failing the people of the UK' (Figure 14.5).
- **Personal action being undertaken to reduce climate impacts.** Minimising energy use and using alternatives to cars are behaviours perceived as having the most impact in tackling climate change. Despite being one of the most important changes that individuals can make, reducing meat and dairy intake are rated as having the lowest impact (see Figure 14.6). Switching away from gas boilers does not feature. Most people (around 90%) report doing at least one climate-positive behaviour in their everyday life (Figure 14.7), but around 70% of people agree that they could make more changes in their life (Figure 14.8).
- **Communications and public engagement processes around climate change.** Trust in the UK Government to provide accurate information about climate change has increased from 47% in 2019 to 59% in 2021. Of the sources asked about in this survey, the most trusted sources are scientists working at universities, and the least trusted source is social media (see Figure 14.9).

In addition, indicators of attitudes to specific green technologies and low-carbon choices across different sectors are set out in the Monitoring Framework document accompanying this report, and reported in other chapters (e.g. attitudes to electric cars are in the transport chapter).

We will continue to provide advice on public engagement and develop our indicators on public engagement further over the next year.

Public concern about climate change has increased since 2012 and awareness of the concept of Net Zero has also risen, with 63% aware in 2021.

Figure 14.4 Public concern and awareness

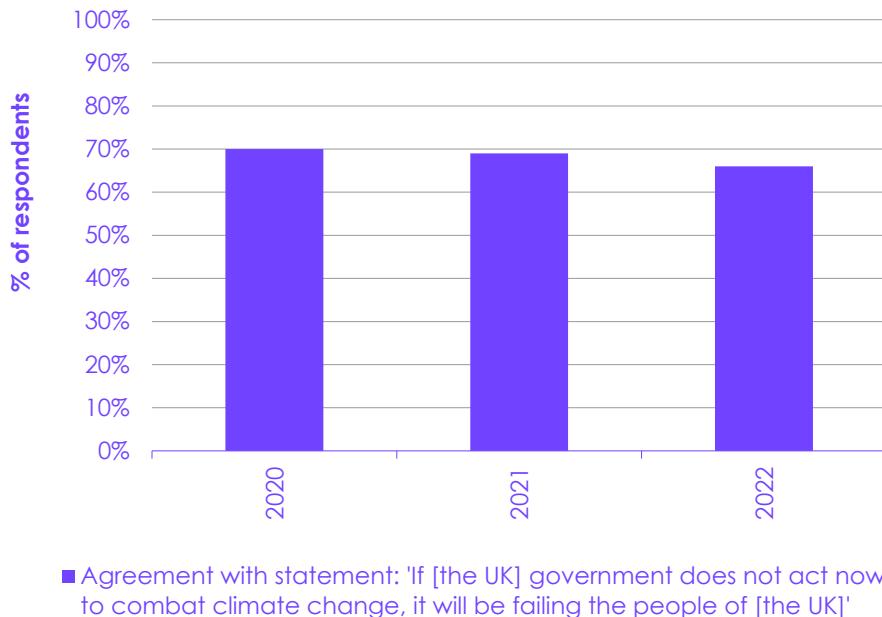


Source: BEIS (2022) *Public Attitudes Tracker*.

Notes: Survey question for concern about climate change: 'How concerned, if at all, are you about climate change, sometimes referred to as 'global warming'?' Responses counted as concerned include 'very concerned' and 'fairly concerned'. Survey question for awareness of Net Zero: 'Before today, how much, if anything, did you know about the concept of 'Net Zero'?' Responses counted as aware include 'a lot', 'a fair amount' and 'a little', but exclude 'hardly anything'. This question is asked every quarter; we calculate an annual average response.

Most people (around 70%) agree that if the 'Government does not act now to combat climate change it will be failing the people of the UK.'

Figure 14.5 Support for Government action on climate change

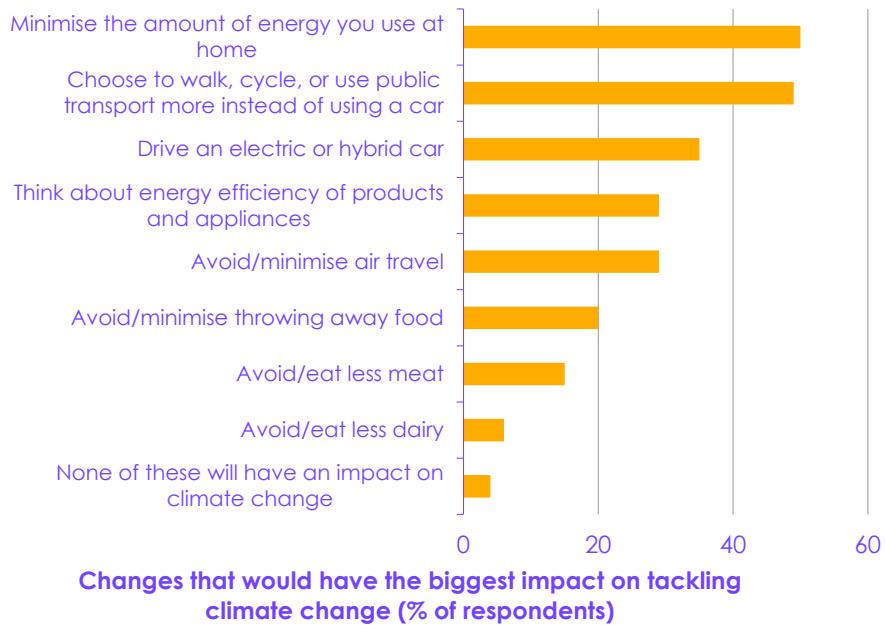


Source: IPSOS (2022) *Earth Day survey*.

Notes: Data corresponds to the survey question 'To what extent do you agree or disagree with the following: If [the UK] government does not act now to combat climate change, it will be failing the people of [the UK].' Results from 1000+ participants from Great Britain as part of a global survey.

Behaviours perceived to have the biggest impact on tackling climate are minimising energy use and using car alternatives. Lowest perceived impact behaviours are reducing meat and dairy intake.

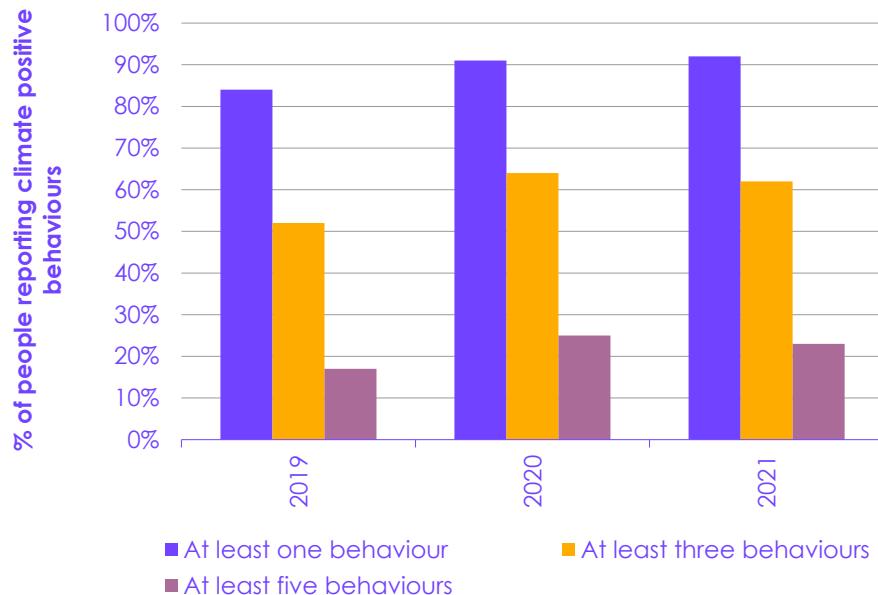
Figure 14.6 Perception of behaviours with the biggest impact on tackling climate change (2021)



Source: BEIS (2022) Public Attitudes Tracker.
Notes: Responses correspond to the survey question: 'If everybody in the UK did the following, which three of these do you think would have the biggest impact on tackling climate change in the UK?'. Excludes respondents who previously said there isn't such a thing as climate change. The survey question wording on energy efficiency was 'Think about energy efficiency of products and appliances when making a purchase', shortened here to fit on the axis label.

Around 90% of people self-report doing at least one climate-positive behaviour in everyday life, with this dropping to around 20% for at least five behaviours.

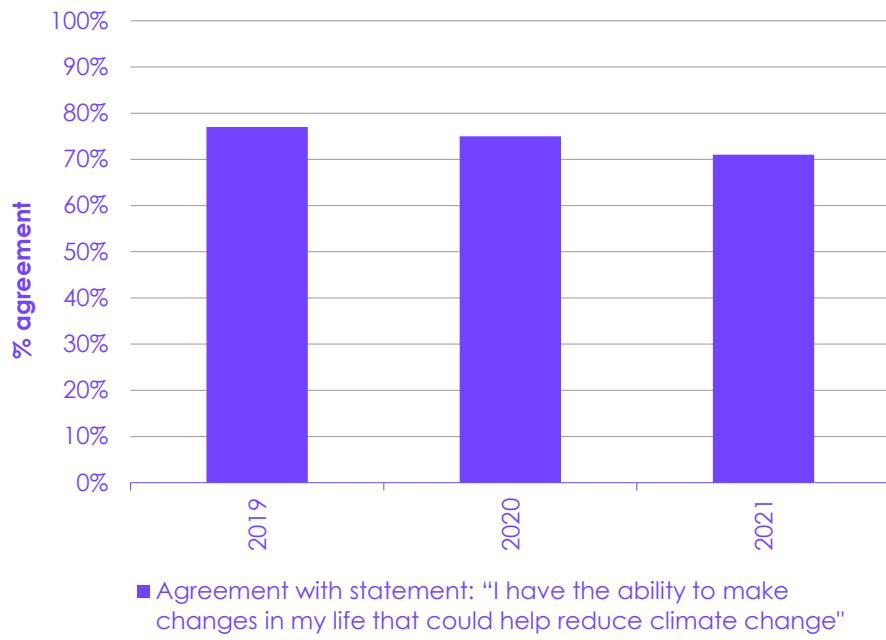
Figure 14.7 Self-reporting of climate positive behaviours



Source: BEIS (2022) Public Attitudes Tracker.
Notes: Data on self-reporting on behaviours in everyday life from the following: avoid/minimise food waste, minimise energy use, choosing alternatives to car travel, energy efficiency of appliances, avoid/reduce meat consumption, avoid/minimise plane travel, avoid/minimise dairy consumption, drive an EV/hybrid car.

Most people (around 70%) agree that they have the ability to make changes in their life that could help reduce climate change.

Figure 14.8 Perceived ability to do more climate positive actions

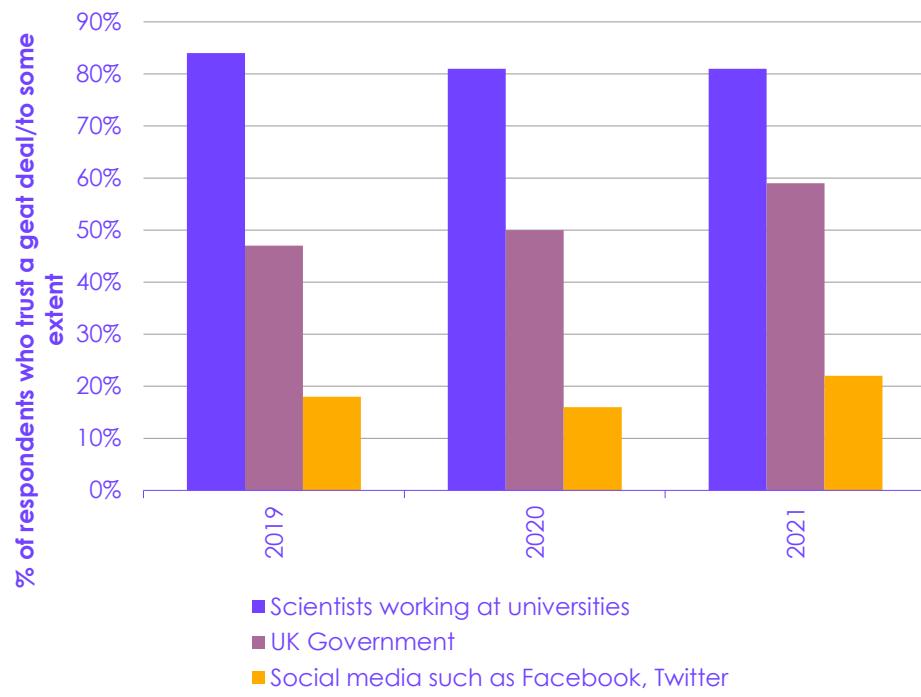


Source: BEIS (2022) Public Attitudes Tracker.

Notes: Data corresponds to the survey question 'How much do you agree or disagree with the following statement: I have the ability to make changes in my life that could help reduce climate change'. Responses counted include those that 'agree strongly' and 'agree slightly'.

The public place most trust in scientists to provide accurate information about climate change and the least trust in social media. Trust in Government information about climate change has increased from 47% in 2019 to 59% in 2021. Government information about climate change has increased from 47% in 2019 to 59% in 2021.

Figure 14.9 Trust in sources to provide accurate information about climate change



Source: BEIS (2022) Public Attitudes Tracker.

Notes: Data corresponds to the survey question 'How much do you trust [this information source] to provide accurate information about climate change?'

(b) Policy progress

The Government has set out sensible commitments and principles on public engagement, which should now be implemented.

The Government's Net Zero Strategy recognised the need for public engagement in meeting Net Zero. It summarised the Government's commitments in four steps and introduced a set of six principles for how the Government will empower everyone to make green choices (Box 14.6). These are a good platform, which should now be implemented.

Box 14.6 Government Net Zero Strategy

Four key commitments:

- Explore how to improve and enhance public facing climate content and advice on gov.uk. The Government will also enhance their digitally-led Simple Energy Advice (SEA) service to provide homeowners with personal, tailored advice on improving and decarbonising their homes, including tailored retrofit advice in local areas, and links to local, accredited, trusted installers.
- Continue supporting UK businesses to meet their Net Zero commitments, including exploring a Government-led advice service that consolidates and simplifies advice and other support on Net Zero.
- Increase awareness of Net Zero and empower businesses and the public to make green choices, by building on Government communications and engagement, and exploring providing environmental impact labelling of products, goods, and services.
- Make green choices affordable and easy by working with businesses and industry to set strong regulatory signals and collaborating to reduce costs and provide better quality, longer lasting and lower environmental impact products, and services

Principles underpinning green public and business choices:

- Minimise the 'ask' by sending clear regulatory signals
- Make the green choice the easiest
- Make the green choice affordable
- Empower people and businesses to make their own choices
- Motivate and build public acceptability for major changes
- Present a clear vision of how we will get to Net Zero and what the role of people and business will be

Source: BEIS (2021) *Net Zero Strategy: Build Back Greener*.

The Net Zero Strategy also highlights the importance of community engagement and action that can bring wider benefits to local areas such as green jobs and health improvements. Beyond the strategy, there have been some specific processes that contribute to these objectives:

Public deliberation is any form of engagement where members of the public are given the chance to increase their understanding and develop their views prior to putting across their position on a policy issue.

- The Government has run deliberative dialogues on a range of Net Zero issues including green choices, homes, heating, transport decarbonisation, hydrogen, food, carbon capture and storage and advanced nuclear technologies. It has also run a number of communications campaigns such as 'Together for our Planet' and underneath this 'One Step Greener'. Defra has also recently conducted a public dialogue on climate change adaptation, looking to understand views on what a well-adapted UK would look like and some of the key trade-offs in adaptation policy.

- The Government continues to undertake social research to understand how best to engage the public with Net Zero policies. There are 21 listed Government Social Research groups in the UK Government. While BEIS spent £240 million on R&D for Net Zero projects from 2021 to 2022, it is not clear how much was spent on social research.
- There is also evidence that the Government has engaged in behavioural policy processes (e.g. COM-B29 and the Behaviour Change Wheel). However, for many key green public actions, there remain barriers that block green choices (e.g. active travel relies on the infrastructure being in place and heat pump adoption can be complicated by certain planning requirements).

Alongside Government deliberative processes, there have been a number of recent citizens' assemblies on climate change and Net Zero:

- The largest was commissioned by the UK Parliament in 2020, which sought people's views on an extensive range of actions needed to meet Net Zero, and was used to inform the CCC Sixth Carbon Budget advice.
- Cities and local authorities are also undertaking such processes, with 25 processes tracked by Involve in 2020-21. These have covered a diverse range of topics covering community energy, housing, nature, green spaces, transport, low-emission zones, food and low-carbon opportunities. These aim to make recommendations on how to embed green policy in local communities.
- Deliberative processes add value in helping policy makers to develop a better understanding of people's views and values, while also improving the trust of the public in policy design.³⁰

However, there has been little or no progress in the following areas:

- There is no overarching plan on how to engage people in Net Zero and how to embed different forms of public engagement across the Government.
- There is no communications strategy to help people understand the changes the Government is proposing and how best to promote the benefits of Net Zero.
- There is a lack of advice on how local authorities and other community groups can best engage people in the Net Zero transition.
- Key behavioural barriers remain unaddressed by policies in many sectors due to policy gaps that fail to enable green choices.

(c) Next steps

Building on its good intentions, the Government should launch and implement a wide-ranging strategy for public engagement.

The Government needs to implement its strategy for public engagement for the transition to Net Zero. Our recommendations set out our initial views on key elements of effective public engagement. Key recommendations are:

- **Overarching public engagement plans.** The Government should publish a public engagement strategy by the end of 2022 that sets out a clear long-term vision of how to engage people and businesses in delivering Net Zero. This should be inclusive and representative of the UK's diverse communities.

- **Communications.** Strategic public communications must be used consistently to inform key audiences about the critical changes required to deliver Net Zero, and to build understanding of the associated timelines, benefits and costs.
- **Deliberative and participatory processes.** The Government should embed participatory and deliberative methods in the Net Zero policy-making process, where appropriate, as a means of improving the acceptability of, and public support for, new policies. BEIS should take responsibility for ensuring these methods are co-ordinated across Government departments.
- **Social research and behavioural science.** The Government should embed key pillars of behavioural science into Net Zero policy design. This should result in policies that support making green choices easier and stimulate markets for low-carbon goods and services that are accessible and affordable to all communities.

The planned energy advice service has a vital role in helping consumers in the face of current high energy prices and should have a large reach.

A clear priority, given the current energy bills crisis and continued slow progress on buildings decarbonisation, is to deliver an effective energy advice service and accompany it with a strategic public communications campaign to ensure it reaches millions of households. We cover this priority in Chapter 4 on Buildings.

The Committee have been working with academics at Lancaster University on the role of deliberative processes in climate policy, with the first findings now available (Box 14.7).³¹ In the latest phase of that collaboration, we have also been supporting a deliberative process on policy for decarbonising buildings. The findings of this research will be published in due course.

The Committee has supported new work on the use of deliberative processes.

Box 14.7

Lancaster University: The role of deliberative processes in climate policy development

We have been working with Lancaster University to review evidence of the potential contribution of citizen deliberation to climate policy and governance. They have reviewed 29 case studies where deliberative processes have been embedded into decision-making. The case studies cover climate policy as well as other sectors such as health, housing and transport. The full report will be published in due course. It found seven ways in which deliberative methods can contribute to better policy-making:

- Increasing trust in the policy-making process and ensuring that the full policy mix is considered. This can help to bring in different views and develop mutual understanding.
- Generating action and giving policy-makers a mandate to act. This can help with issues that are socially difficult to discuss or implement effective policies around.
- Ensuring representation and building legitimacy and trust can increase belief that policy-makers are listening to people. However, this depends on how the results are used.
- Diffusing conflict, helping to bring different sides of a debate together so that a mutual understanding is reached.
- Road-testing policy arguments where it is not always possible to predict whether a policy proposal will prove controversial.
- Enabling testing of the acceptability and governance of new technologies. Some low-carbon technologies are not well-known to the public, but may be needed for Net Zero (e.g. engineered removals). Deliberative processes can gather views on a range of issues associated with these, including safety and governance.

- Enabling a wider range of views to be heard, ensuring representation from all of society. Processes can be structured to ensure that all parts of society are properly represented, particularly minority groups.

Source: Willis, R and Ainscough, J. (forthcoming) *The role of deliberative public engagement in climate policy development: A report for the Climate Change Committee*.

(d) Risks / uncertainties

Without effective public engagement, multiple parts of the Net Zero transition would be at risk.

A failure to engage effectively with the public would lead to a number of risks that could hamper delivery of Net Zero:

- If the public do not buy into the measures required to deliver Net Zero and are not prepared to make changes, then costs could increase significantly (for example, by requiring a reliance on more expensive supply-side technologies, like synthetic fuels, that require less consumer buy-in) or the transition may not be achievable where alternatives are not available.
- Similarly, if businesses (from large to small and medium enterprises) are not engaged, there is a risk that they do not prioritise offering and promoting low-carbon options to customers. There could also be a knowledge gap, which would limit businesses' role as a trusted messenger for consumers.
- If the Government does not conduct effective public engagement, this could lead to poor policy making that has unfair impacts across society and could further lead to disengagement from some groups. Ultimately, this could make the policy-making process and the transition to Net Zero more difficult.
- If the public do not see the wider benefits of climate action, there is a risk of Net Zero being seen as conflicting with other objectives and deprioritised. The Government has a window of opportunity to promote the wider benefits of Net Zero in terms of improved energy security and lower energy bills for households and businesses, as well as for jobs, health, air quality, comfortable homes and nature.
 - It is also important that policy ensures these benefits occur in practice. If the public see Net Zero policies leading to unintended consequences (e.g. housing interventions giving rise to issues such as damp/mould, summertime overheating, or reduced indoor air quality), then support for the transition will be lost and it will become harder to persuade people to make low-carbon choices.

Table 14.2

Major risks and required mitigating actions - Public engagement and choices

Risk category	Description	Mitigating action
Public buy-in	The public do not buy into Net Zero and are not prepared to make changes required for Net Zero.	The Government and other delivery bodies should ensure the public are effectively engaged and all groups in society are supportive of measures required for Net Zero.
Business buy-in	Business and industry do not prioritise developing and offering attractive low-carbon goods and services on time and at a price that is affordable to most people.	The Government and other delivery bodies should ensure that effective engagement and policy making leads to businesses developing low-carbon markets for goods and services at a high standard that are affordable to all sections of society.
Public not involved in policy design	Policy making leads to unfair distributional impacts across society and disengagement from certain groups.	Effective public engagement on policy choices and measures needed to ensure equity across all groups.
Climate deprioritised	The public do not see the wider benefits of climate action and public support is not built upon, leading to a de-prioritisation of climate action.	The Government should build on the current grain of support for Net Zero, encouraging green choices and emphasising their co-benefits to current issues, such as energy security.

3. Fair funding and affordability

Introduction and key messages

Funding the transition to Net Zero will require costs and investments to be spread across households, businesses, and the Exchequer.

The transition to Net Zero will lead to costs and savings for households, but fairness will depend on their distribution across society.

Households are likely to experience costs, from the ‘upfront’ investment in heat decarbonisation in particular, but also savings, notably from the shift to electric cars. The distribution of these costs and wider benefits across households will depend on Government’s approach to funding – passing costs through to consumers or making use of targeted public funding, for example. Assessing distributional impacts is a key step to ensuring policies are fair and are perceived as such, and supporting rather than hindering the transition to Net Zero.

While the private sector is expected to finance most of the transition (see section on Business and Finance), the Government’s approach to funding will still have implications for the Exchequer, as it will lose revenue in some areas – notably from road fuel duty – and will require alternatives to raise revenue.

Our key messages for this year are:

- While we are considering medium- and long-term issues around fair funding of the transition to Net Zero, it is important to recognise that the context for decarbonisation of the energy system has changed substantially due to very high fossil fuel prices, especially following the invasion of Ukraine. This new context has shifted the relative economics of decarbonisation options and made the issue of affordability a top priority.
 - **Changing economics for decarbonisation.** The Government’s Energy Security Strategy (ESS)³² recognised that accelerating the transition to Net Zero could address concerns over energy security raised by the invasion of Ukraine. Whereas our analysis for the Sixth Carbon Budget indicated a total cost of decarbonisation of less than 1% of GDP relative to a high emissions scenario, sustained very high gas prices could turn this into a saving of 0.5% of GDP (Box 14.8).
 - **Reduced fossil fuel consumption.** Reducing fossil fuel consumption would decrease emissions and limit energy bills. Immediate action across society such as turning off lights when not in use, using alternatives to the car, or driving more slowly can make immediate contributions to reducing consumption. There are also a range of medium- to long-term investments which can offer significant, sustained benefits through energy efficiency improvements and electrification, particularly in homes. The ESS prioritised supply-side measures that are likely to be delivered on a longer timescale, and missed an opportunity to incentivise demand-side action which can both support households during this energy crisis and reduce emissions in the long-term.

The Government should prioritise the measures that generate synergies between addressing the cost-of-living crisis and supporting long-term decarbonisation efforts.

Treasury should address the remaining strategic gaps from the Net Zero Review and undertake a review of the role of tax in delivering Net Zero.

Moving away from fossil fuel consumption will both benefit households as it will reduce exposure to volatile fossil fuel prices and reduce emissions.

– **Addressing the cost of living.** There are policies that can be put in place now to address the affordability crisis and accelerate decarbonisation efforts, such as moving policy costs linked to historical subsidies from electricity bills to general taxation. New measures announced since the Spring Statement will also contribute to supporting households during the current cost-of-living crisis but there is scope for more measures to support energy efficiency improvements in homes. The issue of affordability represents a risk to decarbonisation efforts, in particular for heat.

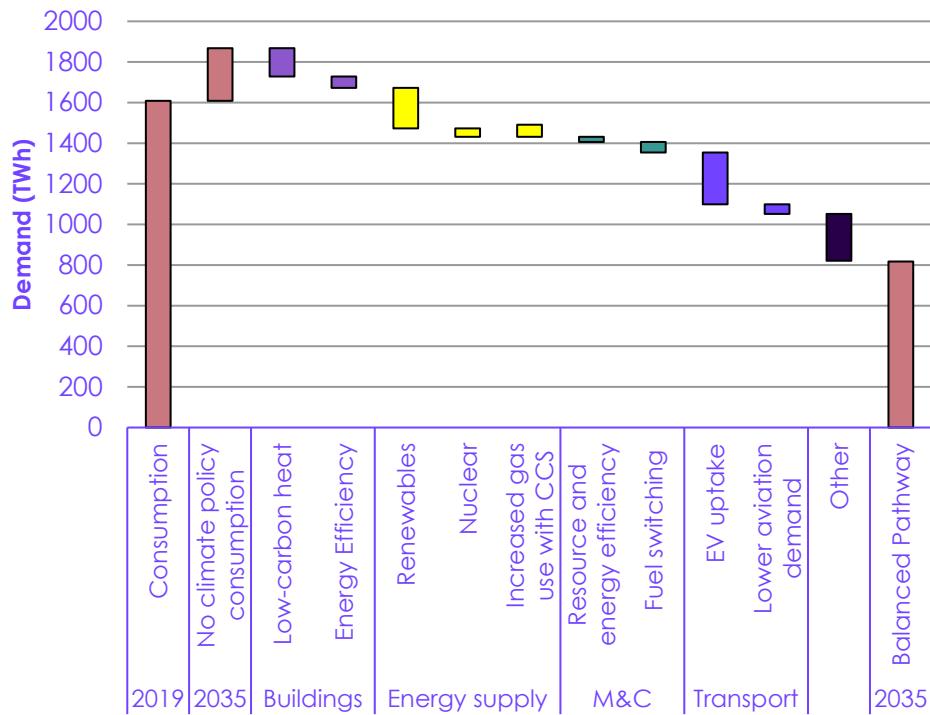
- HM Treasury's Net Zero Review set out the key principles to fund Net Zero, which focus on mobilising private finance and targeting public funding for measures that support lower income households, particularly for decarbonising homes. There remain serious strategic gaps as the review did not set out how Treasury will replace the revenue loss from fuel duty, nor did it present an assessment of the distributional impacts of its principles for funding Net Zero.
- We recommend that the Government, specifically the Treasury, undertake a Net Zero Tax Review to establish how the tax system can best support the transition to Net Zero, by correcting distortions that often penalise low-carbon technologies and ensuring that the significant consumer savings from using many low-carbon technologies are enjoyed widely.

The fossil fuel price crisis

The recent spike in fossil fuel prices – which started before the invasion of Ukraine but has been exacerbated by it – has changed the context for energy use and decarbonisation in the UK.

- A shift towards non-fossil energy (e.g. renewables, nuclear) will be beneficial for energy security as it can contribute to reducing UK exposure to volatile fossil fuel prices.
 - Our Balanced Pathway already saw a move away from oil and gas. Electrification alongside investments in insulation in buildings and more efficient industrial processes bring about a 50% reduction in fossil fuel consumption by 2035, but also a significant reduction in total use of energy, while still meeting end use demand (Figure 14.10). Given that measures to move demand away from fossil fuels are currently less costly (or more cost-saving) now than previously, an accelerated shift would therefore meet both climate and security objectives.
 - Sustained high fossil fuel prices would mean that deeper energy efficiency retrofits would be more cost-effective. Under current fossil fuel prices the analysis undertaken for our Sixth Carbon Budget advice would have resulted in more extensive roll-out of fabric efficiency than in our Balanced Pathway, likely towards the upper end of take-up in our Sixth Carbon Budget scenarios.
 - We estimated that our Balanced Pathway would result in a cost of less than 1% of GDP in 2035. We find that our Balanced Pathway would result in a cost saving (compared to a high-carbon scenario) of 0.5% of GDP under sustained high gas prices (Box 14.8).

Figure 14.10 Reduced oil and gas consumption in the Sixth Carbon Budget Balanced Pathway



Source: CCC analysis.

Notes: Consumption in 2019 and in the Balanced pathway refer to oil and gas consumption. We assume that the share of renewable and low-carbon electricity generation displaces the same proportion of unabated gas use in power.

The relative costs of decarbonisation have improved under high fossil fuel prices, thus incentivising a faster move towards Net Zero.

The increase in gas prices has also changed the relative economics of some low-carbon technologies. Should high fossil fuel prices be sustained, this would favour measures that do not rely on fossil fuels:

- Under current gas and electricity prices, the cost of running a heat pump would typically still be 10% higher than a gas boiler.* The economics of heat pumps will therefore continue to depend on rebalancing the policy costs on electricity and gas (see Chapter 4 on buildings), as well as meeting upfront capital and installation costs, and the emerging UK market delivering reductions in those costs.
- Technologies that do not rely on fossil fuels could be favoured over the use of gas with CCS across power, hydrogen, and industry. This could mean a larger share of green (from electrolysis) rather than blue (from gas with carbon capture and storage) hydrogen production, for example.

High fossil fuel prices have fuelled the cost-of-living crisis and made the issue of affordability a top priority.

Looking at the relative costs of decarbonisation alone would tell an incomplete story on costs given that the drastic increase in energy prices has contributed to shrinking household disposable income, as a larger proportion of income is used to pay for energy.

* CCC analysis based on the level of the energy price cap in May 2022 (resulting in a gas price of 7 p/kWh and an electricity price of 27 p/kWh) and assumptions from our Sixth Carbon Budget on energy consumption (3.6 MWh/year), heat pump and gas boiler efficiencies (3.0 and 0.9 respectively).

The issue of energy affordability will become increasingly urgent in the coming winter. Rising bills will particularly affect low-income households, pushing millions of people into – or further into – fuel poverty.

The Government has rightly acted to support households with immediate energy bill pressures through two large packages on the cost of living, as well as the Energy Security Strategy (ESS). In order to continue to address both the current affordability crisis and the funding of Net Zero in the medium to long-term, Government has multiple levers at hand:

The Government has multiple levers at hand that can both address the current cost-of-living crisis and support long-term decarbonisation efforts.

- Supporting energy efficiency improvements in homes through existing and new policies such as the Local Authority Delivery scheme, Home Upgrade Grant, Social Housing Decarbonisation Fund and Energy Company Obligation.
- Policies to support a switch away from fossil fuels, especially through electrification (e.g. electric vehicles and heat pumps).
- Rebalancing policy costs that are currently charged primarily on electricity bills and present a market distortion.
- Increasing and better targeting support for decarbonisation of fuel poor homes. The Government's schemes to reduce fuel poverty could be better targeted at fuel poor households by using the existing benefit system and improving information-sharing between Government departments.
- Addressing the distributional impacts of these policies. These policies should be put forward with views to support fair funding in the longer term. We are currently developing a modelling framework to assess these distributional impacts and intend to publish a report in 2023 to set out our advice.

If high gas prices were sustained, the path to Net Zero would result in a saving of 0.5% of GDP in 2035.

Box 14.8

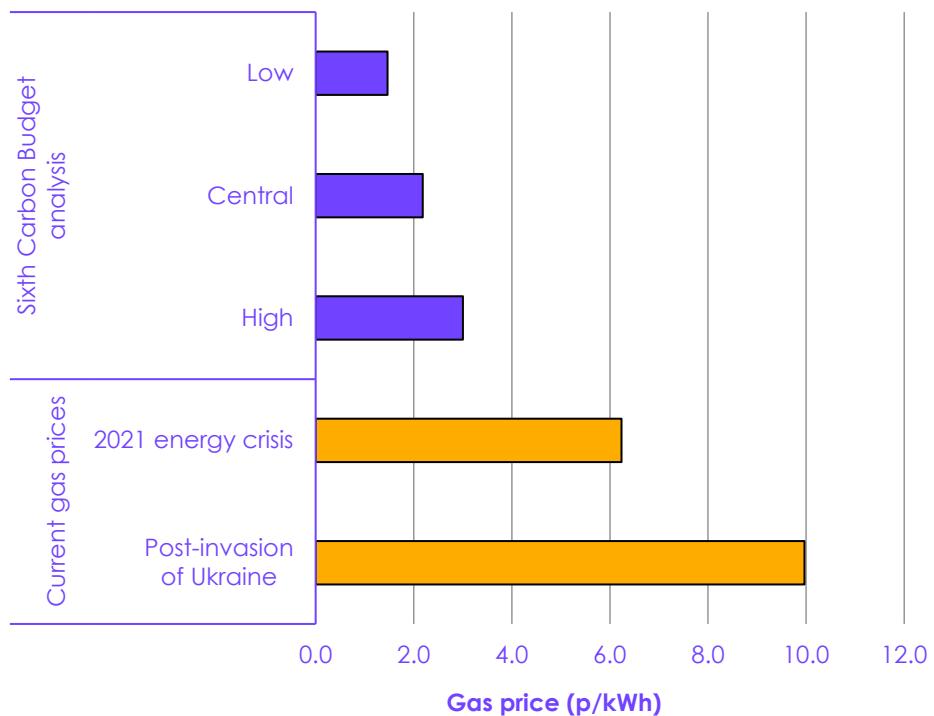
A changing context

In our Sixth Carbon Budget analysis, undertaken in 2020, we assumed wholesale gas prices ranging from 1.5 p/kWh to 3.0 p/kWh for 2022 based on fossil fuel price assumptions produced by BEIS at a time when gas prices were 1.6 p/kWh (Figure B14.8).

The UK is currently experiencing wholesale gas prices that are four times higher than those we assumed. The Office for Budget Responsibility expects prices to remain at these levels throughout the year, before falling in 2023.³³ However, there remains significant uncertainty, which suggests our future analysis should consider a wider range of prices to account for the volatility of fossil fuels.

This increase in energy prices has pushed the relative costs of decarbonisation down. On aggregate, our Sixth Carbon Budget analysis found that decarbonising the entire economy would cost less than 1% of GDP each year by 2035. If recent very high gas prices were to be sustained over the long term, decarbonising the economy would result in a saving of 0.5%* of GDP in 2035.

Figure B14.8 Gas prices currently experienced relative to Sixth Carbon Budget assumptions



Source: Office for Budget Responsibility (2022) Economic and fiscal outlook; CCC analysis.

Source: CCC analysis.

(a) Indicators

We have not yet developed indicators to monitor progress towards fair funding. However, we are currently developing a modelling framework that will assess the distributional impacts of different decarbonisation policies on household archetypes, which will inform analysis for an upcoming report in 2023.

* Assuming gas prices stayed at 7.2 p/kWh (the average price between 1 Jan and 3 March 2022) until 2035.

We will consider using this as the basis for developing indicators in our 2023 Progress Report. These could potentially include policy impacts on household income, committed public spending and private investment.

(b) Policy progress

In this section, we assess the progress that the Government has made in the past year in setting out plans to fund the transition to a low-carbon economy in a way that is fair and addresses affordability. Specifically, we review the Government's approach to fair funding in addition to the measures put forward to deal with the current energy price crisis.

The Government has outlined a high-level approach to funding Net Zero:

The Net Zero Review set out the key principles for funding Net Zero.

- HM Treasury's Net Zero Review, which was published alongside the Net Zero Strategy in 2021, recognised that the cost of inaction on climate change would be much larger than the upfront investment needed for Net Zero. In this review, the Treasury presented principles to guide the mobilisation of required funding, including:
 - Making use of targeted public funding to mobilise private investment in order to drive down costs of low-carbon technologies through innovation.
 - Using carbon pricing, but also regulation, to drive emissions reductions by addressing market externalities, notably those arising from greenhouse gas emissions.
 - Managing the risks of carbon leakage through the free allocation of UK Emissions Trading Scheme (ETS) allowances, Carbon Border Adjustment Mechanisms, product standards, and wider international coordination.
 - Mitigating distributional impacts using public spending to target specific decarbonisation measures for low-income households, rather than universal grants or changes in the tax system.
- The Greening Finance Roadmap³⁴ further highlighted a clear role for the financial sector in aligning to and delivering Net Zero. This included a commitment of £10 billion per annum in a green bond issuance, some of which should be used to pay for Net Zero.

This approach focused on targeted public funding, plans to leverage private finance and financial incentives for low-carbon options has also been reflected in sectoral decarbonisation strategies:

The Heat and Buildings Strategy recognised the role of public funding in leveraging private finance and targeting support for low-income households.

- **Buildings.** The Government has made new commitments in the Heat and Buildings strategy:³⁵
 - The strategy focused on the role of the private sector to finance Net Zero. As part of this, the Government consulted on market-based mechanisms to deliver buildings decarbonisation, which includes the possibility of placing obligations on heating appliance manufacturers and using mortgage lenders to support homeowners to improve the energy performance of their properties.

- In parallel, the use of targeted public funding was put forward as a key mechanism to support decarbonisation.
 - The Government schemes that provide funding for energy improvements and low-carbon heat in fuel poor homes add up to £8.2 billion out to 2026.³⁶ As set out in the Buildings section there are issues with the targeting of this funding towards those most in need, which need to be addressed.
 - The Boiler Upgrade Scheme provides funding of at least £450 million to support 90,000 households to replace their heat pumps over three years. The limited size of this funding commitment may not result in the increases in heat pump uptake (there were 54,000 heat pump installations in 2021) required to drive market scale-up in the next few years.
 - It further committed to launching a Fairness and Affordability Call for Evidence to make decisions in 2022 on energy levies and obligations, to help rebalance electricity and gas prices and support green choices. Government is yet to publish this, which risks further delaying a decision that is already long overdue. A decision on this will be required before the winter.
- **Transport.** Government also made commitments in the Transport Decarbonisation Plan. Public funding has been made available to remove barriers to EV uptake for households.
 - The £620 million of new investment for delivering public charging facilities reflects Government's increasing focus on meeting the needs of drivers who cannot install home chargers.
 - In parallel, Ofgem consulted on the 'Access and Forward-Looking Charges Review' to inform whether the costs associated with a new connection could be socialised across energy bill payers, reducing the costs for the connecting customers.
- Government support with energy bills is important to address the current affordability crisis. A series of measures were put forward in the latest Spring Statement³⁷ and the Energy Security Strategy,³⁸ before being scaled up in recent announcements of an additional £15 billion package for the cost-of-living crisis.³⁹ These include:
 - General support to households in England through a non-repayable £150 council rebate and in Great Britain through the Energy Bills Support Scheme that will reduce energy bills by £400.
 - More targeted support delivered through the Warm Home Discount that will be extended to an additional 3 million people for a £150 discount. An additional £500 million to the Household Support Fund that adds up to £1 billion to help the most vulnerable households pay for essentials, including utilities. Additional payments (£150-650) have been made available for pensioners, low-income groups, and those with disabilities.

The Transport Decarbonisation Plan has committed funding to remove barriers for households.

The Government has put forward a large funding package to support households during the cost-of-living crisis.

- A fuel duty cut of 5 pence per litre of diesel and petrol. While these should directly lead to cost savings for consumers, they are expected to be quite low relative to the increase of 40-50 pence per litre on average since Spring 2021.
- A cut in VAT to 0% for energy saving measures such as the installation of solar panels, heat pumps, and insulation, wind and water turbines, which could contribute to boosting energy efficiency.
- A temporary Energy Profits Levy will also capture some of the increase in oil and gas operators' profits at a time of high fossil fuel prices to return these to consumers.
- The Government has made progress in committing funding for Net Zero and targeting the most vulnerable households, but there remain gaps.

Treasury has not yet identified policies to mitigate the potential loss in revenue from the transition to Net Zero.

There is a missing assessment of the distributional impacts of Net Zero that can inform the delivery of a fair transition.

- Even though the Net Zero Review recognised that the loss of revenue from fuel duty and Vehicle Excise Duty was the largest fiscal risk of Net Zero, Treasury has not set out how it intends to raise alternative sources of revenue.
- The Net Zero Review also failed to present the impacts of Net Zero on the distribution of costs and benefits across society. Without this, it is unclear how it can be ensured that the funding of Net Zero is fair and that it is perceived as such. The current cost-of-living crisis reinforces the need to distribute costs fairly.
- Beyond support with energy bills in the short-term, there is a need to set out policies for energy efficiency measures that will both reduce costs for households and support the transition away from fossil fuel consumption in the longer term.

(c) Next steps

While the Government has already taken steps to consider the trade-offs that exist in some areas between incentivising decarbonisation and minimising distributional impacts, it will need to make decisions and take action to ensure the costs and benefits of Net Zero are distributed fairly.

The Government should undertake a review of the role of tax policy in delivering Net Zero.

- The Government should develop a Net Zero Tax Review that sets out how a tax strategy can support the transition to Net Zero by correcting distortions that penalise low-carbon technologies.
 - Heat pumps in particular have faced much higher levies on their electricity use than gas for gas boilers, thus slowing down their uptake. Yet, growing a low-carbon market will most likely require going beyond a level playing field, and designing an advantageous tax treatment for low-carbon technologies.
 - This review could directly support commitments in the Glasgow Climate Pact to phase down inefficient subsidies for fossil fuels, including post-tax subsidies that stem from a disproportionately low carbon price.
- The upfront investment needed to decarbonise heat in homes will represent one of the largest sources of costs for households. As such, the distributional impacts are likely to be considerable.

The rebalancing of policy costs on electricity and gas is now long overdue.

- The Committee would support moving the policy costs due to historical subsidies off electricity bills and onto general public spending, which would improve energy affordability and, by lowering electricity prices relative to those of fossil fuels, improve the incentive to switch heating from fossil fuels to electricity.
 - The Government should also launch the delayed Fairness and Affordability Call for Evidence and then publish further plans for energy price reform which remove market distortions and consider the role of carbon pricing. Plans should ensure that heat pumps will be cheaper to run than gas boilers. This would require assessing how the allocation of these costs can be made fair, particularly for low-income households.
 - The case for energy efficiency improvement schemes is exceptionally strong in the context of the current energy crisis. Further funding is required to support decarbonisation in fuel poor homes. A credible policy package is also needed for energy efficiency in non-fuel poor homes (see Chapter 4 on buildings).
 - Beyond energy bills, Government should drive demand for the Boiler Upgrade Scheme and make additional funding available to match it, finalise its plans for a market-based mechanism for heat pumps and outline a comprehensive vision to leverage private financing for the retrofit of UK homes and businesses.
- In parallel, switching to electric vehicles should result in significant fuel cost savings. However, without the revenue from existing fuel duty, the Exchequer will be faced with a considerable revenue gap.
 - The Government should consider the distributional impacts of transport policy in more detail, including the effects on EV and ICE drivers of cutting fuel duty and the accessibility of the EV charging infrastructure.
 - It should further consider the availability of support schemes for purchasing second-hand EV cars.

The Committee will be exploring longer-term issues over the allocation of costs and benefits of the transition in the coming months, as we develop our own assessment of distributional impacts on households and the Exchequer from the transition to Net Zero.

4. Workers and skills

Introduction and key messages

Even though the transition to Net Zero could add jobs overall, the impact on workers will be felt differently across the UK.

The transition to a low-carbon economy will involve opportunities for job creation in parallel to a shift away from high-carbon jobs. Workers will need to develop new skills both to support the creation of new low-carbon markets and to transform processes, products and supply chains for decarbonisation. Given that impacts on workers will be felt differently across sectors, regions, skill levels and demographic groups, clear planning will be required to manage the transition, particularly for workers in sectors and occupations facing the biggest changes.

The Government has already put forward policies to help workers adjust to a changing labour market, recognising the importance of further education and skills policy in delivering a fair transition. However, there remain multiple policy gaps and limitations in our understanding of future changes, which can risk the timely delivery of decarbonisation efforts.

This year, our key messages are:

- **Policy progress.** The Government's Net Zero Strategy sets out an ambition for its targets and policies to support up to 440,000 jobs by 2030. The Government has brought forward policies that aim to identify skills requirements at the local level and align the skills sector with employers' needs, prepare new entrants into the low-carbon economy and retrain the existing workforce. More will need to be done to build a workforce that can meet the pace and scale of Net Zero.
- **Evidence.** While both our initial analysis and Government estimates point to a positive net effect on jobs from the Net Zero transition (Box 14.9), evidence is patchy on sectoral impacts, skills requirements and issues such as job quality. There are data gaps on current levels of employment in certain key growth occupations (e.g. home retrofit coordinators) which limit our ability to effectively track skills requirements. In the absence of suitable evidence, skills and labour availability must be considered a risk to progress. Government should consider whether additional changes to the Standard Occupational Classification – such as those recently undertaken to incorporate heat pump installers – are needed to account for other Net Zero professions.
- **Net Zero Skills Action Plan.** There are a range of existing policies which aim to identify the skills needed in a changing labour market. However, despite a Government commitment for a Net Zero skills action plan, there is still no comprehensive assessment of when, where, and in which sectors there might be skill gaps specific to Net Zero. This should now be delivered.
- **Clear definition of responsibilities.** Existing policies signal an important role for local authorities, education and training providers, and businesses to lead the transition in skills. However, it is not yet clear who will be responsible for driving opportunities for low-carbon job creation and for supporting workers at risk – particularly in sectors where the transition might be sudden and localised.

The Government has put in place policies that will support workers during the transition, but there remain policy gaps.

A stronger evidence base is needed to inform policy, notably potential changes to the Standard Occupational Classification.

A strategic view on the impact of Net Zero on labour markets and the role of Government – both in supporting workers at risk and plugging skills gaps – is needed.

An Action Plan for Net Zero skills could address uncertainty on impacts on workers and clarify the roles and means through which a fair transition can be delivered.

- **Sustained funding and policy clarity.** The Government has already committed some funding for training out to 2025. It will be important for effective training schemes to benefit from sustained and adequate funding where these are found to be viable. Where Government hopes to spur market growth through early-stage public funding (e.g. heat pumps, heat networks), credible commitments that go beyond Spending Review cycles will be critical in signalling to businesses and workers that these markets will be profitable and employable in the longer-term.

(a) Indicators

The Committee has not yet developed indicators for monitoring progress towards a fair transition for workers, partly reflecting the limitations in the evidence base. We intend to publish a report in the next year that will include an assessment of skill needs and policy recommendations to ensure workers and skills can help deliver Net Zero. We will consider indicators as part of this, which could cover areas such as employees in low-carbon sectors, future skills requirements and availability of routes for reskilling.

(b) Policy progress

In this section, we provide our assessment of existing policies relevant to workers and skills that support the delivery of Net Zero. We focus in particular on the measures put forward by the Government in the Net Zero Strategy⁴⁰ and the Heat and Buildings Strategy,⁴¹ which built on the Skills for Jobs White Paper.⁴²

The Net Zero Strategy estimates that its targets and policies could support up to 440,000 jobs by 2030.

The Government's Net Zero Strategy sets out an ambition for its targets and policies to support up to 440,000 jobs by 2030. While our initial analysis suggests that Net Zero is likely to result in positive impacts for employment (see Box 14.9), further data and research are needed to understand better both the current employment picture in relevant sectors as well as future impacts. Aggregate figures can mask significant localised impacts, and a better grasp of how different sectors, occupations, regions and demographic groups may be affected is necessary (see section on next steps).

The Government has brought forward policies that aim to identify skills requirements at the local level and align the skills sector with employer's needs, prepare new entrants into the low-carbon economy and retrain the existing workforce:

The Government has already put in place policies to help the existing workforce and new entrants enter the low-carbon economy.

- **Identifying skills needs.** An important challenge for the Government will be to identify where jobs may be lost and how to support workers during the transition given ambitions set out in the Net Zero Strategy and the Energy Security Strategy. Some progress has been made on this front:

- Existing policy has mainly focused on identifying skill needs at the local level, albeit not comprehensively. Such initiatives include the Local Skills Improvement Plans (LSIPs) and the Energy Supply Chain Taskforce (ESCT), for example.
- While not all these policies are specifically focused on Net Zero, they aim to support the responsiveness of local skills systems to changing employer skills requirements, including for Net Zero.

Current policy aims to identify local skill needs, which will support but not target Net Zero requirements.

- **Preparing new entrants.** The Government has started supporting new entrants to ensure they are prepared for the future labour market:
 - The Department for Education recently published a Sustainability and Climate Change Strategy that embeds green skills and climate in education and training.⁴³ While this strategy includes a strong set of actions and policies, such as prioritising green skills in the Skills and Post-16 Education Act, it is unclear whether the pace and scale of Net Zero will be met in the absence of a strategic assessment of its impacts on labour markets.
 - This strategy confirmed the creation of a Green Apprenticeships Advisory Panel that will aim to align apprenticeships to Net Zero objectives and employer needs. Work is underway to map apprenticeship standards to green occupations and consider where new standards are needed in areas such as home retrofits.
- **Retraining and reskilling the existing workforce.** Decarbonisation will be a widespread economic transition which will shift employment and skills requirements. The Government estimates that around 80% of the 2030 workforce is already in employment now,⁴⁴ suggesting a significant role for reskilling and retraining. Some policies have been put forward to support this:
 - The New National Skills Fund committed £2.5 billion for retraining and upskilling in view of supporting the green recovery and Net Zero transition.
 - Net Zero has been included in efforts to reform the skills system through programmes such as the Lifetime Skills Guarantee, which supports workers to reskill and retrain, including through Skills Bootcamps in areas like housing retrofit. Other measures like the Lifelong Loan Entitlement could provide individuals with a loan to invest in technical and academic education throughout the transition to a low-carbon economy.
 - These policies are mostly led by local employers and authorities, with Government support through public funding. This includes £65 million of public grant funding through the Strategic Development Fund. £15 million of public funding has also been committed towards the second phase of the Public Sector Low Carbon Skills scheme, which helps public sector organisations gain expert skills to unlock decarbonisation projects.
- **Skills plans in Scotland.** The Scottish Government has made considerable progress in this area, notably through the Climate Emergency Skills Action Plan:⁴⁵
 - Similar to the UK-wide policies, the Scottish Government's plan prioritises increasing the responsiveness of skills and training systems to local skills needs and creating opportunities for upskilling and retraining.

- The Scottish Action Plan included a commitment to building the evidence base to better understand skill requirements specific to Net Zero and mainstreaming issues of fairness in policies. In addition, it identified the role of different organisations, including local authorities and businesses, in delivering each priority of the plan. These steps are also required at UK level.

(c) Next steps

As set out above, the Government has made positive steps toward identifying the impact of Net Zero on the labour market and associated skills needs. It has also put forward several policies to support sectors at risk and help meet skills requirements. However, more will need to be done to build a workforce that can meet the pace and scale of Net Zero. Progress is needed on two main fronts: 1) building a strong evidence base on both current employment in growth sectors and future skills needs; 2) setting a strategic framework for the role of Government and developing policies to support skills in growth sectors.

Building the evidence base

The Government should build a stronger evidence base and collect data for monitoring progress:

More data collection will be needed to monitor progress towards building a low-carbon workforce.

- **The current labour market picture.** Data on current employment in some relevant sectors – both sectors with potential for growth and at-risk sectors – is lacking or incomplete. For example, there is no publicly available data on the current number of home retrofit coordinators in the UK. Positively, the ONS included heat pump installers within the Standard Occupational Classification (SOC) this year, and data should be available from next year. The Government should consider whether other relevant occupations should be included within the SOC going forward.
- **Labour force and skills requirements in growth sectors.** New analysis is required to understand which additional jobs will be needed to achieve Net Zero and the training pathways available for entrance into these professions (i.e. retraining versus new entrants), so that policy can be better targeted in facilitating this entrance.
- **Sectors at risk.** Further analysis on occupations at risk, including where workers are located, is needed for plans to support these workers to be targeted and developed (see below). This should include consideration of wages and job quality of existing jobs compared to any retraining opportunities.

Analysis is needed to identify occupations at risk due to Net Zero and develop appropriate policy.

Strategic planning and skills policy

The Government should do more to clarify its role in protecting workers that are currently employed in at-risk sectors, and delivering skills requirements. There is a need for the Government to provide clarity on policy and long-term funding for training in order to create certainty for both workers and employers.

- **Clear definition of responsibilities.** Developing a strategic framework to deliver a fair transition for workers. This should clarify the roles of Government, businesses, local authorities, education providers and workers.

- **A Net Zero Skills Action Plan.** The Government should publish its comprehensive assessment of when, where, and in which sectors there will be skill gaps specific to Net Zero. This should include consideration of particular barriers to labour market entry into occupations needed for the transition and Government plans for action on the skill system to facilitate entry into these occupations. This assessment should be used to target policy and funding towards the more pressing skills needs and to consider the role of incentive payments to workers, where workers might be bearing costs or losing earnings due to training.*
- **Protecting those at risk.** Once sectors most at risk have been identified and the Government has clarified roles, there will be a need for policies to deliver opportunities and incentives for workers to retrain and move into other sectors.
- **Sustained funding and policy clarity.** Where existing policy trials and schemes are found to be adequate and effective, funding should be sustained to provide certainty to the workforce and the skills landscape. Where the Government hopes to spur market growth through early-stage public funding (e.g. heat pumps, heat networks), credible commitments that go beyond Spending Review cycles will be critical in signalling to businesses and workers that these markets will be profitable and employable in the longer-term.

Box 14.9

Interim CCC analysis on workers and skills

The CCC are currently working on a report assessing the potential employment opportunities and risks from Net Zero in different sectors, regions, and demographic groups. This report will set out what we know based on the existing literature and our Sixth Carbon Budget analysis, and highlight any additional evidence gaps on the labour market impacts of Net Zero.

Our analysis of employment impacts in the existing literature suggests that the transition to Net Zero will have large-scale implications for the workforce, with impacts felt differently across different sectors. These impacts are similar in scale to past UK transitions and will happen in a labour market that is already changing:

- Overall, Net Zero is likely to have a net positive effect on job creation (Figure B14.9). However, some sectors will be more affected than others:
 - As the UK moves away from fossil fuel consumption, the role for UK oil and gas production should continue to decline, leading to up to 60,000[†] fewer jobs.⁴⁶ Affected workers might be able to transition to low-carbon energy supply jobs that require similar skills, such as hydrogen or carbon capture and storage.
 - In other sectors, the net impact is likely to be positive, such as in buildings where up to 230,000 jobs could be created by 2030.⁴⁷
- The overall net impact on jobs of Net Zero could be similar in scale to what the UK economy experienced in the past, such as the transition away from steel manufacturing.⁴⁸ While automation could have a wider impact on workers than Net Zero, the uncertainty around this impact is also very significant.⁴⁹
- Job impacts are often policy or choice dependant. For instance, job creation or losses in car manufacturing are likely to depend on whether battery manufacturing gigafactories will be located in the UK or abroad.⁵⁰

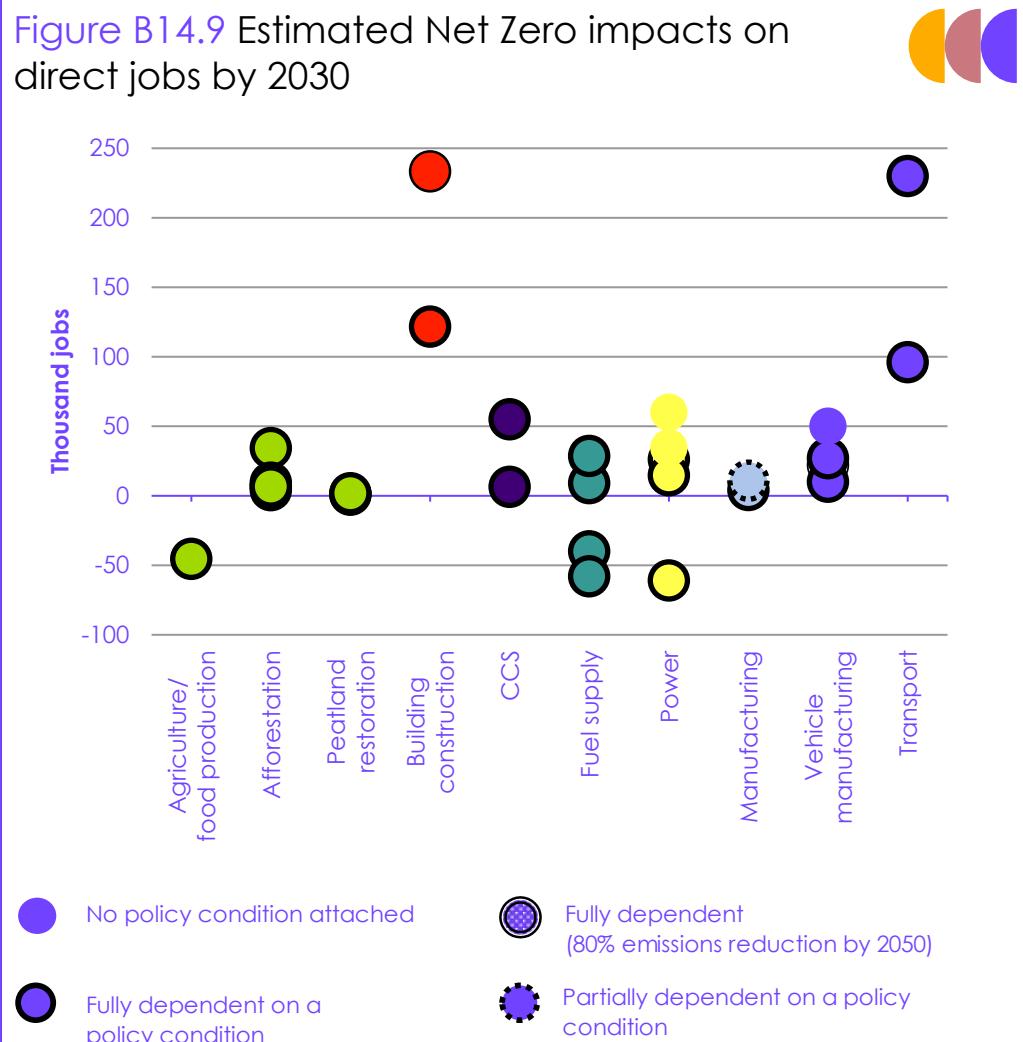
* For example, in construction, despite a stated willingness to retrain from many workers, a heat pump installer could have to pay £2,000 for training.

[†] This estimate represents the gross reduction of direct and indirect jobs in the oil and gas sector; however it includes jobs that could be transferable to other low-carbon sectors.

- As well as impacts on sector size, Net Zero will have impacts on the nature of work undertaken in some sectors, and the skills required to undertake certain roles (e.g. different skills may be needed to manufacture an electric car than a car with an internal combustion engine). Estimates suggest that more than 6 million workers could be subject to some change in skills.⁵¹
- It is equally important to consider where in the country changes will occur. The development of a new nuclear plant could benefit a local community while the retrofitting of heat pumps is likely to be widespread in the UK. Similarly, an oil field closing down could impact an entire local community, while a shrinking need for vehicle maintenance would likely affect workers across the UK. Regional considerations, and, in particular, whether job losses are likely to be sudden and localised, should inform the role of Government in managing the impacts of the transition.

We will continue our assessment of Net Zero labour market impacts with a focus on skills in the second half of this year. We intend to develop further policy recommendations and a framework to monitor progress on a fair transition for UK workers.

Figure B14.9 Estimated Net Zero impacts on direct jobs by 2030



Source: CCC analysis based on BEIS (2019) Energy Innovation Needs Assessments, BEIS (2021) Net Zero Strategy, Onward (2021) Greening the Giants, IPPR (2020) Transforming the Economy After COVID-19, Faraday Institute (2020) UK electric vehicle and battery production potential to 2040, BEIS (2021) Hydrogen Strategy, BEIS (2021) North Sea Transition Deal, Offshore Wind Council (2021) Offshore Wind Skills Intelligence Report, Renewable Energy, Energy and Utility Skills (2018) Skills and labour requirements of the UK offshore wind industry, Eunomia for the Construction Industry Training Board (2021) Building Skills for Net Zero, TUC (2021) Safeguarding the UK's manufacturing jobs with climate action, European Commission (2019) Waste not, want not: A bio-economic impact assessment of household food waste reductions in the EU.

Notes: This analysis looked across a dozen reports. While these estimates consider Net Zero impacts across a wide range of sectors, the assessment is not exhaustive of all sectors of the economy. As such, we note that the impacts of Net Zero on certain sectors will not be included. For example, impacts on vehicle maintenance, which is likely to result in job losses, has limited evidence and has therefore not been included in this chart.

5. Business and finance

Introduction and key messages

The private sector will be the primary delivery agent of the UK's transition to Net Zero, and of important aspects of climate adaptation. Businesses must cut their own emissions (scopes 1 and 2) and those of their products and supply chains (scope 3).⁵¹ Private sector actors also need to grow new markets in low-carbon technologies and behaviours, reskill employees, decarbonise and future-proof supply chains, make appropriate investments and support necessary policies. The onus is on both Government policy and private sector actors themselves to ensure this happens.

Both the public and private sector need to move beyond impressive targets and information-sharing towards establishing and implementing policies, tools and plans that lead to corporate action with impact.

The role of business and finance is at the heart of progress in all the main sectors, and for several enablers including workers and skills and innovation, as well as for adaptation. Enablers and sector progress are covered in the respective chapters of this report.

Our key messages are:

The focus for the next year should be sustaining momentum from COP26, translating ambitions to align the UK financial sector with Net Zero into firm policy, and regulating voluntary carbon offsets.

- **Good progress on green finance.** In October 2021 the Government published its Green Finance Roadmap, setting out ambitious plans to make the UK the world's first Net Zero-aligned Financial Centre, including a requirement for listed companies and financial institutions to publish Net Zero transition plans.⁵² A shift from setting ambition to finalising firm standards and policy for transition plans, the UK Green Taxonomy, and investment product labelling is now needed.
- **A Net Zero transition plan standard.** The Government should follow through on its commitments by taking steps to legislate for listed UK companies and financial institutions to publish Net Zero transition plans as soon as possible. A Net Zero transition plan standard should be developed to ensure corporate Net Zero transition plans set quantitative long-term targets backed up by detailed and measurable implementation plans and accompanied by regular progress updates. It should enable businesses to communicate their full Net Zero strategy, extending beyond direct emissions reduction to include climate-related risks and wider contributions to the UK's Net Zero pathway.
- **Leveraging private finance.** Investment will play a key role in providing the capital needed for the transition, alongside public funding. The Government should publish a Green Finance Strategy which sets out a comprehensive vision for the scale of private investment and how it will be leveraged, and outlines how financial flows will be monitored.

* The Greenhouse Gas Protocol defines three "scopes" of emissions for companies. Scope 1 emissions are direct greenhouse gas emissions occurring from sources owned or controlled by the company, such as from company boilers or vehicles. Scope 2 emissions are emissions arising from the generation of electricity that the company purchases. Scope 3 emissions capture all other indirect emissions that occur as a consequence of the activity of the company, such as the extraction of materials, transportation of purchased fuels, or use of sold products and services.

- **Momentum from COP26.** COP26 saw a formalisation of commitments to reduce greenhouse gas (GHG) emissions and invest in the zero-carbon economy. While this is encouraging, a number of large UK corporates are yet to make Net Zero commitments, and there are early signs of reduced attention and resource following COP26 for engaging with businesses, in particular small and medium-sized enterprises (SMEs).^{*} The Government must double down on catalysing business Net Zero action for businesses of all sizes, bringing along both climate leaders and climate laggards.
- **Clear long-term policy signals.** Policies which facilitate and amplify voluntary corporate Net Zero ambition are valuable, but should not be pursued in place of an effective regulatory environment and well-aligned financial incentives. Planned regulations and financial incentives such as carbon pricing should be communicated to the private sector well in advance to support a smooth transition.
- **Voluntary carbon offsets.** Demand for voluntary carbon offsets continues to grow, despite limited UK guidance or policy on the conditions for legitimate use of offsets in Net Zero corporate claims. In the next year the Government should develop policy levers to regulate the use of voluntary carbon offsets by UK actors in the UK and globally, to avoid greenwash and ensure offset funds are aligned with Net Zero transition plans and directed to the highest impact activities.

(a) Indicators

Later this year we will publish a report on the role of business and the private sector, in which we will evaluate progress for businesses and financial institutions in transitioning to Net Zero and outline a full set of indicators to track progress. For now, we include key signals of progress for UK business and investment in the last year which may be included in our indicator framework:

Commercial scope 1 emissions have seen a steady decrease in the last two decades. They comprise roughly two thirds of UK territorial emissions.

Net Zero corporate commitments have increased, but often with limited quality, and low uptake from SMEs.

- **Business scope 1 emissions.** Estimated business scope 1 emissions comprise two-thirds of UK-wide emissions and have seen a significant decrease in the last two decades (Figure 14.11):
 - Businesses represent two-thirds of remaining scope 1 emissions, and most of UK emissions can be associated with business-related scope 1, 2 or 3 emissions.
 - Over the last ten years, falling emissions within business scope 1 emissions have generally driven the decrease in UK emissions.
 - This reflects fuel switching in the power sector, and efficiency gains coupled with relatively flat demand for commercial agriculture and industry.
- **Net Zero corporate commitments.** Net Zero corporate commitments have increased, but there remains limited progress with SME commitments (Figure 14.12), and the quality and depth of Net Zero plans is mixed:

^{*} SMEs are typically businesses with fewer than 250 employees and, based on the European definition that has been widely adopted in UK policy making, an annual turnover of less than €50 million/balance sheet of €43m. A small business that is a subsidiary of a large business is not an SME.

- There has been a steady increase in UK businesses that have a Science Based Target (SBT) in place or a commitment to a SBT as approved by the Science Based Targets initiative (SBTi).
- Commitments by large corporates, in particular the FTSE100, greatly outstrip those by SMEs, with less than 0.1% of SMEs committing to set a SBT, compared to 6% of large corporates and 60% of the FTSE100.
- There are early signs of a slowing rate of new commitments, possibly due to the conclusion of COP26. There is in general an under-representation of heavy-emitting industry, and many businesses committed to SBTs still did not publish progress updates this year.⁵³
- The proportion of FTSE100 companies including scope 3 emissions in their emissions reduction targets has remained at around one-third. There has been a growth in the use of voluntary carbon offsets to a quarter of the FTSE100.*⁵⁴

Few UK businesses report plans to take action to reduce their emissions in substantial ways, such as switching to low-carbon heating or electrifying vehicle fleets.

- **Changes made by businesses. Reported UK business action** peaked around COP26, but remained focussed on 'small wins' rather than more significant changes to low-carbon heating or electrifying vehicle fleets:
 - There was a peak in October 2021 in UK businesses reporting having taken action to reduce their carbon emissions in the last 12 months (two-thirds), followed by a decline in early 2022 (two-fifths).⁵⁵
 - As of February 2022, a quarter of businesses plan to take action in the next 12 months, similar to the proportion in 2021.⁵⁶ The most common completed and planned actions are switching to LED lighting and adjusting heat and cooling systems.
 - Very few businesses (less than 10%) plan to take more substantial actions such as electrifying their fleet, insulating their buildings or installing renewable heating.
- **UK ranking in global indexes.** The UK has retained high rankings in global indexes for green finance and corporate climate leadership. However, it also has some of the worst performing large companies:
 - The UK continues to have the largest share of companies (120 out of 401) in the Financial Times' Europe's Climate Leaders list of companies that have achieved the greatest GHG emissions intensity reduction from 2015-2020.⁵⁷
 - Half of Eco-Act's top ten companies for climate leadership (comprising DOW 30, Euro STOXX 50 and FTSE100) were from the FTSE100 in 2021. However, 17 out of 20 of the bottom companies were also from the FTSE100, and as a result the average score the FTSE100 received has been consistently lower than the average score for the other groups. The bottom companies were from a range of sectors, with greater representation from financial institutions and hospitality.

* This only considers FTSE100 emissions reduction plans which purchase offsets from projects certified by international standards.

– London came at the top of the Global Green Finance Index (GGFI)*. The index ranks cities based on the quality and depth of their green finance offerings, capabilities and mechanisms. Western Europe continues to lead the way, and London has consistently been in the top six financial centres for green finance since 2018. Its top place this year coincides with the UK's first issuance of green sovereign bonds and COP26 Presidency.⁵⁸

The 'green' economy remains a significant source of turnover in the UK, despite slow growth in important areas such as insulation and electric vehicles.

- **'Green' economy turnover.** The 'green' economy remains a significant source of turnover, although there is slow growth in important areas for the transition such as insulation and electric vehicles:

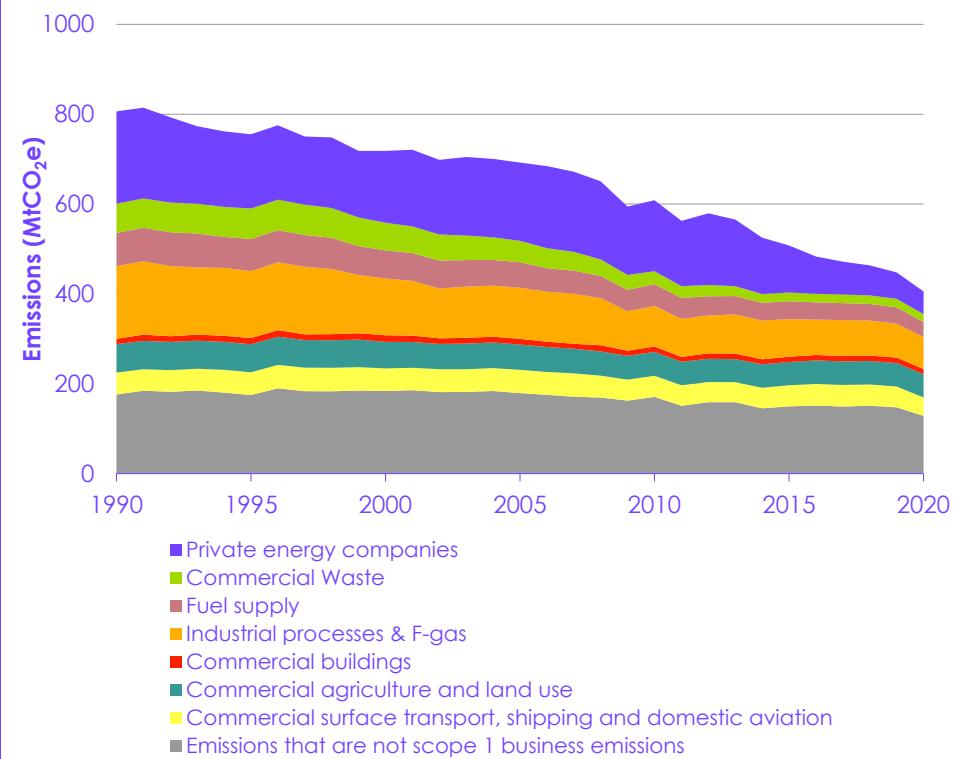
- Since 2010 there has been an increase in turnover from 'environmental goods and services' from £62 billion to £84 billion in 2018[†], largely driven by an increase in renewable energy production, and to a lesser extent waste. Most other areas (insulation, organic agriculture, recycling) have shown little change.⁵⁹
- Estimated turnover from the 'low carbon and renewable economy' was around £41 billion in 2020, similar to the last 5 years. The most significant turnover has consistently come from energy efficient products and low-carbon electricity. There has been a growth in turnover from low emission vehicles since 2016.⁶⁰

* The Global Green Finance Index invites finance professionals to rate financial centres based on the extent to which green finance has penetrated business and the quality of green financial products on offer.

† The Environmental Goods and Services Framework, adopted under the UN System of Environmental Accounting, provides a definition of areas that start to represent the 'green' economy. It includes waste, organic agriculture, environment-related construction, insulation activities, management of forest ecosystems, energy saving and sustainable energy systems and managerial activities, among other things.

Estimated UK business scope 1 emissions are about half their levels in 1990. Businesses will continue to play a key role in reducing UK emissions, with two-thirds of UK emissions falling within scope 1 business emissions.

Figure 14.11 Estimated breakdown of UK territorial emissions attributed to business scope 1 emissions

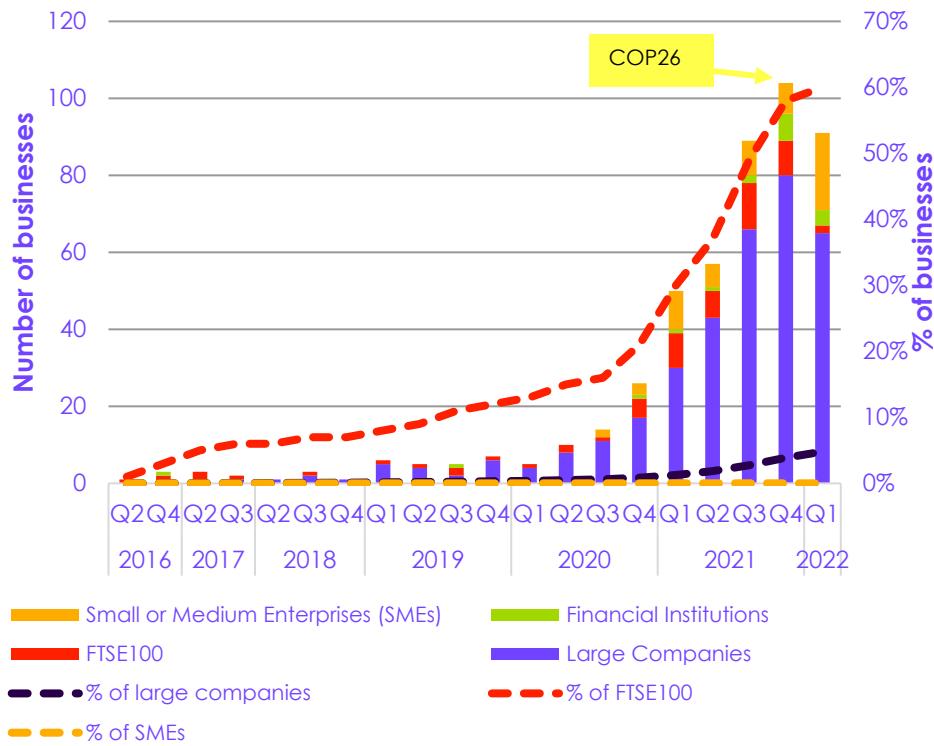


Source: BEIS (2022) Provisional UK greenhouse gas emissions national statistics; CCC analysis.

Notes: Each emitting activity was labelled as either not falling within a business's scope 1 emissions, falling within a business's scope 1 emissions, or having a proportion fall within a business's scope 1 emissions. For example, we assumed 8% of emissions from passenger vehicles fell within a business's scope 1 emissions, based on the proportion of vehicles on the road in the UK that are registered for commercial use. Different proportions were assumed for HGVs and other surface transport. For sectors such as waste, where even household waste is processed by a private company, all emissions were marked as scope 1 business emissions. We hold the proportion of an emitting activity's emissions associated with commercial scope 1 emissions as constant across time.

The number of the FTSE100 setting or committing to set SBTs has increased rapidly since 2019. SMEs and other large corporations lag behind.

Figure 14.12 Businesses committed to a Science Based Target (SBT) by business type



Source: SBTi (2022) Companies Taking Action Data; CCC analysis.

Notes: This does not include financial institutions and oil & gas companies. Includes companies that have both committed to setting a target and those that have fully implemented a Science Based Target. FTSE100 companies are not included within the numbers for large companies. SBTi's definition of SMEs includes all non-subsidiary, independent companies with fewer than 500 employees.

(b) Policy progress

Out of our four recommendations from last year, one is achieved, one is showing sufficient progress and two are not achieved.

Out of the four 2021 Progress Report recommendations, one is achieved, one is showing sufficient progress and two are not achieved:

- **Achieved (1):** The UK Government's framework for green finance broadly aligned with Net Zero funding priorities.⁶¹
- **Sufficient Progress (1):** There is promising initial progress in establishing a UK Green Taxonomy and transition plans to make the UK the world's first Net Zero-aligned Financial Centre. More progress is needed on monitoring financial flows.
- **Not Achieved (2):** More progress is needed on sustaining momentum in business emissions reduction targets after COP26 for businesses of all sizes and ambition levels. More progress is also needed to regulate the voluntary carbon offset market in the UK.

The UK's Net Zero Strategy. The Net Zero Strategy was published in October 2021. It emphasised the role of market mechanisms and business reporting, but had limited commitments on demand reduction:

- Two of the Net Zero Strategy's four principles for the costs of the transition were market-focussed and included ensuring the biggest polluters pay

most. It emphasised the role of private sector and market mechanisms for delivery, in particular in heat pump markets, electric vehicles sales, hydrogen and Carbon Capture and Storage (CCS).⁶²

- There was progress in proposals for business transparency and reporting for food waste, environmental products and airline tickets.
- The Strategy has limited commitments on demand reduction or behaviour change, which is an area where, without policy, businesses may struggle to lead the way without losing competitive edge.

The Government has published promising plans to embed Net Zero into financial decision-making, through the Sustainability Disclosure Requirement (SDR) and UK Green Taxonomy.⁶³ It has issued its first green gilts and announced tax relief on green technologies. However, momentum and support for Net Zero business commitments has waned following COP26, and the UK voluntary carbon offset market continues to lack guidance and regulation.

A series of private sector coalitions announced new commitments at COP26. Sustained engagement with the laggards and SMEs is needed to maintain momentum.

- **Business engagement.** There has been mixed progress on supporting businesses of all sizes to play their full role in transitioning and adapting, extending the role of the Net Zero Business Champion, and building on campaigns such as Race to Zero and Race to Resilience:
 - At COP26, business and investor alliances announced and formalised commitments to set Net Zero standards or create low-carbon markets. These commitments are: The Race to Zero campaign; Glasgow Financial Alliance for Net Zero (GFANZ); First Movers Coalition; International Sustainability Standards Board and Net Zero Standard from SBTi. Further detail is in our 2021 report on COP26 outcomes.⁶⁴
 - The number of FTSE100 companies signed up to the UN's Race to Zero* campaign has doubled since our 2021 Progress Report to over 60%.⁶⁵ The rate of sign-ups has declined after COP26, as has reported business action to reduce emissions.⁶⁶
 - The role of the Net Zero Business Champion has not been extended. A strategy for how Race to Zero will continue to raise ambition of existing members and attract new members is needed.
 - There are some public or private finance schemes available for SMEs. However, SMEs continue to receive less funding and focus than large corporates.⁶⁷ Less than 1% of UK SMEs have signed up to the UK SME Climate Hub Commitment.⁶⁸
- **Greening finance and financing green.** There has been good progress in developing ways to embed Net Zero and climate risk in financial decisions by UK firms, through mandatory disclosure and plans for a robust Green Taxonomy:
 - In October 2021 the UK published its Green Finance Roadmap, announcing plans for a Sustainability Disclosure Requirement (SDR).

The UK's Sustainability Disclosure Requirement (SDR) set out promising plans to require listed UK companies to publish Net Zero transition plans.

* By signing up to Race to Zero, companies pledge to: reach Net Zero emissions by 2050, set an interim target toward a fair share of 50% global emissions reduction by 2030 and set out what actions will be taken to achieve the pledge in the short to medium-term. The commitment is not binding.

It included a new requirement from 2023 for UK listed companies and financial institutions to publish Net Zero transition plans. It also included plans to improve investment product labelling.⁶⁹

- The requirement for all premium listed companies and financial institutions to report under Task Force on Climate-Related Financial Disclosures (TCFD) on a 'comply or explain' basis resulted in the first reports in spring 2022. TCFD disclosures have been of varied quality, with insufficient detail on performance against targets, scenarios and the impact on business strategy.^{70,71}
- The UK Green Taxonomy is under development, with plans to legislate the first two technical screening criteria by end of 2022 and four more by end of 2023.
- In May 2022 the Government published a Call for Evidence to inform an updated Green Finance Strategy due to be published in late 2022.

More guidance and regulation is needed in the UK for voluntary carbon offsetting.

- **Voluntary carbon offsetting.** There has been good global progress but limited domestic progress in establishing regulations and guidance for carbon offsetting by UK corporates:

- At COP26, an update to the Article 6 rulebook was negotiated, which made a provision for 'corresponding adjustments' to prevent double counting. This is not mandated for voluntary credits purchased by private companies.⁷²
- The UK announced its support of the Voluntary Carbon Markets Integrity Initiative (VCMI), which is due to provide international guidance on corporate claims and associated governance relating to carbon offsetting.⁷³ In June 2022 VCMI launched a consultation on a provisional Code of Practice for the role of carbon credits in corporate claims.⁷⁴
- Beyond this, domestically no guidance or regulations have been published.

The UK's first green gilts were more successful than its sovereign bonds. The planned areas of spending broadly align with Net Zero priorities.

- **Green bonds and gilts.** The UK Government issued its first green sovereign bonds and gilts, which generally were successful in leveraging funds, and look set to be used for appropriate investments:

- In June 2021 the Government published its Green Financing Framework to outline how funds leveraged from Government green bonds and gilts will be spent.⁷⁵
- The priority areas are broadly in line with the Sixth Carbon Budget, with greater proportional spend on transport and natural resources, and less on energy efficiency, than total costs.⁷⁶ An outline of an overall strategy for how total capital costs of Net Zero will be met is needed to confirm if this is the appropriate balance.
- The Government exceeded its target for green gilts, raising £16.1 billion in green gilts in 2021.^{77,78,79} However, it raised only £0.3 billion from sales of green saving bonds for the retail market as of March 2022.⁸⁰ This may be due to the interest rates offered (0.65% and then 1.30%) being relatively low for retail investors.

- The Government already raises significant funds through bonds for spending more generally; it is possible Government funds would have been made available for green activities anyway. Due to this issue of fungibility it is not clear whether the funding is unlocking additional public green spending.
- **Business tax relief.** In March 2022, the Government confirmed a business rate tax relief for green technologies such as heat pumps, solar panels and low-carbon heat networks, and reduced VAT on energy saving materials from 5% to 0%.⁸¹ These changes are particularly important as high energy prices may impact on businesses' ability to fund and prioritise the transition, although it is unclear if they will be sufficient, in particular for SMEs.

(c) Next steps

In the next year, the Government should publish a comprehensive Green Finance Strategy and publish plans for a robust transition plan standard. They should develop regulations for voluntary carbon offsetting and increase engagement with SMEs. They should continue to communicate regulations and incentives well in advance to direct business planning.

Green Finance Strategy. In the updated Green Finance Strategy expected later this year, the Government should include plans for how financial flows can be meaningfully monitored in advance of 2023, setting out key incentives for investors to shift practices, and an overall strategy for how total capital costs of Net Zero will be met by public and private funding sources. This will enable institutions such as the UK Infrastructure Bank (UKIB), green gilts and other mechanisms for directing investment towards the transition to ensure the right areas are being prioritised.

Net Zero transition plan standard. The Government should follow through on commitments made at COP26 by taking steps to legislate for listed UK companies and financial institutions to publish Net Zero transition plans as soon as possible, to meet their 2023 timeline for introducing the requirement. The Government should publish plans for a clear transition plan standard, based on a transparent consultative process with experts, practitioners and private sector actors, and building on lessons learnt from TCFD. It will be important to ensure the metrics and requirements are sufficiently ambitious, and to ensure businesses can communicate their full contribution to the Net Zero transition, beyond direct emissions reduction. See Box 14.10 and Table 14.4 for more detail.

- While the highest impact action a business can take to reduce emissions will vary, actions which businesses might be encouraged to take across the board could include electrifying fleets, reducing the impact of employee commuting and business travel, switching to low-carbon heating and insulating their buildings.

Voluntary carbon offsets. Building on the VCMI consultation in summer 2022, the Government should develop proposals for standardising and regulating the claims that corporates can make relating to offsets, for ensuring the quality and additionality of offsets on the market, and for directing carbon offsets to the highest quality and impact projects by mid-2023.

SME engagement and support. The Government should develop a strategy for engaging with SMEs on decarbonisation, particularly high-emission, low-engagement businesses. It should introduce a package of measures within this, including a one-stop-shop for SMEs to access decarbonisation advice with a carbon foot-printing tool, building on the UK SME Climate Hub. The Government should also develop a strengthened low-carbon advisor / auditor role for SMEs and an effective financing strategy to support SME decarbonisation. See Box 14.11 for more detail.

Regulations, incentives and long-term signals. Across all sectors, for planned regulations and incentives such as carbon pricing, Government should ensure thorough consultation with the private sector throughout the policy development process. Signals of intent should be given well in advance so that the private sector by default moves in step with the UK transition to Net Zero.

In the coming months, we will publish a briefing on voluntary carbon offsets (autumn 2022), a report on the role of the private sector in the UK's pathway to Net Zero (winter 2022) and a report on financing adaptation to climate change (winter 2022).

(d) Risks

Table 14.3
Major risks and required mitigating actions - Business and Finance

Risk category	Description	Mitigating actions	
		Description	In place?
Greenwash and perverse outcomes	Corporate Net Zero targets could paint an overly optimistic picture of expected emissions reduction, particularly where they lack robust delivery plans and rely heavily on voluntary carbon offsets. They could lead to perverse outcomes, such as UK land being bought for offsetting at the expense of other land uses.	Implement robust Net Zero transition plan standards which ensure Net Zero targets are backed up by strong implementation plans (see recommendations and Box 14.10). Publish clear guidance and regulations to direct appropriate offset use in Net Zero targets (see recommendations). Develop a UK Land Use Strategy to balance multiple objectives land must deliver (see Chapter 8).	Partly
Voluntary target setting - no additionality	The emphasis on voluntary corporate Net Zero targets/offsets could undermine the importance of regulation. Resulting corporate plans may capture progress that would have taken place anyway due to policies or particularly ambitious companies.	Do not deprioritise strong regulatory signals and financial incentives such as carbon pricing. Highlight where business action beyond what will be delivered by policies/regulations is particularly beneficial (e.g. growing heat pump markets) and embed this into corporate reporting requirements. Focus not only on facilitating accurate reporting of climate leadership, but also on mechanisms to move the 'climate laggards' forwards.	Partly
Insufficient incentives for financial flows	The emphasis on improving information available to financial institutions (Green Taxonomy, corporate transition plans) and requiring disclosure (financial institution transition plans, investment product labelling) may not create sufficient incentives to result in real economy changes in financial flows.	Monitor the changes in financial flows annually, and review in 2024 whether the current approach is working, or whether further incentives for financial institutions are needed. In the Green Finance Strategy, set out a comprehensive outline of how the costs of the transition will be funded, publicly and privately, and mechanisms for securing and tracking private investment (see recommendations).	Yes

Delivery through market mechanisms	The Net Zero Strategy use of markets to deliver emissions reductions from heating, transport and hydrogen has its merits, but carries a risk of unpredictability and limited control over outcomes.	Monitor the development of key markets, and review whether the market mechanism approaches are working. Keep in close dialogue with private sector actors on emerging barriers or enablers to success.	Partly
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Box 14.10

A high-quality transition plan standard

Background. In October 2021 the Government announced plans to require listed UK companies and asset managers to publish Net Zero transition plans. In April 2022 the Transition Plan Taskforce was established to propose robust transition plan standards by the end of 2022. It launched a Call for Evidence in May 2022.

An independent think piece. In January 2022 the CCC commissioned an independent think piece to outline a strawman vision of what a high-quality transition plan standard could look like and to consider mechanisms to ensure transition plans have appropriate ambition. This is published alongside this Progress Report.⁸²

CCC assessment. Here we summarise our own assessment of what a high-quality transition plan standard could include, based on our review of existing frameworks.

Observations:

- **Limited transparency.** The lack of a defined structure in corporate emissions reduction plans often results in inadequate disclosure and limited opportunities for comparing transition plans. There is an overemphasis on cherry-picking metrics to show progress in the last year rather than developing longer-term targets and strategies for implementation.
- **Opportunities.** A Net Zero transition plan standard is an opportunity to (1) ensure investors can make informed decisions, (2) help companies to develop ambitious but realistic pathways, and (3) monitor corporate alignment with national pathways.
- **Risks.** There is a risk that Net Zero transition plans (1) focus purely on emissions reduction rather than the wider contribution of the business to the transition through innovation and influence, (2) fail to consider a fair workforce transition or adaptation, (3) are not sufficiently open, transparent, comparable or comprehensive, and (4) are resource intensive and fail to differentiate between proactive actions and changes that regulations would have forced to happen anyway.

Key components of a Net Zero transition plan standard:

- **Quantitative long-term emissions targets.** Targets aligned with UK Net Zero pathway.
- **Measurable implementation plan.** A detailed and realistic implementation plan to achieve long-term targets, including for capital expenditure.
- **Key Performance Indicators (KPIs).** Measurable KPIs for the short- and medium-term. Where possible, including metrics which are comparable (e.g. performance against sector benchmarks, success in meeting implementation targets, or degree of alignment with the UK Green Taxonomy).
- **Link to UK Net Zero pathway.** An outline of how the firm's plans relate to the UK Net Zero Strategy pathway, with distinction between actions required by regulations and actions which are additional.
- **Holistic strategy.** A structure to enable businesses to outline a full business strategy for their place in the UK transition to Net Zero, including at a minimum a decarbonisation plan. Other elements could include climate-related risks and adaptation, low-carbon products and services, innovation, supply chain engagement, and policy influence.

Governance and monitoring:

- **Regular monitoring.** Publication of annual updates on the KPIs, along with any changes to the implementation plan or targets, integrated with annual reporting.
- **Verification.** Requirement to publish methodologies for emissions and targets. Proportionate verification expectations for emissions data, ratcheting up over time.
- **Learning and improving.** Scope for iterating and improving both the Net Zero transition plan standard and policies, based on corporate feedback, and for corporates to develop and then improve their transition plans. Communicating the transition plan standard in a way that is clear to those with limited exposure to Net Zero.

Illustrative example. In the table below we set out a summary of some of the key components a transition plan standard could include. This is intended as an illustrative example and not a comprehensive outline. Although the table below summarises components in an overarching transition plan standard, separate standards for real economy companies and financial institutions (such as banks and insurance companies) may be needed.

Source: Authors of transition plan frameworks we reviewed included Ricardo, CA100+, ICAPS, CDP, ACT, TPI, GFANZ, TCFD, CBI, ICAM and IIGCC.

Table 14.4

Illustrative example of what a transition plan standard could include

Section	Sub-section	Details of what the sub-section includes
Targets	Targets	<p>Priority: Clear target to reach Net Zero by 2050 at the latest, covering scopes 1, 2 and, where relevant, scope 3 emissions. Interim short-term (2025) and medium-term (2026 - 2035) targets. Details on methodology used to determine target(s), and how target(s) align with UK Net Zero pathway. The role of offsets, separate to gross emissions reduction targets.</p> <p>Where relevant: Sector intensity target.</p>
Strategy	Implementation strategy	<p>Priority: Clear time-bound actions explaining how greenhouse gas (GHG) reduction targets will be met. Outline of where this aligns, exceeds or fails to meet the UK Net Zero Strategy pathway milestones (e.g. boiler phase out) and priorities for business (e.g. growing heat pump markets). Assessment of trade-offs (e.g. co-benefits, unintended consequences).</p> <p>Where relevant: Role of green revenues and low-carbon products.</p>
	Financial plan	<p>Priority: Commitment to align capital expenditure (capex) with GHG reduction targets. Methodology for aligning expenditure with implementation strategy. Planned investment in capital, new products and R&D. Targets for capex and other financial indicators.</p> <p>Where relevant: Commitments for mergers and acquisitions, responsible retirement plan for high-emitting assets and products, and level of locked-in emissions.</p>
	Scenario analysis	<p>Priority: Task Force on Climate-Related Financial Disclosure (TCFD) reporting.</p>
Tracking Progress	Tracking Progress	<p>Priority: Annual outline of planned actions and annual report on fulfilment of actions, ideally integrated with wider environmental reporting. Key Performance Indicators (KPIs), with rationale for relevance to emissions reduction pathway. These could be company specific or sector specific. Review the transition plan and targets every 5 years and disclose any changes.</p> <p>Where relevant: KPIs could include emissions intensity, energy use and capex or operational expenses (opex).</p>

Governance	Company governance	Priority: Outline how the board ensures oversight, including who holds responsibility for climate change risks and emissions reduction, incentives that are in place (such as executive renumeration or an internal price of carbon) and board competencies.
	Verification	Priority: Methodology for targets and baseline emissions. Potentially: Eventually carbon accounting could become similar to financial accounting, with strong auditing in place. To begin with, credibility of plans could stem from the financial reports and executive renumeration, eventually moving to more resource-intensive verification for high emitters.
Wider impacts	Policy influence	Priority: Current and future engagement with domestic and international policy and advocacy efforts with Government, both direct and collective. Membership of trade bodies and policy on handling trade body policy divergence. Where relevant: What additional help from policy would help with transition planning.
	Supply chain and customer engagement	Where relevant: Share of low-carbon products offered. Strategies on supply chains and patenting.
	Climate resilience	Priority: Transition plan includes disclosures relating to TCFD and the Adaptation Reporting powers under the Climate Change Act. Where relevant: Wider climate resilience priorities.
	Fair workforce transition	Priority: A plan for ensuring a fair transition for employees.

Box 14.11

Summary of key research commissioned in relation to SMEs

The CCC commissioned research to understand the policy and funding landscape, and priorities for strengthening policy for SMEs. The research focussed on a select group of high-emitting low-engagement SMEs: horticulture, restaurants, manufacturing of apparel, electrical, plumbing, and other construction and installation trades. The full report is published alongside this Report and will be discussed in our Business Report.⁸³

Key non-sector specific findings and observations:

- There is no UK Government SME-specific decarbonisation strategy, with policies spread across a range of responsible parties, strategies and frameworks. This has led to significant policy gaps, lack of priority given to SME decarbonisation and disjointed implementation. The response of the devolved administrations (DAs) varies widely, with England typically falling short relative to the DAs.
- Opportunities for emissions reductions for SMEs vary significantly by sector and include making premises more energy efficient, replacing heating with low-emission alternatives (like heat pumps), switching to electric vehicles, replacing inefficient equipment and reducing waste.
- SMEs are time and resource poor; support needs to be consistent, joined-up and simple to access. Their awareness of government targets for energy emissions are mixed and depends on the size of organisation. Key drivers for action are legislation and government targets, high operational costs, and pressure from customers. Many SMEs feel that they have done as much as is within their control and that there are limited options to reduce their emissions.
- Activity at a sub-national level has been delivered through regional development funding, though there has been limited coordination with national policy or sharing of learnings between projects funded through this route. The new UK Shared Prosperity Fund (UKSPF) puts only a limited focus on SME decarbonisation.

Implications for policy priorities across all sectors:

1. **A stronger Government framework for SME decarbonisation:** This should address the common, distinct challenges that apply to SMEs across all sectors. It should include an ongoing awareness campaign to provide information that SMEs trust and alignment of policy with funding, such as under the UKSPF.
2. **More effective coordination and knowledge-sharing between national, regional and local initiatives:** Ensure that policy best practice is shared between regions, particularly in England. Policies should be frequently evaluated, and the results shared widely.
3. **A Low-Carbon Business one-stop shop for SME decarbonisation:** Build on the work of the SME Climate Hub but expand its reach to provide an initial point of contact with a seamless link through to appropriate tailored support based on SMEs' geographic location and industry sector. A carbon foot-printing tool should supplement the support so as many SMEs as possible undertake a foot-printing exercise.
4. **An effective financing strategy to support SME decarbonisation:** Public finance is needed to help SMEs decarbonise with cost acting as a key barrier. The British Business Bank should also play a role in developing the market for SMEs to access private finance.

A strengthened low carbon advisor/auditor role for SMEs: It is vital to strengthen and standardise the role for low carbon auditors, so SMEs are willing to pay for, and act upon, detailed and effective advice. This should include the training and development of a national corps of low carbon advisors for different sectors.

Source: Energy Saving Trust, Purple Market Research, R Blundel & S Hampton (2022) *How can policy better support SMEs in the pathway to Net Zero?*

6. Innovation

Introduction and key messages

Innovation is a fundamental component in the transition to Net Zero, which will require advances in the development and scale-up of new methods, services and technologies.

Innovation is a fundamental component in the transition to Net Zero, which will require advances in the development and scale-up of new methods, services and technologies. While many technologies already exist, innovation is needed on delivery and ensuring sufficient consumer take-up. Policy for funding during the early and middle stages of innovation is particularly important, when there are fewer incentives for private investment.

The Net Zero Strategy recognises the vital role for innovation, and the recent spending review allocated significant funding. Overall progress in this area is promising. In implementing its innovation plans the Government should ensure that projects can be supported through their lifecycle, and that effective processes are in place for knowledge sharing and the progression of successful research through to application.

(a) Policy progress

The importance of innovation is clearly highlighted in the Government's Net Zero Strategy, with a focus on making the UK a global leader in low-carbon technologies and on job creation.

- The importance of innovation is clearly highlighted in the Government's Net Zero Strategy, with a focus on making the UK a global leader in low-carbon technologies and on job creation. There is a welcome commitment to increase innovation funding to £1.5 billion over the next three-year spending review period (up to 2024), from the £1 billion already committed in 2020 through the Net Zero Innovation Portfolio.
- The UK's Net Zero Research & Innovation Framework will be used to prioritise funding for the key areas for innovation and research, which will be assigned on a competitive basis. The framework targets priorities in the next 5-10 years, allowing adjustment of priorities in the longer term as the landscape evolves.
- The priorities are consistent with those implied in our Sixth Carbon Budget advice. They include, but are not limited to, the following high-priority areas:
 - **Electricity supply:** floating offshore wind; small and advanced modular nuclear reactors; system integration and flexibility; bioenergy.
 - **Surface transport:** alternative battery chemistries and making battery cells more easily recyclable; charging technologies; zero-emission HGV technologies.
 - **Buildings:** reducing costs of electric heat-pumps; hydrogen heating; real-world performance of energy efficiency measures; reducing costs through systems engineering (e.g. Whole House Retrofit).
 - **Aviation:** low-emission fuels; zero-emission aircraft and airspace efficiency.
 - **Agriculture and land use:** Land-use planning, sustainable management of forest ecosystems and peatlands; soil health; low-carbon farming practices and the sustainable production of biomass.

- **Carbon capture and storage and engineered removals:** efficiencies in carbon capture technologies; removal technologies; transport and storage of CO₂.
- **Industry and hydrogen:** efficient hydrogen production; industrial resource and energy efficiency.
- In addition to innovation of technologies, the framework supports research and innovation related to business models, regulatory frameworks and socio-economic considerations. This is vital to ensure that new technologies are successfully deployed, and we stress the importance of ensuring this research is appropriately funded going forwards.

Our assessment is that the Government is making sufficient progress towards our 2021 progress report recommendation that innovation funding drives forward an extensive research and innovation package for delivering Net Zero. The six additional sectoral recommendations related to innovation were all scored as achieved, at least in part, underway or making sufficient progress.

(b) Next steps

The Government should develop mechanisms to ensure knowledge is built upon and not lost, in order to speed up innovation, as well as accelerate and learn from implementation.

Our recommendations relating to innovation are available in the accompanying tables in the Annex (grouped by department) and on our website. As well as the sector specific recommendations there is an overarching one that focusses on the need to support innovations through their different stages and on the need to support knowledge sharing.

- Many innovation projects related to the Net Zero transition are long-term in nature, requiring a portfolio of funding to enable projects to move through all the necessary stages of development. Since funding rounds have a limited timeframe there is a risk that a project may be finished prematurely, and the acquired knowledge may be lost. The Government, together with UKRI including Innovate UK, should review whether the current funding portfolio allows sufficient time for projects to complete and should consider allowing for continuation funding where necessary.
- It is vitally important that innovation research results are disseminated and that there is transparency in the methodologies used, which should adhere to high standards. The Government, together with UKRI including Innovate UK, should ensure a coherent approach to innovation, following these principles:
 - Knowledge should be built upon and not lost.
 - Results should be built on good evidence.
 - The expertise in UK universities should be utilised in a coordinated way.
 - Whole-system interdependencies in the application of knowledge should be properly evaluated.
 - Public support and trust in the process should be built through transparency.

While important, innovation must not be treated as a panacea. Sufficient solutions are already available that, with further development and complemented by societal action, can achieve the necessary reductions in greenhouse gas emissions and resilience against climate change.

Innovation can bring about important benefits in, for example, reduction of cost and environmental impact, increases in the efficiency of technology and provision of optionality. However, expected development of new technologies should not be relied upon to avoid societal action or social innovation. Entirely new technologies typically take decades from first proposal to commercial viability.⁸⁴

For new technologies, policy must support the full innovation chain, not just research and development. Demonstration and learning-by-doing during deployment are also crucial, as seen for offshore wind over the past decade. Policies must remove barriers to uptake and overcome initial inertia in developing new markets.

7. Infrastructure

Introduction and key messages

A strengthened and climate-resilient infrastructure system will be a key part of reaching Net Zero. Emissions reduction and adaptation must be considered together when planning for Net Zero, so that upgrades to existing and development of new infrastructure are resilient to expected future changes in the climate, especially in the energy, water and transport sectors.

Infrastructure is largely integrated through the sectoral chapters of this report, which cover, for example, roll-out of renewables in the power sector, improving the energy efficiency of buildings, and development of a charging infrastructure for electric vehicles. In this chapter we pick out some of the cross-cutting infrastructure policies such as the National Infrastructure Bank, and plans for key low-carbon networks, such as CCS.

(a) Policy progress

The Government has not introduced legislation to ensure that new infrastructure is compliant with Net Zero, but it has made some progress on plans for Carbon Capture and Storage, and it has launched the UK Investment Bank.

Last year, we recommended that the UK Government should amend the upcoming Planning Bill to ensure that developments and infrastructure are compliant with Net Zero. The Government has not done this, having scrapped the Planning Bill. Planning reforms will now be part of the new Levelling Up and Regeneration Bill.

Planning is largely devolved to the four nations of the UK, and Scotland has been consulting on its draft fourth National Planning Framework, on which we wrote a letter giving our feedback.⁸⁵

The Government has made some progress in developing plans for Carbon Capture and Storage (CCS), in line with its ambition to establish CCS in at least four industrial clusters by 2030:

- In October 2021, BEIS announced that the HyNet and East Coast clusters had been selected as 'Track 1' clusters under Phase 1 of the Cluster Sequencing Process (with NECCUS Scotland as reserve).
- For 'Track 2' clusters, the Government aims to conclude negotiations with projects in time for final investment decisions to be made from 2024 and for them to be operational from 2027.⁸⁶ However, a more detailed timeline is currently lacking. The CCS Association has flagged the risk of this uncertainty, and has recommended that BEIS confirms detailed timings, eligibility and allocation for the Track 2 sequencing process in 2022, to ensure continued investor confidence in clusters outside of Track 1.⁸⁷
- While there is some increased clarity for clusters (at least those chosen under Track 1), there has been no update in the past year on a strategy for dispersed sites.

BEIS also published an update on its planned business model for CO₂ transport and storage (the Transport & Storage Regulatory Investment (TRI) business model) in January 2022.⁸⁸ BEIS aims to publish a further update by Q3 2022, and to finalise the TRI model before the end of 2022, although the longer-term timeline is unclear.

As discussed in Chapter 7, in August 2021 the Government published the UK Hydrogen strategy. There is limited detail on the delivery of hydrogen infrastructure and networks required for low-carbon hydrogen production and distribution at scale in the UK, although there is a commitment to continue to explore how best to deliver the necessary distribution and storage infrastructure.

The UK Infrastructure Bank (UKIB) was launched in June 2021 as a new government-owned policy bank, focused on increasing infrastructure investment where there is an under-supply of private finance, to help address climate change and support regional economic growth. The UKIB will have £12 billion for lending and investment and £10 billion of government guarantees. A consultation on investment priorities closed in February 2022. The proposed outline had a focus on key Net Zero infrastructure priorities, although it has no mention of adaptation.

- Full utilisation of new low carbon sources of energy will be impossible without sufficient, timely development of network capacity and innovation in system operation. As part of the Energy Security Strategy (ESS) the Government announced the creation of a new Future System Operator (FSO) to take a strategic cross-cutting approach to network infrastructure and system operability, plus a range of steps for working with network owners to develop electricity networks in line with increasing future demand (see Chapter 6 on electricity).
- The FSO should be given a clear mandate to work with asset owners to ensure sufficient resilience of electricity supply, given changes to the technologies used to generate power and increasing societal exposure (through the Net Zero transition and through digitisation) to cascading infrastructure failures due to the impacts of extreme weather on electricity generation.

We also note that in its 2022 progress review the National Infrastructure Commission raised concerns over the slow progress improving the energy efficiency of UK homes and installing low-carbon heating.⁸⁹ It also described the roll-out of electric vehicle charging points as being ‘too slow’. We cover these vital infrastructure challenges in our sectoral chapters on buildings and surface transport.

(b) Indicators

We have not developed a comprehensive set of indicators for low-carbon infrastructure, although some sector-specific ones are included within the sectoral chapters. For now, we include key areas of progress in the last year:

The North Sea Transition Authority has awarded six CO₂ storage licences on the UK Continental Shelf that could store up to 23 Mtpa of carbon dioxide by 2038.

- **CO₂ storage licences:**
 - In order to deploy CCS, which is expected from 2025, the necessary transport and storage infrastructure must first be licenced and built.
 - The North Sea Transition Authority has now awarded six CO₂ storage licences on the UK Continental Shelf, which could store up to 23 Mtpa of CO₂ by 2038. The latest of which were awarded to BP and Equinor in May 2022 and are off the coast of the Humber side.
 - The UK's first ever CO₂ storage licensing round has just been announced⁹⁰ which should allow for more licenses to be awarded.

The licenced CO₂ storage sites are in the North Sea and the Irish Sea.

Figure 14.13 UK licenced offshore CO₂ storage



Source: North Sea Transition Authority (NSTA) Open Data Site – Licence Data.⁹¹

Notes: Pink areas represent licensed CO₂ storage sites.

(c) Next steps

We recommend that the UKIB takes steps to ensure that it tackles climate change effectively, and that the Government makes effective plans to support future CCS and hydrogen infrastructure.

We recommend that the first plan of the UKIB, due in summer 2022, gives consideration for how to navigate the dual goals of the organisation (to tackle climate change and support economic growth), introduces a Net Zero test on all investments, and outlines how to capture wider social and resilience benefits of investments beyond financial returns.

In our tables of recommendations (in the annex and on our website), we make several recommendations regarding the development of transport and storage infrastructure and networks for CCS and hydrogen, including finalising the Transport and Storage Regulatory Investment (TRI) business model; and planning for hydrogen and CCS infrastructure outside of industrial clusters.

8. Trade, carbon leakage and reducing consumption emissions

Introduction and key messages

Reducing global emissions associated with UK consumption (i.e. consumption emissions), not just UK's territorial emissions, is an important part of the UK's contribution to global climate action.

To ensure that policy designed to reduce territorial emissions does not increase consumption emissions, it must be designed to avoid causing carbon leakage – the situation that may occur if, for reasons of costs related to climate policies, businesses were to transfer production to other countries with less stringent emissions constraints.

Trade policy offers a key option for both avoiding carbon leakage and making further contributions to reducing our consumption emissions.

Trade policy offers a key option for both (a) avoiding carbon leakage and (b) making further contributions to reducing consumption emissions by, for example, reducing deforestation or providing a leadership signal to the international community.

This section covers these three issues of trade, carbon leakage and reducing consumption emissions, which are interlinked by their interactions with imported emissions.

Our key messages for this year are:

We will set out an indicator pathway for consumption emissions in the coming year, against which we will seek to track progress in future.

- **Tracking consumption emissions.** We intend to set out an indicator pathway for consumption emissions in the coming year, against which we will seek to track progress in future.
- **Consumption emissions reporting.** The Government should increase investment in, and improve the collection and reporting of, consumption emissions data. This should include (a) establishing a short- and medium-term strategy to improve the underlying methodology to ensure it can capture key improvements in the carbon-intensity of imports, and (b) ensuring the resource to enable annual emissions statistics to be produced promptly each year.
- **Longer-term carbon leakage policy progress.** The Government has made some small steps towards developing its longer-term approach to managing carbon leakage risk. It has co-established an international programme to standardise how the embodied emissions of steel and cement are measured and reported, and has announced it will consult on product standards and a Carbon Border Adjustment Mechanism (CBAM). However, the UK has not undertaken any clear actions to foster international consensus around trade policies to address carbon leakage.
- **Short-term carbon leakage policy progress.** The UK's two main ongoing schemes for managing carbon leakage – compensation for indirect emissions costs and free allocation of ETS allowances – have been extended and had extensions proposed, respectively.

- **Wider consumption emissions policy progress.** The Government's Net Zero Strategy puts less weight on demand-side and consumption policy than our Balanced Pathway, so it uses less of the potential to reduce consumption emissions through these actions. The Government's programme to help developing countries decarbonise is more positive and will help reduce UK consumption emissions.

The Government should consult on plans to implement, CBAMs and mandatory minimum climate-related standards on some imports by 2030.

The Government should develop the option of applying minimum environmental standards to imports of selected agricultural products.

- **Trade in manufactured and energy products.** The Government should consult on plans to implement, by 2030 or earlier, CBAMs and mandatory minimum climate-related standards on imports of selected manufactured and energy products.
- **Trade in agricultural products and forest-risk commodities.** The Government should develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application by businesses (i.e. due diligence) or at the border. It should also implement its proposed policy on due diligence of forest-risk commodities and develop a further policy to remove unsustainable legal deforestation from UK supply chains that avoids the risk of 'shuffling' unsustainable products to other countries, rather than actually reducing their production.

The rest of this section sets out further detail on progress in the areas of trade, carbon leakage and reducing consumption emissions, and the next steps required.

(a) Indicators

We have not yet produced a full framework of indicators for trade, carbon leakage and reducing consumption emissions.

At present, our key indicator in this area is UK consumption emissions, for which the latest data are presented in Chapter 2, split by sector, and below in Figure 14.14 split by origin. We intend to set out an indicator pathway for consumption emissions in the coming year, against which we will seek to track progress in future. In developing this pathway, we will consider which emissions scope is most appropriate for tracking.

- Figure 14.14 shows that 43% of the UK's consumption emissions are associated with imported goods and services.
- Recent context changes will affect UK consumption emissions – the UK's trade patterns have been changing due to the end of the transition period for exiting the European Union and have been disrupted due to the COVID-19 pandemic, which has also changed UK consumption patterns. The effects of these changes will not be apparent until the UK's 2020 consumption emissions accounts are published in 2023. Increased trade with high-carbon producers could lead to increased overseas supply-chain emissions.

We already track some indicators relevant to this area. These relate to resource and energy efficiency and reduced consumption across the sectors. Progress in these areas is set out in the sectoral chapters of this report. Action in these areas contributes to reducing consumption emissions.

Our Monitoring Framework sets out more detail on how we plan to track progress on trade, carbon leakage and consumption emissions in future. We will consider tracking imported emissions, the emissions-intensity of imports, products imported, the source of imports, relative carbon costs and climate actions in trade deals.

The Government should increase investment in, and improve the collection and reporting of, consumption emissions data.

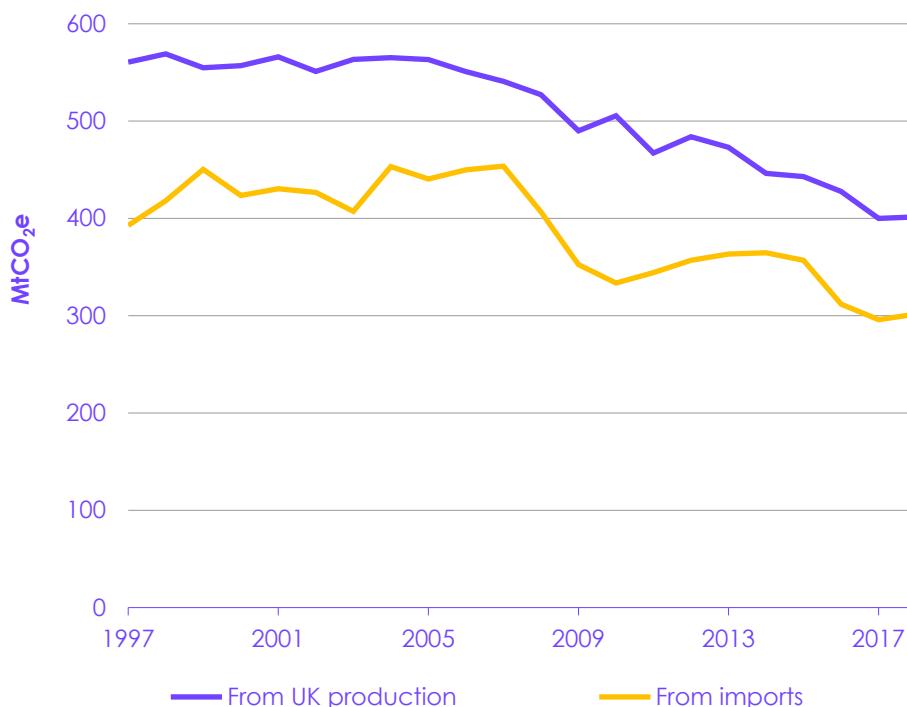
The Government should improve data collection and standardise methodologies for monitoring of, and reporting on, international land use emissions that arise from UK consumption, particularly from deforestation.

43% of the UK's consumption emissions are associated with imported goods and services.

To improve the UK's capacity to track progress on consumption emissions, the Government should increase investment in, and improve the collection and reporting of, consumption emissions data. This should include (a) establishing a short- and medium-term strategy to improve the underlying methodology to ensure it can capture key improvements in the carbon-intensity of imports (b) ensuring the resource to enable annual emissions statistics to be produced promptly each year (this year there will be a 30-month lag between the end of the 2019 emissions year, and data publication). Without further improvements, there is a risk that consumption emissions statistics will not capture reductions in the UK's carbon footprint, because of the methodological approach.

Furthermore, annual consumption emissions statistics do not account for international deforestation emissions (nor wider land use emissions) that arise from UK consumption. We recommend that the Government improves data collection and standardises methodologies for monitoring of, and reporting on, international land use emissions that arise from UK consumption, particularly from deforestation. The Government should aim to report on these international emissions from deforestation on an annual basis from 2023. This may build on the experimental statistic of the Joint Nature Conservation Committee.⁹²

Figure 14.14 UK consumption emissions, split by origin 1997-2018



Source: Defra (2021) UK's Carbon Footprint 1997-2018; CCC analysis.

(b) Policy progress

The past year has seen some modest progress on carbon leakage policy and on wider policies that could support the reduction of imported emissions. Of the three 2021 CCC recommendations made under this theme, our priority recommendation has been partly achieved, one is underway, and the other has seen sufficient progress.

Carbon leakage policy

This year, the Government has made some small steps towards developing its longer-term approach to managing carbon leakage risk, while taking steps to ensure it maintains its short-term approach.

The Government has undertaken three actions that are likely to help the development of Carbon Border Adjustment Mechanisms and mandatory minimum product standards.

Product standards and Carbon Border Adjustment Mechanisms

With regards to longer-term carbon leakage policy, the Government has undertaken three actions that are likely to help the development of the options of a Carbon Border Adjustment Mechanisms (CBAM) and mandatory minimum product standards:

- The UK and India-led Industrial Deep Decarbonisation Initiative (IDDI), which is coordinated by the UN Industrial Development Organisation, is establishing an international programme to standardise how the embodied carbon of steel and cement (only) are measured and reported.⁹³
- BEIS have completed a call for evidence on the development of industrial product standards, which considers both voluntary and mandatory options for both labelling and minimum emissions standards.⁹⁴
- The Government has announced its intention to consult later in the year on a range of carbon leakage mitigation options, including on whether measures such as product standards and a CBAM could be appropriate tools in the UK's policy mix.⁹⁵

However, the UK has not undertaken any clear actions to foster international consensus around trade policies to address carbon leakage. As such, we assess that the Government has partly achieved our 2021 recommendation in this area.

The Government has provided some very modest clarity over its medium-long-term plans for carbon leakage policy in areas where carbon leakage policy is currently applied.

More generally, the Government has provided some very modest clarity over its longer-term plans for carbon leakage policy in areas where carbon leakage policy is currently applied:

- The Government's Free Allocation Review states that "after the first phase of the UK ETS", which runs to 2030, Government "will look to other potential options for mitigating carbon leakage risk".⁹⁶ The document then sets out a CBAM and Mandatory Product Standards as options. It notes that "if Government chooses to pursue a mandatory standards regime, and potential legal and trade barriers can be overcome, mandatory standards could be introduced in some sectors over the course of the mid to late 2020s".
- The BEIS call for evidence on industrial product standards reaffirmed the Government position that demand-side policies (labelling and or product standards) will be introduced in the future.
- While the review and call for evidence explicitly cover industrial products, there has been no explicit mention of a longer-term strategy to manage potential carbon leakage from decarbonisation of agricultural products. It is not clear whether oil, gas and power are covered by these documents. However, the Net Zero Review did set out the factors that suggest carbon leakage may be a future risk to the agricultural sector and energy sectors.⁹⁷

The EU plans to introduce a CBAM in 2026, with a transition period from 2023-25.

Internationally, the EU plans to introduce a CBAM in two phases, with final joint approval by the EU Council, European Parliament and European Commission timetabled for later this year. The two-phase plan is for the CBAM adjustment to be introduced in 2026, with a transition period from 2023-25, where only reporting of imported good's emissions-intensity will be required. Germany, in its Presidency of the G7, is seeking to develop a climate club, which is not yet well defined but could become a basis for plurilateral cooperation on carbon leakage beyond just the EU.⁹⁸

- The Energy Intensive Industries (EII) Compensation Scheme was extended for a further three years to March 2025.⁹⁹ This scheme provides compensation to firms at risk of carbon leakage, for the indirect emission cost in electricity prices due to the UK ETS and carbon price support mechanism. The percentage of indirect emissions for which the scheme provides compensation was also increased.¹⁰⁰ The Government has also stated that it is considering increasing the renewable obligation exemption to 100%.¹⁰¹
- The Government consulted on plans to extend the allocation of free UK ETS allowances to broadly continue the current approach until the end of 2025.¹⁰² The consultation also indicated the intention to continue allocating free allowances until 2030, but with a revised allocation methodology from 2026. The Government will consult on this methodology no later than the end of 2023. Indicative proposals suggest the new methodology could reduce participant's free allowances,* or the number of sectors receiving them. The proposal also commits to develop this methodology to ensure it appropriately mitigates carbon leakage risk.

Other policy on imported emissions

Beyond action on policies to manage carbon leakage, there has been some progress on the wider set of policy options that reduce imported emissions. Actions include policies on wider trade levers, consumption, international leadership on mitigation and international development support.

The greatest climate impact of new UK trade deals may be the impact on trade flows and subsequently UK production and consumption emissions.

Other imported-emissions-related trade policy

Three new free-trade agreements have been signed in the past year, with Australia, New Zealand and Singapore.¹⁰³ Last year we recommended that DIT use these to encourage increased ambition on both climate change mitigation and adaptation in other countries. The most notable climate action within these trade agreements has been for the partners to reaffirm their commitment to all the aims of the Paris Agreement, although it is not clear whether these clauses will have any substantial effect on climate change action. A greater impact of the trade agreements may be the impact on trade flows and subsequently UK production and consumption emissions. The impact of this year's trade deals is modest for current UK emissions, but the relative contribution may increase as the UK decarbonises.

- The Government's impact assessment of the UK-Australia trade deal estimates that overall greenhouse gas emissions associated with UK-based production will be largely unchanged from the agreement, but that transport-related emissions would increase by around 0.1-0.3 MtCO₂e/year due to increased trade flows.¹⁰⁴

* If the cross-sectoral correction factor kicks in, which it may not if spare allowances help increase the future industry cap, or if sectoral scope is changed.

- The Government's scoping assessment for a potential UK-India trade deal estimates that overall greenhouse gas emissions associated with UK-based production could increase by around 0.08-0.14% (0.4-0.7 MtCO₂e/year) depending on the depth of a UK-India free trade agreement, and that increase transport related emissions could increase by up to 0.8-1.4 MtCO₂ each year.¹⁰⁵

Outside of the development of free-trade agreements, the UK and US are seeking to work together to reduce the carbon-intensity of the steel and aluminium industries, by addressing this simultaneously with the issue of excess capacity from 'non-market' (subsidised) sources.¹⁰⁶ In practice, this appears to focus on removing tariffs on UK and US sources and keeping tariffs on 'non-market' sources, which also tend to have higher carbon-intensity.¹⁰⁷

The Government has made several commitments relating to imports of commodities that can cause deforestation.

In addition to these bilateral actions, the Government has made several commitments relating to imports of commodities that can cause deforestation.

- The Government has established powers through the Environment Act 2021 for the Government to set an obligation on large businesses to ensure that 'forest-risk commodities'* must have been produced in accordance with local laws, and that businesses must undertake due diligence steps to ensure this.
- The UK also co-launched the Forest, Agriculture, Commodity Trade Dialogue at COP26 and signed up to the G7 2030 Nature Compact, which both establish plurilateral support for reducing deforestation.
- In a Biomass Policy Statement, the Government reiterated its commitment to using only sustainable biomass, derived from either domestic or international sources.

Consumption policy

The Government's Net Zero Strategy puts less weight on demand-side and consumption policy than our Balanced Pathway which means it uses less of the potential to reduce consumption emissions through this lever.

The Government has taken some actions on demand-side policies that would reduce imported emissions, including on public procurement, demand reduction and efficiency policies, and encouraging voluntary company and consumer action through labelling and advice. Detail of these actions are outlined in our sectoral chapters, as they are also important levers for reducing territorial emissions.

Overall, the Government's Net Zero Strategy puts less weight on demand-side and consumption policy than our Balanced Pathway, which means it uses less of the potential to reduce consumption emissions through this lever.

- To encourage less consumption, several energy and resource efficiency/productivity policies and ambitions have been updated across the Agriculture, Manufacturing and Construction, Waste and Buildings sectors (see relevant chapters). The Government has less ambition of reducing demand for aviation.
- In planning to shift consumption to lower-carbon manufactured products by consumers and the private and public sectors (see Manufacturing chapter for detail), BEIS have completed a call for evidence to work towards implementing product emissions-intensity labelling. The Industrial Deep Decarbonisation Initiative plans to drive public procurement of green steel and cement.

* Defined as commodities that can cause wide-scale deforestation.

- While the Net Zero Strategy did not address dietary shifts to low-carbon alternatives, there is evidence that consumer trends are moving in that direction (see Agriculture chapter).
- Furthermore, there has been policy progress across several sectors in supporting switching from fossil fuel use to low-carbon energy sources, which will in most cases put downwards pressure on the UK's imported emissions associated with the production of oil, gas and coal.

UK international leadership on mitigation and international development support is helping to reduce embedded carbon in UK imports and so helps to reduce UK consumption emissions.

UK trade policy has focussed on increasing trade in 'environmental goods and services'.

It is important that UK efforts to decarbonise domestic emissions do not lead to carbon leakage, or damage other environmental objectives and that the UK considers its wider consumption footprint.

To manage carbon leakage and consumption emissions, we assess that the most effective policy packages will require policies that apply to imports, from 2030 or earlier.

International leadership on mitigation and international development support

The UK Presidency of the COP26 negotiations helped to deliver increased global ambition to reduce emissions and multi-lateral pledges on key sectors which, as part of their wider impact, will help to reduce UK consumption emissions (see Chapter 1 'The Global Picture'). The UK also directs support through several programmes to help developing countries decarbonise.^{108,109} This reduces embedded carbon in UK imports and so helps to reduce UK consumption emissions.

Trade policy on low-operational-emissions goods

Beyond trade policy that targets or affects imported emissions, some trade policy is focused on increasing trade in 'environmental goods and services', such as wind turbines. As part of the UK Global Tariff, it has removed tariffs on 100 goods that benefit the environment or conserve energy and natural resources.¹¹⁰

(c) Next steps

It is important that UK efforts to decarbonise domestic emissions do not lead to carbon leakage, or damage other environmental objectives and that the UK considers its wider consumption footprint. This applies across manufactured and energy products and agricultural and forestry products. To ensure this, the UK will need to take further steps on trade policy and wider policy to reduce consumption emissions.

Trade policy

To manage carbon leakage and consumption emissions, we assess that the most effective policy packages will require policies that apply to imports, from 2030 or earlier. For sectors at risk of carbon leakage that are covered by the UK ETS, this is most likely to involve carbon border adjustments as the primary mechanism. For other sectors, this is most likely to involve the application of mandatory minimum product standards, either applied at the border or via due diligence.

To deliver these policies it will be important to allow a substantial lead-time, both because this will be practically required, but also to maximise benefits to the UK. This requires initiation of some processes now, particularly those requiring international engagement.

- A substantial lead-time will be required for engagement with international partners to develop plurilateral cooperation and for engagement with trading partners.
- The UK will benefit from initiating involvement in talks on emissions-related import policy, by having a greater opportunity to influence international discussions, which are now already progressing.

- The development and international agreement of measurement standards will similarly take a substantial amount of time.
- UK policy development, including complicated design decisions add further need for a lead-time.
- Early signalling will help to maximise the effect of leading emissions reductions in other countries, benefitting UK consumption emissions.

Without initiating those aspects now, we would expect an increased risk of delay in the implementation of these policies and ultimately delay in domestic decarbonisation. It would also increase the risk of carbon leakage.

To reduce these risks and allow a sufficient lead-time for policy development, we recommend that the Government take the next steps towards implementing import policy, which differs by product and by sector, as follows.

The Government should consult on plans to implement, by 2030 or earlier, CBAMs and mandatory minimum climate-related standards on imports of selected manufactured and energy products.

- The Government should consult on plans to implement, by 2030 or earlier, CBAMs and mandatory minimum climate-related standards on imports of selected manufactured and energy products, with the respective policies applying to different products, or potentially for some products both policies applying. It should:
 - Work with a plurilateral grouping of countries to coordinate development of this mix of policies.
 - Extend the UK's international work on development of environmental measurement standards to a wider range of sectors.
 - Complete internal work to identify the preferred approach and timeline in each subsector.
 - Engage with trading partners and developing countries early in the process.

The Government should develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application via due diligence or at the border.

- The Government should develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application via due diligence or at the border. The first step towards this should be to improve data collection and standardise methodologies on the environmental impacts of food across different countries.
- It should also implement its proposed policy on due diligence of forest-risk commodities and develop a further policy to remove unsustainable legal deforestation from UK supply chains that avoids the risk of resource shuffling.

We would expect these policies to also help prompt more international climate action, beyond the UK's consumption footprint, as it will help to drive the pace of transitions.

There are also further 'softer' trade options for driving international climate change action, such as including requirements for countries to reaffirm their commitments under the Paris Agreement as part of trade deals with the UK. The Government should continue to use these 'softer' trade levers to encourage increased ambition on both climate change mitigation and adaptation in other countries.

Wider policy to reduce consumption emissions

The Government should outline the UK's future ambitions on reducing consumption emissions.

Beyond trade policy, the Government should outline the UK's future ambitions on reducing consumption emissions. Important aspects of this will include its international leadership and development and consumption policy.

Chapter 1 sets out our recommendations on wider international leadership and development including that the UK should continue to lead by example domestically in implementing Net Zero and that UK Government must ambitiously and transparently lead by example across all Glasgow Climate Pact commitments and COP26 Pledges.

On consumption policy, we set out a series of recommendations across our sectoral chapters and the business section above. These include recommendations on walking and cycling; reducing car travel; recycling and material efficiency; agricultural productivity; food waste reduction; low-carbon diets; energy advice services; domestic, commercial and industrial energy efficiency support; and incentivising alternatives to flying.

In particular, the Government should consider how it works with international businesses to set incentives for them to work with their supply chains.

Box 14.12

Trade policies and emissions reduction: establishing and assessing options

The CCC commissioned the UK Trade Policy Observatory at the University of Sussex to review trade policy options, with a particular focus on CBAMs and mandatory minimum product standards. The project set out a taxonomy of trade policy options, the current landscape, an assessment of the key design decisions for CBAMs and product standards and practical steps required for implementing these policies.

In its assessment of design options, the project highlighted that it is difficult to design measures that are simultaneously environmentally ambitious, technically feasible to implement and address concerns about fairness and equity, both domestically and for UK trade partners. Some trade-offs between these objectives are likely to be necessary. The assessments highlighted several key messages:

- **Product or sector scope:** The more limited the scope of sectoral coverage, the more feasible to implement. However, restricting CBAMs to direct emissions for a few trade-exposed primary commodities risks failing to address carbon leakage. Phased introduction can allow for a learning process through which firms adjust.
- **Developing countries:** Providing support for developing countries is in keeping with the spirit of the Paris Agreement's principle of Common but Differentiated Responsibilities and Respective Capacities. Such support can take place through administering regulation differently, for example forgiving Least Developed Countries (LDCs) CBAM fees and/or phasing in requirements more slowly. It can also take place through directing CBAM revenues or other climate finance to LDCs and providing training in the implementation of requirements.
- **Climate clubs:** Participation in nascent climate clubs can prevent new trade barriers with climate allies. But climate clubs that impose tariffs on non-participating countries risk World Trade Organisation (WTO) non-compliance. A key challenge is establishing equivalence between implicit (regulatory) and explicit carbon pricing. Participating countries can reduce the risk of non-compliance by basing membership on the requirement that participants have equivalent policy, and ensuring that membership criteria are clear, transparent, and open to all countries.
- **Applicability to exports:** UK export competitiveness is a critical challenge for introducing CBAMs. If exporters receive rebates, this can undermine the perception that CBAMs support climate objectives. A phased approach to export rebates based on emissions-intensity can satisfy environment, WTO non-discrimination and industry objectives, but will increase technical complexity.
- **Free allowances:** The UK currently provides trade-exposed industries with free allowances to prevent carbon leakage. Phasing out free allowances upon introduction of a CBAM will contribute greatly to WTO-compliance.

In setting out steps required to implement CBAMs or product standards, it highlighted:

- **Domestic steps:** Coordination across a wide range of Departments is required, as well as industry consultation to inform the timing/structure of CBAMs or product standards.
- **International steps:** The UK should actively participate in discussions about developing methodologies for assessing embodied emissions. The UK must also inform trade partners, in particular the EU and developing country partners, of plans to introduce CBAM or product standards in advance of their introduction.

Finally, it noted that CBAMs or standards are only one part of supporting global decarbonisation. A comprehensive approach includes actively supporting low-carbon innovation and supply chains, including through green investment and climate finance, cooperation on the development of standards, and technology transfer.

Source: UK Trade Policy Observatory and Vital Economics (2022) *Trade policies and emissions reduction: establishing and assessing options*.

Box 14.13

Results of Ricardo Agriculture and Land Use project

Ricardo carried out a study for the CCC to assess the policy options that could be used to a) reduce the risk of carbon leakage in the agriculture and land use sector and b) address UK demand for imported products of deforestation. Key findings include:

Agriculture and land use sector

- **Detailed, transparent and evidence-based methodologies** are key for ensuring that measures affecting the price or content of imports are compliant with WTO rules. There will also be a requirement that imports and UK production are held to similar standards or face similar carbon prices if trade-based measures are introduced.
- **Data collection can pose significant issues** in agri-food commodities. Accurately measuring emissions from individual farms is difficult given the impact of factors such as land type, farming practices and animal responses to climate and feedstocks on realised emission levels. This increases the complexity of applying policies that involve carbon pricing or minimum standards to many agricultural commodities.
- **Use of CBAMs should be limited to fertilisers and fertiliser ingredients** given feasibility issues in applying a carbon price to other agricultural commodities.
- **Multiple objective measures** (that consider other environmental factors alongside GHG emissions) are valuable in addressing concerns around the sustainability of agricultural imports. Examples include minimum standards (with or without due diligence), tariff reductions and sustainable import guarantees.

UK demand for imported products of deforestation

- **Policies should be expanded to consider aspects of legal deforestation as well as illegal deforestation** to address the UK's overall deforestation footprint.
- **Public procurement measures** that require food used by public bodies to be sustainably produced and deforestation-free has high potential impact, as the public sector serves around 1.9 billion meals per year.

Cross-cutting

- **Consumer engagement** on the sustainability or deforestation risk associated with agricultural products or forest commodities is a good complement for supply-focused policies.
- **International engagement and development spending** can help ensure that trade-based policies are smoothly implemented and that countries facing capacity issues are supported in implementing sustainable agriculture, land use and forestry practices.
- **Resource shuffling.** There is a risk that UK import policy intended to reduce the global production of higher emission or lower integrity products, may instead only redirect higher-emission or lower-integrity exported products toward other countries with less stringent regulation or fewer measures. This potential policy failure is referred to as resource shuffling. The risk of resource shuffling can be mitigated through international coordination on policies, particularly between consumer countries with large shares of the global market.

Source: Ricardo Energy and Environment (2022) *Trade policies and emissions reduction: Establishing and Assessing Options – Agriculture and Land Use*.

9. Adaptation

Introduction and key messages

Continued changes in UK climate over the coming decades are inevitable.

These climate changes will create risks across society and need proactive adaptation actions to minimise impacts on people and ecosystems.

Without considering adaptation the achievement of Net Zero will be at risk.

Further climate change in the UK over the coming decades is inevitable, even with rapid reductions in UK greenhouse gas emissions. Global (and UK) temperature will keep on rising until global CO₂ emissions reach Net Zero and sea levels around the UK coast will continue to rise even after global temperature has been stabilised. The extent of the further changes in the global and UK climate beyond the next few decades depends on the success of global emissions reduction efforts – with more rapid reductions in global emissions leading to a significantly lower range of possible global and UK temperature in the second half of the century (Figure 14.15).

These expected changes in the UK climate will lead to risks across all areas of the UK's economy, society and environment. These were documented extensively in the Committee's 2021 **Independent Assessment of UK Climate Risk**, with many risks expected to be felt most acutely by vulnerable people across the country.

Adaptation action must be undertaken today to prepare for these impacts and is essential alongside (but not in place of) efforts to reach Net Zero.

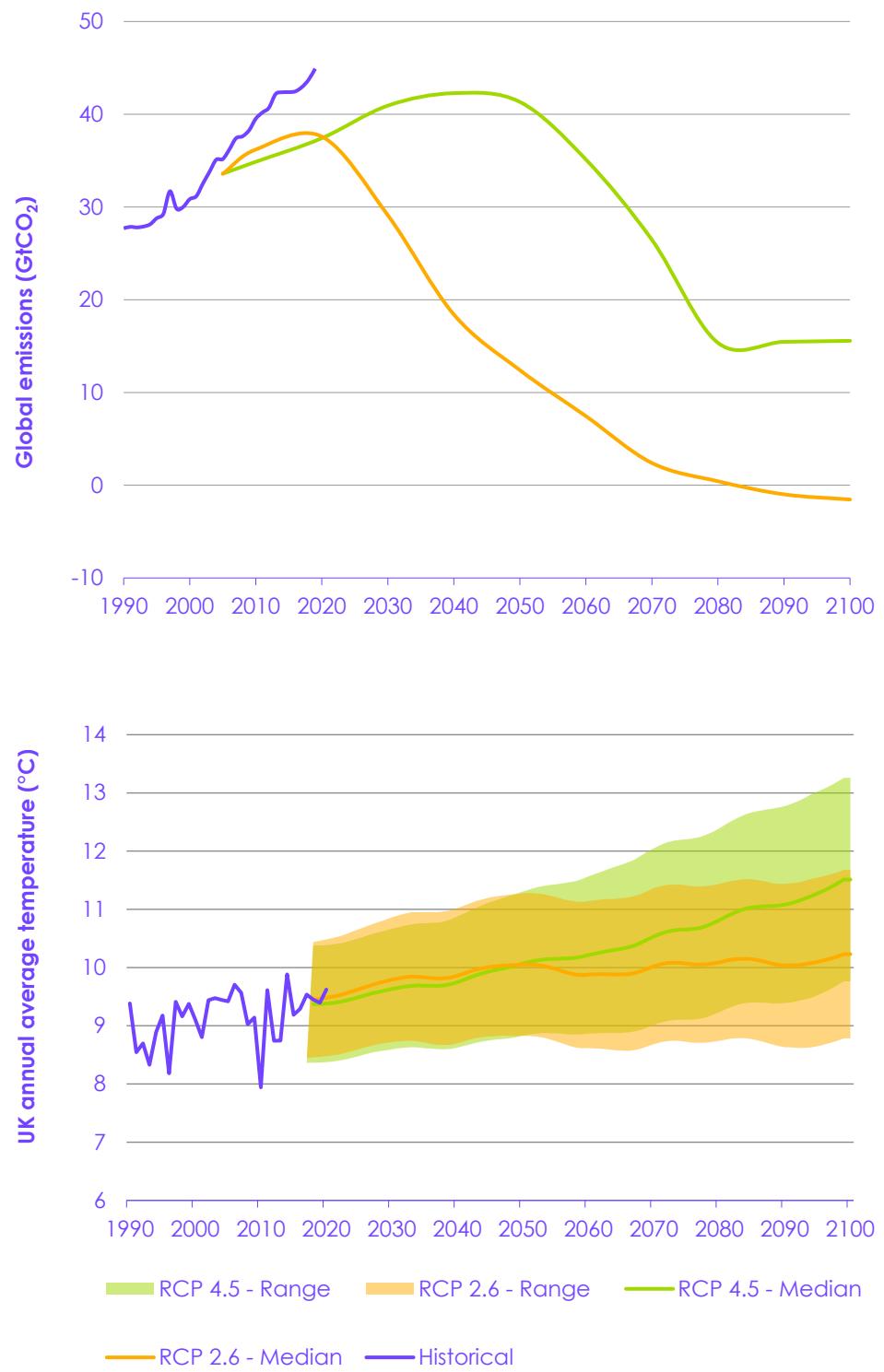
Without proactive and well-planned adaptation, many of the climate risks facing the UK will put efforts to rapidly reduce emissions over the next decade, and to Net Zero by 2050, at risk. In other areas, implementing actions to reduce emissions without considering the future UK climate could risk working against needed adaptation actions.

- **Increasing long-term carbon storage in UK land:** There are risks and opportunities from climate change for the ability of land to contribute to Net Zero. Peatlands are critical for both carbon storage and environment services such as water regulation. If peatlands are not in good condition, they are at higher risk of degradation and carbon loss as the UK's climate changes, as well as failing to deliver their other benefits. Peatland restoration therefore benefits both climate resilience and carbon storage. Tree and hedgerow planting and catchment-sensitive farming can have benefits for increasing climate resilience (e.g. flood prevention) and biodiversity, as well as carbon sequestration. However, careful planning about species mix, location and management is necessary to ensure such benefits are maintained over the long-term despite a changing climate. Policy therefore needs to be designed with future climate risks to the natural carbon stores fully incorporated to ensure that carbon sequestered into UK land is maintained permanently.
- **Maintaining a resilient power system:** Access to reliable and plentiful electricity is essential to the functioning of the UK's economy and society. Far-reaching changes in the supply, use and management of electricity are required to reach Net Zero. The growing dependence of other systems on electricity and the move towards an energy system more dominated by variable renewables highlights the importance of considering changing climate hazards as part of diligent planning of this Net Zero electricity system – with the consequences of failure more acutely felt by the more vulnerable in society. Much of the UK's Net Zero electricity system is yet to be built and must be designed to be resilient to the weather and climate conditions expected in the future to maintain security of supply.

This large investment into new assets for the electricity system presents an opportunity to simultaneously reduce emissions and ensure that the system is sufficiently resilient to future climate conditions.

- **Decarbonisation of the UK's building stock:** Action to reduce emissions from buildings, in particular improvements to fabric efficiency, can also make them more resilient to future changes in climate (e.g. more frequent and intense heatwaves) if designed and implemented well. Buildings should be warm in the winter, and cool in summer. Without consideration of future climate when undertaking retrofit programmes, emissions reduction measures such as increasing the energy efficiency of homes may inadvertently increase the risk of overheating in buildings and worsen indoor air quality. The Government's plans for reducing emissions from buildings do not yet adequately include adapting to future overheating to minimise the risk of unintended consequences for adaptation efforts.

Figure 14.15 UK average temperature under future global emissions scenarios



Source: Friedlingstein, P. et al. (2022) Global Carbon Budget 2021. *Earth Syst. Sci. Data*, 14, 1917–2005; UKCP18 projections; RCP database.

Notes: Global CO₂ emissions (top) are taken from the marker scenarios for two RCP scenarios. RCP 2.6 is indicative of keeping global temperature rise below 2° by 2100. RCP 4.5 is indicative of current global policies. The bottom panel shows observed UK annual average temperature projected under the RCP scenarios from the UKCP18 probabilistic projections. Ranges show 5–95 percentiles of the projections.

(a) Policy progress

In 2021 the Committee published an in-depth assessment of adaptation progress in the UK.

The assessment found large gaps in preparing the UK for a changing climate.

The CCC is required to provide a detailed assessment of progress in preparing the UK for climate change every other year through the Climate Change Act. The most recent detailed assessment was published by the Committee in 2021.

The conclusions of this assessment were:

- UK adaptation policy has to-date not produced the necessary resilience to fully address the risks that a changing climate poses to the UK across the economy.
- The gap between future levels of risk and planned adaptation has widened in the last 5 years.
- Planning for a global warming level of 2°C and considering a 4°C warmer world is not happening.
- No adaptation priority area achieved the highest risk management score, although some were scored as having good consideration of adaptation in planning.

In the 2021 progress report we made a set of 82 recommendations for actions over the last year that would help progress adaptation ambition and delivery prior to the publication of the next National Adaptation Programme (NAP3) in 2023. Of these, 42 recommendations related to adaptation specifically, while 40 combined adaptation and mitigation.*

The vast majority of recommendations from the 2021 assessment have not yet been fully implemented.

Our scoring of these recommendations in this report indicates that only 5 of the cross-cutting recommendations were achieved and none of the adaptation specific recommendations have been implemented in full despite some areas of progress.

- **Areas with no progress.** There are many recommendations for strengthened action ahead of NAP3 that have not been acted on. These include those related to risk areas which the Committee highlighted as priorities for action prior to the next NAP. For example, there has been no update to the peatland restoration target outlined in the England Peat strategy, which is needed to ensure resilience of these carbon-rich environment, and adaptation has not been sufficiently included within key strategies and planning for the electricity system such as the Energy Security Strategy. Many recommendations to take account of flood risk have also not been acted on.

* There were seven international and cross-cutting recommendations. There were eight recommendations relating to the natural environment. There were eleven recommendations relating to health and buildings. There were four recommendations relating to infrastructure. There were six recommendations relating to business and finance. There were twelve recommendations relating to the need to outline appropriate actions in the upcoming National Adaptation Programme. While some departments are making progress towards these aims, we are not yet able to assess fully whether these recommendations have been met.

- **Areas with some progress or progress underway.** In many cases, recommendations have been partially met or are currently underway. For example, Defra have launched a public engagement programme ahead of NAP3 as recommended, and draft statutory outcome-based targets for the Environment Act have been proposed, including a target on reducing non-household water demand. These ongoing actions need to be completed to fully meet our recommendations.
- **Significant progress.** There are also some examples of policy progress in addressing climate risks. Overheating risks were mentioned as an objective within the Heat and Buildings Strategy and new requirements on overheating risk have been added to the Buildings Regulations for new residential buildings. Overheating in existing homes remains a key policy gap, however. There has also been important progress in financing for adaptation. The Government's Green Financing Framework identifies climate change adaptation as one of the eligible green expenditures for proceeds through the issuance of green gilts and the retail Green Savings Bonds. Good progress is also being made to develop further ways to embed Net Zero and climate risk in financial decisions by UK firms.

There has been important progress in addressing risks from overheating in new buildings and green finance.

Closing these significant adaptation gaps in the next National Adaptation Programme in 2023 is vital.

This assessment indicates that there is a substantial gap in adaptation action that will need to be closed by the next NAP, which is currently in preparation. It is vital that this NAP is more ambitious, more comprehensive, and better focussed on implementation than its predecessors in order to improve national resilience to climate change. The NAP also needs to include actions to address risks to the UK from climate change occurring overseas. Beyond the NAP, adaptation urgently needs to be integrated into a range of key policies – including delivery of Net Zero.

The Committee will provide a further detailed assessment of UK adaptation progress in 2023.

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Annex: Recommendations

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CCC's departmental recommendations set out the steps required by each Government department, devolved administration and key regulators to stay on track to meeting the UK's climate targets. This year, we present over 300 recommendations, spanning across all sectors and reflecting the scale of the Net Zero challenge. In our following progress report to Parliament (June 2023), we will assess Government progress against these recommendations.

These recommendations, while specific, are not intended to be prescriptive. We recognise that there can be more than one route to achieving the targets.

For completeness, our recommendations cover both reducing emissions and adapting to climate change, though mitigation is the focus of this report. The CCC also produces a progress report on adaptation every two years.

The recommendations are organised by department. For each recommendation, we have identified the department with **primary responsibility** who we expect to take the lead. Given the cross-cutting nature of this challenge, many recommendations require collaboration between multiple departments. In these cases, we highlight the **supporting actors** involved.

In each table, the priority recommendations are grouped at the top. Other recommendations are then organised by sector or theme. Recommendations where the department is a supporting actor are at the end of each table.

We have made our recommendations available in an accessible format on our website.

Priority recommendations

Sector	Topic	Priority recommendations	Timing
Cross-cutting	Governance	<p>Develop a document setting out Government's vision of how its Net Zero Strategy will be delivered. This should clarify roles and responsibilities across central and local government, devolved administrations, regulatory agencies and the wider public sector, and business, how approaches will be coordinated, and how Net Zero interacts with other Government priorities. This document will need to be flexible and some aspects will be uncertain, so it should be updated annually.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10</p>	2022
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; Scotland; Wales; N. Ireland</p>	2022
Cross-cutting	Governance	<p>Develop and begin to implement contingency plans to address the range of risks to meeting carbon budgets. These should broaden the set of emissions reductions pursued, in particular by including demand-side policies, and avoid increasing reliance on engineered removals.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Cross-cutting; Manufacturing & construction; Buildings	Electrification	<p>As part of reforms to electricity pricing, remove legacy policy costs associated with the historical deployment of less mature low-carbon electricity generation from electricity prices. These legacy costs create a market distortion.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Electricity supply	Overall strategy	<p>Publish a comprehensive long-term strategy for achieving 95% low-carbon electricity by 2030, on the path to full decarbonisation by 2035. Ensure this sets out how the low-carbon flexibility options required to replace unabated gas by 2035 will be delivered, and identifies contingencies for addressing key risks (e.g. nuclear, hydrogen, carbon capture and storage).</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Electricity supply	Electricity market design	<p>Through the Review of Electricity Market Arrangements, develop a strategy as soon as possible on market design for the medium- to long-term for a fully decarbonised, resilient electricity system in the 2030s and onwards.</p> <p>Primary responsibility: BEIS</p>	2023
Electricity supply	Networks	<p>Publish a strategy to coordinate the development of interconnectors and connections for offshore wind farms to the onshore network, taking prompt action to ensure efficient implementation of the detailed regulatory and legislative changes necessary for their timely delivery.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022

Sector	Topic	Priority recommendations	Timing
Electricity supply	Networks	<p>Publish a strategic framework identifying the network requirements for Net Zero, and the changes needed to ensure investments in resilient infrastructure are identified, planned, consented and built in sufficient time to accommodate increased demand and generation.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022
Manufacturing & construction; Fuel supply; Electricity supply	Trade and consumption emissions	<p>The Government should consult on plans to implement, by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy.</p> <p>Primary responsibility: HMT Supporting actors: BEIS; DIT; Defra</p>	2022
Buildings	Public engagement	<p>Create a public energy advice service to provide households with guidance on decarbonising and adapting their homes to climate change by this summer, as committed in the Energy Security Strategy. This should include an online platform including high-level trusted information and advice (including on Government schemes), a link to local providers who can undertake assessments of home energy performance, and bespoke support for households wishing to undertake more complex retrofits.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Low-carbon heat	<p>Launch the delayed Fairness and Affordability Call for Evidence and follow on by implementing plans for energy price reform which remove market distortions (i.e. that historical policy costs are primarily placed on electricity prices) and consider the role of carbon pricing. Plans should ensure that heat pumps will be cheaper to run than gas boilers.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022
Buildings	Low-carbon heat	<p>Publish a final policy plan for the market-based approach to low-carbon heat. This must include a clear explanation of how the obligation on manufacturers or energy suppliers will work, whether enabling legislation is required, and a timeline for implementation. It should also include details on how the Government will track whether the policy is driving the required market growth, and identify trigger points for further intervention (e.g. funding, regulation) if progress falls behind.</p> <p>Primary responsibility: BEIS</p>	2022
Buildings	Energy efficiency	<p>Develop and publish new policies (with a clear implementation timeline) to ensure that owner-occupied homes reach a minimum energy performance of EPC C by 2035, through incentives or regulation. This should be stronger than the current proposed voluntary minimum requirement for mortgage lenders to improve the efficiency of the homes they lend to, and could include a policy requiring EPC C from 2028 at the point of sale and/or a mandatory minimum requirement for mortgage lenders.</p> <p>Primary responsibility: BEIS</p>	H1 2023

Sector	Topic	Priority recommendations	Timing
Buildings	Public buildings	<p>Increase the multi-year funding commitments for decarbonisation in public buildings up until 2025 to match the Government's ambition for public sector decarbonisation and commit to continuing similar levels of funding beyond 2025.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	H1 2023
Manufacturing & construction	Data	<p>Review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting to enable effective monitoring and evaluation, and policy implementation. This will require additional data collection and reporting to allow for effective tracking of energy efficiency, material efficiency, fuel switching, CCS, including progress developing these measures, and more holistic measurement on a product or whole life cycle carbon basis. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; ONS</p>	Q1 2023
Manufacturing & construction	Electrification	<p>Consult on a funding mechanism(s) to support the additional operational and capital costs of electrification in manufacturing. Support for electrification may be combined with reforms to electricity pricing. In combination, these should incentivise early deployment of new electrification. The mechanism should aim to allow hydrogen and electrification to compete on a level playing field in the medium term.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Manufacturing & construction	Fuel switching	<p>Create a clear incentive for manufacturing facilities not currently covered by the UK ETS to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include changing the Climate Change Levy rates for electricity and gas.</p> <p>Primary responsibility: HMT</p>	Q1 2023
Manufacturing & construction; Waste	Resource efficiency	<p>Publish the Government's ambition for annual abatement from resource efficiency, by year, up to 2030, and clarify or set out the policies to deliver the ambition up until at least 2027.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2022
Fuel supply	Fossil fuel supply	<p>Clarify plans and responsibilities for electrification of oil and gas infrastructure through integration with the offshore wind planning process and/or onshore grid, so that by 2027 new oil and gas platforms can achieve zero emissions from operational energy use.</p> <p>Primary responsibility: BEIS</p>	Q3 2023
Fuel supply	Fossil fuel supply	<p>Develop minimum emissions-intensity standards for domestic oil and gas production by the next licensing round. In development, seek to ensure a consistent measurement approach with emerging international measurement standards.</p> <p>Primary responsibility: BEIS</p>	Q1 2023

Sector	Topic	Priority recommendations	Timing
Fuel supply	Hydrogen	<p>Establish funding mechanisms to support the development of 10 GW of low-carbon hydrogen production by 2030, ensuring these are designed to limit residual and upstream emissions, but also reflect hydrogen costs in a way that does not bias towards hydrogen where electrification is competitive.</p> <p>Primary responsibility: BEIS</p>	2023
International	UK NDC	<p>Update the technical annex (the Information to facilitate Clarity, Transparency and Understanding) of the enhanced 2030 NDC the UK resubmits in 2022 for COP27 to expand on the role of the Net Zero Strategy in meeting the 2030 target. If there is a policy gap to 2030, Government should bring forward more policy and address how the gap will be closed in the enhanced 2030 NDC. The enhanced 2030 NDC should also explain the UK's approach to the Just Transition, public engagement and participation, governance and reporting.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO</p>	2022
International	UK pledges and commitments, Funding	<p>In line with the Glasgow Climate Pact commitment to phase out inefficient fossil fuel subsidies, undertake a review of the role of tax policy in delivering Net Zero, building on the recent Net Zero Review to develop a systematic assessment of taxation and carbon pricing across the economy and addressing distortions from post-tax subsidies that stem from a disproportionately low carbon price.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2023
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals. Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO; DIT; HMT; Defra; DfT</p>	2022
Surface transport	Car demand	<p>Embed sustainable transport within the upcoming planning reforms in the upcoming Levelling Up and Regeneration Bill. This should recognise the role that place-shaping, active travel, public transport, and shared mobility can combine to play in reducing car dependence and realising a range of co-benefits. These factors should be required to be considered from the outset of all development planning.</p> <p>Primary responsibility: DLUHC Supporting actors: DfT</p>	2022
Surface transport	Conventional vehicle efficiency	<p>Introduce regulations to sit alongside the ZEV mandate to ensure that efficiencies of new conventional vehicles continue to improve and manufacturers reverse the trend towards larger vehicles. These need to be suitably ambitious to deliver the efficiency improvements and share of hybrid sales that are required to realise the necessary emissions reductions from these segments of the market.</p> <p>Primary responsibility: DfT</p>	Q1 2023

Sector	Topic	Priority recommendations	Timing
Surface transport	Electric cars and vans	<p>Confirm the details of the ZEV mandate in regulation. As set out in the consultation, this should impose targets on manufacturers that are at least as ambitious as those in the Transport Decarbonisation Plan and should drive consistent growth in sales of EV cars and vans through the 2020s to meet the 2030 phase-out date.</p> <p>Primary responsibility: DfT</p>	Q1 2023
Agriculture & land use	Agriculture and land use strategy	<p>Set out a Net Zero delivery strategy for the agriculture and land use sectors that brings together how land can deliver its multiple functions including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, domestic biomass production and wider environmental goals. The strategy must clearly outline the relationships and interactions between the multiple action plans in development (e.g. including those for peat, trees, nature, plant biosecurity and biomass), be spatially and temporally targeted, and aligned with action in the devolved administrations.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Trees and woodland	<p>Ensure that funding and incentives are set at the correct level to meet the UK Government afforestation target of 30,000 hectares per year by 2025, and illustrative Net Zero Strategy targets of 40,000 hectares and 50,000 hectares by 2030 and 2035 respectively. Further clarity is required regarding funding beyond 2025. This should also address wider objectives for land such as climate adaptation and nature conservation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Aviation	Sustainable aviation fuel	<p>Implement the Sustainable Aviation Fuel Mandate as soon as possible this year with a strong set of criteria for the fuels included in the mandate.</p> <p>Primary responsibility: DfT</p>	2022
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: BEIS; Wales; Scotland; N. Ireland</p>	2023
Shipping	Demand; Low-carbon fuel	<p>Take a leadership role in pushing for inclusion of a Net Zero 2050 target within the 2023 update of the International Maritime Organisation's initial greenhouse gas strategy.</p> <p>Primary responsibility: DfT Supporting actors: CO & Number 10</p>	2023
Engineered removals	Funding	<p>Publish a proposal on the business model for deployment of large-scale (>1 MtCO₂/year) engineered removals.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in the Third Climate Change Risk Assessment.</p> <p>Primary responsibility: Defra</p>	2023

Sector	Topic	Priority recommendations	Timing
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should report how departments have addressed the top eight priority risks set out in the Third Climate Change Risk Assessment Advice Report for urgent action between 2021 and 2023.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the Third Climate Change Risk Assessment Technical Report for the period 2023-2028.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the Third Climate Change Risk Assessment Advice Report.</p> <p>Primary responsibility: Defra</p>	2023

Recommendations for Number 10 and Cabinet Office

Sector	Topic	Recommendations for Number 10 and Cabinet Office	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: CO & Number 10</p>	Ongoing
Cross-cutting	Governance	<p>Ensure that all policies, funding, and delivery mechanisms are properly aligned to the pace of transition required and work together constructively towards Net Zero, for example through introduction of a Net Zero Test.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: BEIS; HMT; Scotland; Wales; N. Ireland</p>	Q1 2023
Cross-cutting	Governance	<p>Extend the delivery of climate skills training across the Civil Service and wider public sector. Consider what wider supporting skills (delivery, coordination, legal, financial) will be needed in the public sector to enable effective delivery of the transition to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: BEIS; Scotland; Wales; N. Ireland</p>	Ongoing
Cross-cutting	Governance	<p>Produce guidance on how departments are expected to reflect Net Zero when updating their Outcome Delivery Plans.</p> <p>Primary responsibility: CO & Number 10</p>	Q1 2023
Cross-cutting	Governance	<p>Review how effective existing mechanisms for coordinating delivery with the devolved administrations (including the Inter-Ministerial Group, the Nations Board, and departmental-level engagement) have been at securing input to the design of and buy-in to implementation of recent major strategies relating to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Buildings	Public buildings	<p>To meet ambitious Government targets and show leadership in public sector buildings decarbonisation ensure public sector organisations, including those not captured by the Greening Government Commitments, have the information and support they need to: monitor their energy use, set targets and reduce emissions from their estate over the next five years. Establish proportionate mechanisms which could be put in place to review overall progress and recurring challenges.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: BEIS; Defra</p>	2023
Cross-cutting	Adaptation	<p>Cabinet Office should ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority Third Climate Change Risk Assessment risk for which it has lead responsibility, coordinating work with other relevant departments as necessary: Multiple risks to the UK from climate change impacts overseas.</p> <p>Primary responsibility: CO & Number 10</p>	2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), Cabinet Office should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: CO & Number 10</p>	2023

Sector	Topic	Recommendations for Number 10 and Cabinet Office	Timing
Cross-cutting	Adaptation	<p>Cabinet Office should build a strong climate resilience capability for the UK, including making use of storyline or ‘what-if’ scenarios to assess risks, in addition to or instead of using ‘reasonable worst-case’ approaches. It should develop an early warning system for global climate shocks.</p> <p>Primary responsibility: CO & Number 10</p>	2023
Cross-cutting	Adaptation	<p>Cabinet Office should consider how more allowance and flexibility can be built into policy making and policy implementation. This could include enhancing the ability of the Government to make fast decisions by bringing in technical advice and expertise quickly when needed, and both protecting, and enhancing, monitoring and surveillance systems to enable faster reactions as events unfold.</p> <p>Primary responsibility: CO & Number 10</p>	2023
Cross-cutting	Governance	<p>Develop a document setting out Government's vision of how its Net Zero Strategy will be delivered. This should clarify roles and responsibilities across central and local government, devolved administrations, regulatory agencies and the wider public sector, and business, how approaches will be coordinated, and how Net Zero interacts with other Government priorities. This document will need to be flexible and some aspects will be uncertain, so it should be updated annually.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10</p>	2022 Priority
Shipping	Demand; Low-carbon fuel	<p>Take a leadership role in pushing for inclusion of a Net Zero 2050 target within the 2023 update of the International Maritime Organisation's initial greenhouse gas strategy.</p> <p>Primary responsibility: DfT Supporting actors: CO & Number 10</p>	2023 Priority
International; Cross-cutting	Strategy	<p>Set out the Government's approach to domestically achieving aims of priority sectoral COP26 Pledges before COP27.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10; Defra; DfT; COP Unit; FCDO; DIT</p>	2022
International	Strategy	<p>Develop a UK negotiating position for COP27 that strives to secure integrity, transparency and accountability of the international climate system, promote high ambition on mitigation and adaptation and provide support and equitable outcomes for developing countries. Communicate the core principles of this position and align with negotiating blocs that share these values.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10; COP Unit</p>	2022
Shipping	Low-carbon fuel	<p>Report on progress in identifying green shipping corridors and the actions to implement them, as agreed within the Clydebank Declaration. This should be published ahead of COP28.</p> <p>Primary responsibility: DfT Supporting actors: CO & Number 10</p>	2023

Recommendations for the COP Unit, FCDO and DIT

Sector	Topic	Recommendations for the COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)	Timing
International; Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: COP Unit; FCDO; DIT</p>	Ongoing
International	Climate finance	<p>Use the remaining COP Presidency and the UK's diplomatic capability to ensure progress is made on developed country climate finance commitments including the delivery of the \$100 billion by 2023 at the latest and the doubling of adaptation finance on 2019 levels by 2025.</p> <p>Primary responsibility: COP Unit; FCDO Supporting actors: BEIS</p>	2022
International	Climate finance	<p>Continue to deliver a broadly 50/50 split between adaptation and mitigation spend under UK International Climate Finance, looking for opportunities that advance both outcomes.</p> <p>Primary responsibility: FCDO Supporting actors: BEIS</p>	Ongoing
Manufacturing & construction; Fuel supply; Electricity supply; Agriculture & land use	Trade and consumption emissions	<p>DIT should enable BEIS, HMT and Defra to meet our recommended next steps on import policies including carbon border adjustment mechanisms, minimum standards and due diligence across manufactured products, energy, agricultural and forestry products.</p> <p>Primary responsibility: DIT</p>	Q1 2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), FCDO should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: FCDO</p>	2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), DIT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: DIT</p>	2023
International	UK NDC	<p>Update the technical annex (the Information to facilitate Clarity, Transparency and Understanding) of the enhanced 2030 NDC the UK resubmits in 2022 for COP27 to expand on the role of the Net Zero Strategy in meeting the 2030 target. If there is a policy gap to 2030, Government should bring forward more policy and address how the gap will be closed in the enhanced 2030 NDC. The enhanced 2030 NDC should also explain the UK's approach to the Just Transition, public engagement and participation, governance and reporting.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO</p>	2022 Priority

Sector	Topic	Recommendations for the COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)	Timing
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals.</p> <p>Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO; DIT; HMT; Defra; DfT</p>	2022 Priority
Manufacturing & construction; Fuel supply; Electricity supply	Trade and consumption emissions	<p>The Government should consult on plans to implement, by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy.</p> <p>Primary responsibility: HMT Supporting actors: DIT; BEIS; Defra</p>	2022 Priority
International; Cross-cutting	Strategy	<p>Set out the Government's approach to domestically achieving aims of priority sectoral COP26 Pledges before COP27.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO; DIT; CO & Number 10; Defra; DfT</p>	2022
Agriculture & land use	Trade and consumption emissions	<p>Develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application via due diligence or at the border.</p> <p>Primary responsibility: Defra Supporting actors: COP Unit; FCDO; DIT</p>	Q1 2023
Agriculture & land use	Trade and consumption emissions	<p>Implement Government's proposed policy on due diligence of forest-risk commodities and develop a further policy to remove unsustainable legal deforestation from UK supply chains that avoids the risk of resource shuffling.</p> <p>Primary responsibility: Defra Supporting actors: COP Unit; FCDO; DIT; BEIS</p>	Q1 2023
International	Strategy	<p>Develop a UK negotiating position for COP27 that strives to secure integrity, transparency and accountability of the international climate system, promote high ambition on mitigation and adaptation and provide support and equitable outcomes for developing countries. Communicate the core principles of this position and align with negotiating blocs that share these values.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; CO & Number 10</p>	2022
International	Climate finance	<p>Follow up on commitment to restore UK Official Development Assistance to 0.7% of Gross National Income once the underlying debt to GDP ratio will be falling and the UK will not be borrowing to finance day-to-day spending, now expected by the OBR in 2023/24.</p> <p>Do not introduce additional conditions relating to macroeconomic and fiscal uncertainty</p> <p>Primary responsibility: HMT Supporting actors: COP Unit; FCDO</p>	2022

Sector	Topic	Recommendations for the COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)	Timing
Cross-cutting	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the Third UK Climate Change Risk Assessment for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary: Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT).</p> <p>Primary responsibility: BEIS Supporting actors: DIT; Defra</p>	2023

Recommendations for HMT

Sector	Topic	Recommendations for HM Treasury (HMT)	Timing
Cross-cutting; Manufacturing & construction; Buildings	Electrification	<p>As part of reforms to electricity pricing, remove legacy policy costs associated with the historical deployment of less mature low-carbon electricity generation from electricity prices. These legacy costs create a market distortion.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022 Priority
Buildings	Public buildings	<p>Increase the multi-year funding commitments for decarbonisation in public buildings up until 2025 to match the Government's ambition for public sector decarbonisation and commit to continuing similar levels of funding beyond 2025.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	H1 2023 Priority
International	UK pledges and commitments, Funding	<p>In line with the Glasgow Climate Pact commitment to phase out inefficient fossil fuel subsidies, undertake a review of the role of tax policy in delivering Net Zero, building on the recent Net Zero Review to develop a systematic assessment of taxation and carbon pricing across the economy and addressing distortions from post-tax subsidies that stem from a disproportionately low carbon price.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2023 Priority
Manufacturing & construction	Fuel switching	<p>Create a clear incentive for manufacturing facilities not currently covered by the UK ETS to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include changing the Climate Change Levy rates for electricity and gas.</p> <p>Primary responsibility: HMT</p>	Q1 2023 Priority
Manufacturing & construction; Fuel supply; Electricity supply	Trade and consumption emissions	<p>The Government should consult on plans to implement, by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy.</p> <p>Primary responsibility: HMT Supporting actors: BEIS; DIT; Defra</p>	2022 Priority
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: HMT</p>	Ongoing
Cross-cutting	Business	<p>In the updated Green Finance Strategy expected later this year, include plans for how financial flows can be meaningfully monitored in advance of 2023, setting out key incentives for investors to shift practices, and an overall strategy for how total capital costs of Net Zero will be met by public and private funding sources.</p> <p>Primary responsibility: HMT</p>	2022

Sector	Topic	Recommendations for HM Treasury (HMT)	Timing
Cross-cutting	Business	<p>Do not delay in taking steps to legislate for listed UK companies and financial institutions to publish transition plans from 2023. Publish plans for a clear transition plan standard, based on a transparent consultative process with experts, practitioners and private sector actors, and building on lessons learnt from the Task Force on Climate-Related Financial Disclosures (TCFD). It will be important to ensure the metrics and requirements are sufficiently ambitious, and where possible allow businesses to communicate their holistic contribution to the Net Zero transition, beyond direct emissions reduction</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Cross-cutting	Business	<p>Building on the Voluntary Carbon Markets Initiative (VCMI) consultation in summer 2022, the Government should develop concrete proposals for standardising and regulating the claims corporates can make relating to offsets, for ensuring the quality and additionality of offsets on the market, and for directing carbon offsets to the highest quality and impact projects.</p> <p>Primary responsibility: HMT Supporting actors: BEIS; Defra</p>	H1 2023
Cross-cutting	Business, Infrastructure	<p>In the first plan of the UK Investment Bank, due in summer 2022, give consideration for how to navigate the dual goals of the organisation (to tackle climate change and support economic growth), introduce a Net Zero test on all investments, and outline how to capture wider social and resilience benefits of investments beyond financial returns.</p> <p>Primary responsibility: HMT Supporting actors: UKIB</p>	Q3 2022
Aviation	Demand	<p>Fiscal policy should be used (e.g. taxation, quotas or a frequent flyer levy), alongside improvements in broadband, to embed positive behaviours that have arisen during the pandemic, replacing business travel with videoconferencing and online collaboration. The price of flying should be raised to the point that it acts as an effective signal to consumers that aviation has high emissions costs.</p> <p>Primary responsibility: HMT Supporting actors: DfT</p>	2022
Aviation	Demand	<p>Demand mitigation measures should be used to address price imbalances between aviation and low-emission forms of surface transport (e.g. rail travel). Taxes should send clearer signals to consumers on the high emissions cost of flying (e.g. by reversing the 2021 cut in Air Passenger Duty). Fair funding mechanisms should be used to ensure alternatives are affordable (e.g. invest in low-emission alternatives for journeys where domestic flights are faster/cheaper than surface transport).</p> <p>Primary responsibility: HMT Supporting actors: DfT</p>	2023

Sector	Topic	Recommendations for HM Treasury (HMT)	Timing
Buildings	Funding	<p>Recognising that the transition needs to scale up over this decade and that stable funding provides certainty to households, businesses, and public bodies, strongly and credibly signal that the Boiler Upgrade Scheme, Home Upgrade Grant, Local Authority Delivery Scheme, Social Housing Decarbonisation Fund, Energy Company Obligation and public sector decarbonisation will continue to be fully funded as required beyond the spending review period.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Buildings	Finance	<p>Outline a comprehensive vision to leverage private financing for the retrofit of UK homes and businesses. Plans should be designed to operate in tandem with the other enablers needed to unlock home retrofit at scale, such as better buildings data and public engagement. Financial levers to consider include green stamp duty, green mortgages, energy as a service, property-linked finance, and using the UKIB to de-risk retail investment into home retrofit.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
International	Climate finance	<p>Follow up on commitment to restore UK Official Development Assistance to 0.7% of Gross National Income once the underlying debt to GDP ratio will be falling and the UK will not be borrowing to finance day-to-day spending, now expected by the OBR in 2023/24. Do not introduce additional conditions relating to macroeconomic and fiscal uncertainty</p> <p>Primary responsibility: HMT Supporting actors: COP Unit; FCDO</p>	2022
Surface transport	Car demand	<p>Scope and develop options for future fiscal policy to replace fuel duty, e.g. road pricing.</p> <p>Primary responsibility: HMT</p>	Q1 2023
Surface transport	Electric cars and vans	<p>Develop plans for how targeted subsidies and taxation gradients will be used to support delivery of the ZEV mandate targets. These incentivise consumers to choose electric options and ensure that cost does not become a significant barrier to EV adoption.</p> <p>Primary responsibility: HMT Supporting actors: DfT</p>	Q1 2023
Waste; Manufacturing & construction	Market conditions	<p>Review the impact of the newly introduced plastics tax and consider opportunities to go further, including integrating an escalator on the price of the tax and the recycling threshold to which it applies.</p> <p>Primary responsibility: HMT Supporting actors: Defra</p>	2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: HMT</p>	2023

Sector	Topic	Recommendations for HM Treasury (HMT)	Timing
Buildings	Low-carbon heat	<p>Launch the delayed Fairness and Affordability Call for Evidence and follow on by implementing plans for energy price reform which remove market distortions (i.e. that historical policy costs are primarily placed on electricity prices) and consider the role of carbon pricing. Plans should ensure that heat pumps will be cheaper to run than gas boilers.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022 Priority
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals. Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: HMT; COP Unit; FCDO; DIT; Defra; DfT</p>	2022 Priority
Cross-cutting	Business	<p>Across all sectors, for planned regulations and incentives such as carbon pricing, ensure thorough consultation with the private sector throughout the policy development process. Signals of intent should be given well in advance so that the private sector by default moves in step with the UK transition to Net Zero.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	Ongoing
Cross-cutting	Governance	<p>Ensure that all policies, funding, and delivery mechanisms are properly aligned to the pace of transition required and work together constructively towards Net Zero, for example through introduction of a Net Zero Test.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: HMT; BEIS; Scotland; Wales; N. Ireland</p>	Q1 2023
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum also addresses the question of local government powers, capability/capacity, and funding to identify gaps and barriers that could hinder the ability of local government to deliver the roles and responsibilities for delivery of Net Zero that have been agreed with central government. This should aim to build a better understanding of the current landscape, so that Government will be able to develop an evidence-based plan for how to enable cost-effective delivery of the actions that are required from local government; and share the insights, lessons and next-steps that the Forum has identified with all relevant authorities.</p> <p>Primary responsibility: BEIS Supporting actors: HMT; DLUHC</p>	Q1 2023
Buildings	Public engagement	<p>Use the planned energy advice service and accompanying awareness campaign to drive demand for the Boiler Upgrade Scheme. Increase available funding as required so that everyone who wants a heat pump through the scheme can get one, as set out as an intention in the Energy Security Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	Ongoing

Sector	Topic	Recommendations for HM Treasury (HMT)	Timing
Buildings	Fuel poor homes	<p>In the context of record high energy prices, recognising that action on energy efficiency can help both meet climate targets and bring down energy bills, increase ambition and public funding commitments for decarbonisation in fuel poor homes.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022
Buildings	Building standards and enforcement	<p>Publish plans to address enforcement issues for building standards and minimum EPC requirements, including consideration of additional measures to monitor compliance of qualified installers, approved inspectors and EPC assessors, and providing local areas with sufficient resource to undertake assessments.</p> <p>Primary responsibility: DLUHC Supporting actors: HMT; BEIS</p>	H1 2023
Surface transport	Car demand	<p>Reform the Transport Appraisal Guidance to ensure that it enables practitioners to make decisions that are consistent with the Net Zero pathway. DfT should consider whether a "vision and validate" approach to the future transport system might be more appropriate than a "predict and provide" one in this context.</p> <p>Primary responsibility: DfT Supporting actors: HMT</p>	2022
Surface transport; Electricity supply	Electric vehicle charging infrastructure	<p>Explore ways to reduce the cost of local public charging for drivers who do not access to private off-street parking to make it more comparable to charging at home. This could include reducing VAT on some public charging, requiring residential building owners to install charge points in shared car parks, or offering subsidised charging for local residents.</p> <p>Primary responsibility: DfT Supporting actors: HMT</p>	Q1 2023
Waste	Market conditions	<p>Publish a review of incentives across the waste sector to ensure they are appropriate for achieving dual aims of waste reduction and decarbonisation. This should consider pricing of waste management solutions as well as materials.</p> <p>Primary responsibility: Defra Supporting actors: HMT</p>	2023
Buildings	Adaptation	<p>Ensure there are properly funded and trained staff in local authorities to assess flood risk.</p> <p>Primary responsibility: DLUHC Supporting actors: HMT</p>	2022
Buildings	Adaptation	<p>Make finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022

Recommendations for BEIS

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Cross-cutting	Governance	<p>Develop a document setting out Government's vision of how its Net Zero Strategy will be delivered. This should clarify roles and responsibilities across central and local government, devolved administrations, regulatory agencies and the wider public sector, and business, how approaches will be coordinated, and how Net Zero interacts with other Government priorities. This document will need to be flexible and some aspects will be uncertain, so it should be updated annually.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10</p>	2022 Priority
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; Scotland; Wales; N. Ireland</p>	2022 Priority
Cross-cutting	Governance	<p>Develop and begin to implement contingency plans to address the range of risks to meeting carbon budgets. These should broaden the set of emissions reductions pursued, in particular by including demand-side policies, and avoid increasing reliance on engineered removals.</p> <p>Primary responsibility: BEIS</p>	Q1 2023 Priority
Buildings	Public engagement	<p>Create a public energy advice service to provide households with guidance on decarbonising and adapting their homes to climate change by this summer, as committed in the Energy Security Strategy. This should include an online platform including high-level trusted information and advice (including on Government schemes), a link to local providers who can undertake assessments of home energy performance, and bespoke support for households wishing to undertake more complex retrofits.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022 Priority
Buildings	Low-carbon heat	<p>Launch the delayed Fairness and Affordability Call for Evidence and follow on by implementing plans for energy price reform which remove market distortions (i.e. that historical policy costs are primarily placed on electricity prices) and consider the role of carbon pricing. Plans should ensure that heat pumps will be cheaper to run than gas boilers.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022 Priority
Buildings	Low-carbon heat	<p>Publish a final policy plan for the market-based approach to low-carbon heat. This must include a clear explanation of how the obligation on manufacturers or energy suppliers will work, whether enabling legislation is required, and a timeline for implementation. It should also include details on how the Government will track whether the policy is driving the required market growth, and identify trigger points for further intervention (e.g. funding, regulation) if progress falls behind.</p> <p>Primary responsibility: BEIS</p>	2022 Priority

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Buildings	Energy efficiency	<p>Develop and publish new policies (with a clear implementation timeline) to ensure that owner-occupied homes reach a minimum energy performance of EPC C by 2035, through incentives or regulation. This should be stronger than the current proposed voluntary minimum requirement for mortgage lenders to improve the efficiency of the homes they lend to, and could include a policy requiring EPC C from 2028 at the point of sale and/or a mandatory minimum requirement for mortgage lenders.</p> <p>Primary responsibility: BEIS</p>	H1 2023 Priority
Electricity supply	Overall strategy	<p>Publish a comprehensive long-term strategy for achieving 95% low-carbon electricity by 2030, on the path to full decarbonisation by 2035. Ensure this sets out how the low-carbon flexibility options required to replace unabated gas by 2035 will be delivered, and identifies contingencies for addressing key risks (e.g. nuclear, hydrogen, carbon capture and storage).</p> <p>Primary responsibility: BEIS</p>	Q1 2023 Priority
Electricity supply	Electricity market design	<p>Through the Review of Electricity Market Arrangements, develop a strategy as soon as possible on market design for the medium- to long-term for a fully decarbonised, resilient electricity system in the 2030s and onwards.</p> <p>Primary responsibility: BEIS</p>	2023 Priority
Electricity supply	Networks	<p>Publish a strategic framework identifying the network requirements for Net Zero, and the changes needed to ensure investments in resilient infrastructure are identified, planned, consented and built in sufficient time to accommodate increased demand and generation.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022 Priority
Electricity supply	Networks	<p>Publish a strategy to coordinate the development of interconnectors and connections for offshore wind farms to the onshore network, taking prompt action to ensure efficient implementation of the detailed regulatory and legislative changes necessary for their timely delivery.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022 Priority
Engineered removals	Funding	<p>Publish a proposal on the business model for deployment of large-scale (>1 MtCO₂/year) engineered removals.</p> <p>Primary responsibility: BEIS</p>	Q1 2023 Priority
Fuel supply	Fossil fuel supply	<p>Clarify plans and responsibilities for electrification of oil and gas infrastructure through integration with the offshore wind planning process and/or onshore grid, so that by 2027 new oil and gas platforms can achieve zero emissions from operational energy use.</p> <p>Primary responsibility: BEIS</p>	Q3 2023 Priority
Fuel supply	Fossil fuel supply	<p>Develop minimum emissions-intensity standards for domestic oil and gas production by the next licensing round. In development, seek to ensure a consistent measurement approach with emerging international measurement standards.</p> <p>Primary responsibility: BEIS</p>	Q1 2023 Priority

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Fuel supply	Hydrogen	<p>Establish funding mechanisms to support the development of 10 GW of low-carbon hydrogen production by 2030, ensuring these are designed to limit residual and upstream emissions, but also reflect hydrogen costs in a way that does not bias towards hydrogen where electrification is competitive.</p> <p>Primary responsibility: BEIS</p>	2023 Priority
International	UK NDC	<p>Update the technical annex (the Information to facilitate Clarity, Transparency and Understanding) of the enhanced 2030 NDC the UK resubmits in 2022 for COP27 to expand on the role of the Net Zero Strategy in meeting the 2030 target. If there is a policy gap to 2030, Government should bring forward more policy and address how the gap will be closed in the enhanced 2030 NDC. The enhanced 2030 NDC should also explain the UK's approach to the Just Transition, public engagement and participation, governance and reporting.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO</p>	2022 Priority
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals. Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: COP Unit; FCDO; DIT; HMT; Defra; DfT</p>	2022 Priority
Manufacturing & construction	Data	<p>Review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting to enable effective monitoring and evaluation, and policy implementation. This will require additional data collection and reporting to allow for effective tracking of energy efficiency, material efficiency, fuel switching, CCS, including progress developing these measures, and more holistic measurement on a product or whole life cycle carbon basis. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; ONS</p>	Q1 2023 Priority
Manufacturing & construction	Electrification	<p>Consult on a funding mechanism(s) to support the additional operational and capital costs of electrification in manufacturing. Support for electrification may be combined with reforms to electricity pricing. In combination, these should incentivise early deployment of new electrification. The mechanism should aim to allow hydrogen and electrification to compete on a level playing field in the medium term.</p> <p>Primary responsibility: BEIS</p>	Q1 2023 Priority
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: BEIS</p>	Ongoing

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Cross-cutting	Business	<p>Across all sectors, for planned regulations and incentives such as carbon pricing, ensure thorough consultation with the private sector throughout the policy development process. Signals of intent should be given well in advance so that the private sector by default moves in step with the UK transition to Net Zero.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	Ongoing
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum also addresses the question of local government powers, capability/capacity, and funding to identify gaps and barriers that could hinder the ability of local government to deliver the roles and responsibilities for delivery of Net Zero that have been agreed with central government. This should aim to build a better understanding of the current landscape, so that Government will be able to develop an evidence-based plan for how to enable cost-effective delivery of the actions that are required from local government; and share the insights, lessons and next-steps that the Forum has identified with all relevant authorities.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; HMT</p>	Q1 2023
Cross-cutting	Governance	<p>Develop an agreed, consistent approach to developing local area energy plans. Local authorities should be supported (financially and with appropriate skills and knowledge-sharing) to develop these credible delivery plans, and they should become a condition of receipt of UK Infrastructure Bank and other Net Zero funding.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	Q1 2023
Cross-cutting	Governance	<p>Ensure that public bodies with a role in delivering Net Zero have a clear duty to facilitate this and work together. This should apply, for example, to Ofgem and the new Future System Operator.</p> <p>Primary responsibility: BEIS</p>	2022
Cross-cutting	Governance	<p>Increase transparency around Government's expected pathways to Net Zero. This should involve publishing more details on the assumptions that underpin these pathways and how the abatement set out in the Net Zero Strategy will be achieved by planned policies, setting out the quantified abatement expected to be achieved by each policy.</p> <p>Primary responsibility: BEIS Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Cross-cutting	Governance	<p>Publish the Terms of Reference and membership list for the Local Net Zero Forum. This should include both broad representation from across local government and senior decision-makers from central Government.</p> <p>Primary responsibility: BEIS</p>	2022
Cross-cutting	Innovation	<p>Develop mechanisms to ensure knowledge is built upon and not lost, in order to speed up innovation, as well as accelerate and learn from implementation. This should build on the Net Zero Research & Innovation Framework and lessons learned from the success of vaccines development during the COVID-19 pandemic.</p> <p>Primary responsibility: BEIS</p>	Ongoing

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Cross-cutting	Public engagement	<p>Publish a public engagement strategy that sets out a clear long-term vision of how to engage people and businesses in delivering Net Zero. This should be inclusive and representative of the UK's diverse communities. It should include public communications to inform key audiences about the critical changes required to deliver Net Zero, and to build understanding of the associated timelines, benefits and costs.</p> <p>Primary responsibility: BEIS</p>	2022
Cross-cutting	Public engagement	<p>Embed participatory and deliberative methods in the Net Zero policy-making process, where appropriate, as a means of improving the design of, the acceptability of, and public support for, new policies. Also embed key pillars of behavioural science to develop policies that make green choices easier. BEIS should take responsibility for ensuring these methods are coordinated across departments.</p> <p>Primary responsibility: BEIS</p>	Ongoing
Cross-cutting	Transparency	<p>Publish a quantified breakdown of the emissions savings from policies and measures that make up the savings given in the Net Zero Strategy.</p> <p>Primary responsibility: BEIS</p>	2022
Cross-cutting	Workers and skills	<p>Publish an Action Plan for Net Zero Skills that includes a comprehensive assessment of when, where, and in which sectors there will be skill gaps specific to Net Zero. This should include consideration of particular barriers to labour market entry into occupations needed for the transition and Government plans for action on the skill system to facilitate entry into these occupations.</p> <p>Primary responsibility: BEIS Supporting actors: DfE; DWP; DLUHC; Home Office</p>	2022
Cross-cutting; Surface transport; Buildings; Manufacturing & Construction; Agriculture & land use; Waste	Business	<p>Develop a strategy for engaging with small and medium-sized enterprises (SMEs) on decarbonisation, particularly high-emission, low-engagement businesses. Introduce a package of measures within this, including a one-stop-shop for SMEs to get decarbonisation advice with a carbon foot-printing tool, develop a strengthened low-carbon advisor / auditor role for SMEs and develop an effective financing strategy to support SME decarbonisation.</p> <p>Primary responsibility: BEIS</p>	2023
International; Cross-cutting	Strategy	<p>Set out the Government's approach to domestically achieving aims of priority sectoral COP26 Pledges before COP27.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10; Defra; DfT; COP Unit; FCDO; DIT</p>	2022
Agriculture & land use	Coastal and marine	<p>Produce a roadmap to inclusion of saltmarsh and seagrass in the greenhouse gas inventory, which specifies a suggested level of inclusion (i.e., Tier 1, 2 or 3), the additional data required to facilitate this, and an indicative timescale to inclusion.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Aviation; Shipping; F-Gas	Carbon budgets	<p>Complete legislative changes for inclusion in the Carbon Budgets of NF3 from the Fourth Carbon Budget onwards and international aviation and shipping from the Sixth Carbon Budget onwards.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Buildings	Public engagement	<p>Support the launch of the energy advice service with a widespread publicity campaign, to ensure awareness of the service reaches millions of households across the UK each year, including those who may not yet have thought about retrofitting their homes.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Public engagement	<p>Use the planned energy advice service and accompanying awareness campaign to drive demand for the Boiler Upgrade Scheme. Increase available funding as required so that everyone who wants a heat pump through the scheme can get one, as set out as an intention in the Energy Security Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	Ongoing
Buildings	Public engagement	<p>Monitor and publish data on the reach and effectiveness of the proposed energy advice service, ensuring the information offered to households on required changes to their homes is continuously improved in line with these findings, and results in genuine carbon savings.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	Ongoing
Buildings	Workers and skills	<p>Clearly set out how plans to grow and upskill the workforce will support the Government's pathways for low-carbon heat and energy efficiency and fill the skills gap identified in the Heat and Buildings Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: DfE; DWP; DLUHC; Home Office</p>	2022
Buildings	Low-carbon heat	<p>Publish a response to the consultation on phasing out the installation of fossil fuel heating in homes off the gas grid, alongside the follow-up technical consultation, to ensure any required changes in legislation can be implemented ahead of 2026.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Buildings	Low-carbon heat	<p>Finalise and publish plans to phase out boiler replacements in off-grid non-residential buildings from 2024, and consult on introducing an earlier phase-out date for gas boilers in non-residential buildings.</p> <p>Primary responsibility: BEIS</p>	2022
Buildings	Energy efficiency	<p>Legislate to require privately rented homes in England and Wales to reach EPC C by 2030 (as was promised in autumn 2021).</p> <p>Primary responsibility: BEIS</p>	2022
Buildings	Energy efficiency	<p>Set a long-term regulatory standard for social homes to reach EPC C by 2028 and finalise policy plans and a delivery mechanism.</p> <p>Primary responsibility: BEIS</p>	2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Buildings	Energy efficiency	<p>Publish proposals for a minimum EPC in owner-occupied commercial buildings.</p> <p>Primary responsibility: BEIS</p>	2023
Buildings	Energy efficiency	<p>Implement the performance-based rating scheme to offices and publish timelines for other building types, outlining how timelines correspond to the expected emissions reduction trajectory of commercial buildings in the 2020s.</p> <p>Primary responsibility: BEIS</p>	2022
Buildings	Energy efficiency	<p>Publish findings on SME energy efficiency from the new research mentioned in the Heat and Buildings Strategy, and outline plans to ensure SMEs are able to invest in retrofit and energy efficiency measures.</p> <p>Primary responsibility: BEIS</p>	2022
Buildings	Fuel poor homes	<p>In the context of record high energy prices, recognising that action on energy efficiency can help both meet climate targets and bring down energy bills, increase ambition and public funding commitments for decarbonisation in fuel poor homes.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022
Buildings	Fuel poor homes	<p>Publish plans to improve the targeting of support for fuel poor households to retrofit their homes, including through clear steps and timelines to facilitate data sharing between Government departments.</p> <p>Primary responsibility: BEIS Supporting actors: DWP; HMRC</p>	2023
Buildings	Heat networks	<p>Implement legislation for heat network zoning in England and Wales this parliamentary session and provide Ofgem with powers to regulate heat networks.</p> <p>Primary responsibility: BEIS</p>	H1 2023
Buildings	Heat networks	<p>Publish targets for low-carbon heat networks which explicitly set out their contribution to decarbonising heat, outline plans for converting existing heat networks to low-carbon, and ensure that new heat networks are low-carbon from the start.</p> <p>Primary responsibility: BEIS</p>	H1 2023
Buildings	Progress monitoring and data	<p>Publish a monitoring framework for tracking delivery of the Heat and Buildings Strategy, setting out how key indicators of progress will be tracked and published. Indicators should include forward tracking of supply chain build up in key areas, like heat pumps, heat networks and energy efficiency.</p> <p>Primary responsibility: BEIS</p>	2023
Electricity supply	Supply chains	<p>Identify and address potential key supply chain bottlenecks for delivering up to 50 GW of offshore wind by 2030, including for investment in ports, adequate vessel capacity, manufacturing capability and floating wind. Take opportunities to link supply chain action to key decision points in offshore leasing and Contract for Difference auctions.</p> <p>Primary responsibility: BEIS</p>	2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Engineered removals	MRV	<p>Publish plans for monitoring, reporting and verification systems for engineered removals, noting the recommendations of the 2021 Task & Finish Group report and responses to the consultation on business models.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Engineered removals	Legislation	<p>Take legislative steps to allow for engineered removals to count towards achievement of UK carbon budgets.</p> <p>Primary responsibility: BEIS</p>	2022
Engineered removals	Governance	<p>Clarify which bodies and departments hold responsibility for delivering at-scale deployment of engineered removals and whether any new bodies will be established.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Engineered removals	Governance	<p>Work with the Interministerial Group for Net Zero, Energy and Climate Change to publish a joint position on the contribution of engineered removals and CCS to meeting UK-wide and DA targets to 2030.</p> <p>Primary responsibility: BEIS Supporting actors: Scotland; N. Ireland</p>	2023
F-Gas; Buildings	F-gas technology replacement	<p>Publish targets for the roll-out from now until 2037 of heat pumps that do not use F-gases as a refrigerant and set out how the Government plans to meet these targets.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Fuel supply	Fossil fuel supply	<p>Make data on oil and gas production and emissions-intensity publicly available in a way that is consistent with the UK greenhouse gas inventory and differentiates between new and existing assets.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Fuel supply; Engineered removals	Bioenergy	<p>Continue to take a global lead on further developing and improving UK and international biomass governance and sustainability criteria.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	Ongoing
Fuel supply; Engineered removals	Bioenergy	<p>The Biomass Strategy needs to set out a best use hierarchy for biomass and address the sustainability of the biomass supply required to support the rapid and sustainable deployment of BECCS (for power and biofuels). The Strategy should consider reducing reliance on imports by increasing domestic biomass supply as part of wider land-use changes (including diet change).</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2022
International	UK NDC	<p>Outline governance and accountability structures for tracking progress against the 2030 NDC target and future UK NDCs, noting that the UK NDC is not in scope of the Climate Change Act (2008) and the Carbon Budgets framework and is therefore not directly accountable to Parliament.</p> <p>Primary responsibility: BEIS</p>	2022

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
International	UK NDC	<p>Conduct a comprehensive public engagement and consultation process on the target level and delivery of the NDC for emissions reductions to 2035 submitted in 2025.</p> <p>Primary responsibility: BEIS</p>	2024
International	UK pledges and commitments	<p>Set out plans for reducing domestic methane emissions in line with the collective aims of the Global Methane Pledge (a reduction in UK methane emissions of at least 30% from 2020 levels by 2030) and announce an intention to set a longer-term pathway for these emissions in 2023. These plans for contributing to the Global Methane Pledge should be included in the enhanced 2030 NDC the UK resubmits in 2022 for COP27.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2022
International	UK pledges and commitments	<p>COP26 Sectoral Pledges signed by the UK should be detailed in the enhanced 2030 NDC the UK resubmits in 2022 for COP27 and UK domestic progress against them should be reported in Biennial Transparency Reports to the UNFCCC.</p> <p>Primary responsibility: BEIS</p>	2022
International	Strategy	<p>Develop a UK negotiating position for COP27 that strives to secure integrity, transparency and accountability of the international climate system, promote high ambition on mitigation and adaptation and provide support and equitable outcomes for developing countries. Communicate the core principles of this position and align with negotiating blocs that share these values.</p> <p>Primary responsibility: BEIS Supporting actors: CO & Number 10; COP Unit</p>	2022
Manufacturing & construction	Cross-cutting	<p>Consult on the policy design of demand-side policies (including product standards) for industrial products, following the commitment in the call for evidence: 'Towards a Market for Low Emissions Industrial Products'.</p> <p>Primary responsibility: BEIS</p>	2022
Manufacturing & construction	Energy efficiency	<p>Publish the Government's ambition for annual abatement from manufacturing energy efficiency underpinning its strategy, and finalise the policies to deliver this energy efficiency abatement from 2023-2027, including by delivering final decisions on the future of Climate Change Agreements and Energy Saving Opportunities Scheme (ESOS) and through new policies, such as policy on energy management system adoption or products standards.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Manufacturing & construction	Cross-cutting	<p>Ensure the policy package for decarbonising manufacturing addresses manufacturers' low appetite for investments with long payback times, either using grants or favourable loans. This could be achieved through a clear longer-term role for the Industrial Energy Transformation Fund.</p> <p>Primary responsibility: BEIS</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Manufacturing & construction	Energy efficiency	<p>Resolve the distortive disincentive against electrification of sites within the UK ETS caused by the design of Climate Change Agreement targets.</p> <p>Primary responsibility: BEIS</p>	2022
Manufacturing & construction	Cross-cutting	<p>Commit to targets for ore-based steelmaking and cement production in the UK to reach near-zero emissions by 2035 and 2040, respectively.</p> <p>Primary responsibility: BEIS</p>	2023
Manufacturing & construction	Innovation	<p>Continue to support innovation and demonstration of fuel switching and CCS technologies for end-use in manufacturing and construction, for example through the Net Zero Innovation Portfolio.</p> <p>Primary responsibility: BEIS</p>	Ongoing
Manufacturing & construction	Workers and skills	<p>Design industrial decarbonisation policies to support and create jobs, especially in regions with reliance on industrial jobs.</p> <p>Primary responsibility: BEIS Supporting actors: DWP</p>	Ongoing
Manufacturing & construction; Agriculture & land use	Off-road mobile machinery	<p>Set out a strategy for decarbonisation of off-road mobile machinery to set direction for the private sector. The strategy should include policy proposals, which could include the future of emissions standards, and a proposal for how best local authorities can bring off-road mobile machinery into their regulatory framework for construction within urban areas.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; DfT; Defra</p>	Q1 2023
Manufacturing & construction; Engineered removals	CCS	<p>Finalise the Industrial Carbon Capture (ICC) business model and deliver the first industrial carbon capture contracts to enable final investment decisions on the first ICC projects in H1 2023, consistent with the Government's ambition to deploy carbon capture in at least two clusters by the mid-2020s.</p> <p>Primary responsibility: BEIS</p>	2022
Manufacturing & construction; Engineered removals; Electricity supply	CCS	<p>Finalise and deliver the Transport and Storage Regulatory Investment business model in 2022, consistent with the Government's ambition to establish at least two CCS transport and storage clusters in the mid-2020s. This will require promptly beginning the process of awarding permits and construction of the necessary infrastructure, to ensure that it is ready in time for deployment.</p> <p>Primary responsibility: BEIS</p>	2022
Manufacturing & construction; Engineered removals; Fuel supply; Waste; Electricity supply	CCS	<p>De-risk the future Carbon Capture and Storage project pipeline by launching the next cluster selection process in 2022, consistent with the Government's ambition to enable final investment decisions on Track 2 projects from 2024.</p> <p>Primary responsibility: BEIS</p>	2022

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Manufacturing & construction; Fuel supply	Hydrogen	<p>Finalise the design of the hydrogen business model and Industrial Decarbonisation and Hydrogen Revenue Scheme (IDHRS) in 2022 to deliver funding to the first hydrogen production projects in 2023, ensuring they can be compatible with electrification/other decarbonisation options in the medium term. In addition, ensure that any further barriers to enabling the first hydrogen-use within industry, are removed.</p> <p>Primary responsibility: BEIS</p>	2022
Manufacturing & construction; Fuel supply	Hydrogen	<p>Publish a plan for distribution and storage of hydrogen and other low-carbon infrastructure outside of clusters.</p> <p>Primary responsibility: BEIS</p>	Q1 2023
Manufacturing & construction; Waste	CCS	<p>Publish a plan for CO₂ transport from dispersed sites before the end of 2022.</p> <p>Primary responsibility: BEIS</p>	2022
Shipping	Demand	<p>Consider how to avoid the extension of the UK Emissions Trading Scheme to shipping displacing activity to higher-carbon alternative modes (e.g. road freight).</p> <p>Primary responsibility: BEIS Supporting actors: DfT</p>	2022
Surface transport	Electric cars and vans	<p>Work with the UK car industry to ensure that, where viable, EV supply chains are localised within the UK. This should include support for gigafactories to scale up at the pace required for UK manufacturing capacity to meet the Faraday Institution's recommendation of 140 GWh per year by 2040.</p> <p>Primary responsibility: BEIS Supporting actors: DfT</p>	Ongoing
Surface transport	Electric cars and vans	<p>Consult on regulations requiring EV batteries sold in the UK to be recyclable. These should be coordinated with requirements in other markets to ensure that batteries can be reliably recycled across jurisdictions.</p> <p>Primary responsibility: BEIS Supporting actors: DfT</p>	2022
Waste	Energy from Waste / Incineration	<p>Continue to develop plans for shifting towards an Energy from Waste fleet fitted with CCS from the end of this decade. As part of this set out an assessment of potential viability of existing and future Energy from Waste sites for CCS and implications for decarbonising the sector.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2023
Waste	Energy from Waste / Incineration	<p>Confirm the position of the draft National Planning Statement for Renewables which states that further Energy from Waste plants should only be built where they can be demonstrated to be consistent with residual waste capacity needs and the waste hierarchy, and set out how these assessments will be made. Any new EfW plants (not currently under construction) should also be required to demonstrate readiness for carbon capture deployment.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Buildings	Adaptation	<p>Conduct further research to understand when overheating occurs in existing homes, including ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and the number of homes currently adapted.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Adaptation	<p>Develop and publish new guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behavioural options and the measures that can be installed to reduce internal temperatures.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Adaptation	<p>Encourage retrofit of passive cooling measures. Consider how policies can ensure that when energy efficiency retrofit is carried out, overheating is considered and mitigated against if necessary.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	Ongoing
Buildings	Adaptation	<p>Make finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.</p> <p>Primary responsibility: BEIS Supporting actors: HMT</p>	2022
Cross-cutting	Adaptation	<p>Make the evidence on climate risks more usable for decision makers through co-design of research programmes with end users, where the user drives the research question from the beginning of the process.</p> <p>Primary responsibility: BEIS</p>	2022
Cross-cutting	Adaptation	<p>BEIS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.</p> <p>Primary responsibility: BEIS</p>	Ongoing
Cross-cutting	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the Third UK Climate Change Risk Assessment for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary: Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT).</p> <p>Primary responsibility: BEIS Supporting actors: Defra; DIT</p>	2023
Cross-cutting	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the Third UK Climate Change Risk Assessment for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary: Risks to people and the economy from climate-related failure of the power system.</p> <p>Primary responsibility: BEIS</p>	2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: BEIS</p>	2023
Cross-cutting	Adaptation	<p>Address the lack of research on impacts in 2°C and 4°C scenarios as an urgent priority ahead of the Fourth Climate Change Risk Assessment.</p> <p>Primary responsibility: BEIS</p>	2022
International	UK NDC and Adaptation	<p>The UK's enhanced 2030 NDC should include language recognising that Net Zero delivery is at risk from climate impacts and that emissions reduction targets cannot be met without actions on adaptation that respond to a warming climate, such as the future proofing of critical energy infrastructure.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2022
Cross-cutting; Manufacturing & construction; Buildings	Electrification	<p>As part of reforms to electricity pricing, remove legacy policy costs associated with the historical deployment of less mature low-carbon electricity generation from electricity prices. These legacy costs create a market distortion.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022 Priority
Buildings	Public buildings	<p>Increase the multi-year funding commitments for decarbonisation in public buildings up until 2025 to match the Government's ambition for public sector decarbonisation and commit to continuing similar levels of funding beyond 2025.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	H1 2023 Priority
International	UK pledges and commitments, Funding	<p>In line with the Glasgow Climate Pact commitment to phase out inefficient fossil fuel subsidies, undertake a review of the role of tax policy in delivering Net Zero, building on the recent Net Zero Review to develop a systematic assessment of taxation and carbon pricing across the economy and addressing distortions from post-tax subsidies that stem from a disproportionately low carbon price.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2023 Priority
Manufacturing & construction; Fuel supply; Electricity supply	Trade and consumption emissions	<p>The Government should consult on plans to implement, by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy.</p> <p>Primary responsibility: HMT Supporting actors: BEIS; DIT; Defra</p>	2022 Priority
Manufacturing & construction; Waste	Resource efficiency	<p>Publish the Government's ambition for annual abatement from resource efficiency, by year, up to 2030, and clarify or set out the policies to deliver the ambition up until at least 2027.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2022 Priority

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: BEIS; Wales; Scotland; N. Ireland</p>	2023 Priority
Cross-cutting	Business	<p>Do not delay in taking steps to legislate for listed UK companies and financial institutions to publish transition plans from 2023. Publish plans for a clear transition plan standard, based on a transparent consultative process with experts, practitioners and private sector actors, and building on lessons learnt from the Task Force on Climate-Related Financial Disclosures (TCFD). It will be important to ensure the metrics and requirements are sufficiently ambitious, and where possible allow businesses to communicate their holistic contribution to the Net Zero transition, beyond direct emissions reduction</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Cross-cutting	Business	<p>Building on the Voluntary Carbon Markets Initiative (VCMI) consultation in summer 2022, the Government should develop concrete proposals for standardising and regulating the claims corporates can make relating to offsets, for ensuring the quality and additionality of offsets on the market, and for directing carbon offsets to the highest quality and impact projects.</p> <p>Primary responsibility: HMT Supporting actors: BEIS; Defra</p>	H1 2023
Cross-cutting	Consumption emissions	<p>The Government should outline the UK's future ambitions on reducing consumption emissions.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	Q1 2023
Cross-cutting	Governance	<p>Ensure that all policies, funding, and delivery mechanisms are properly aligned to the pace of transition required and work together constructively towards Net Zero, for example through introduction of a Net Zero Test.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: BEIS; HMT; Scotland; Wales; N. Ireland</p>	Q1 2023
Cross-cutting	Governance	<p>Extend the delivery of climate skills training across the Civil Service and wider public sector. Consider what wider supporting skills (delivery, coordination, legal, financial) will be needed in the public sector to enable effective delivery of the transition to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: BEIS; Scotland; Wales; N. Ireland</p>	Ongoing
Agriculture & land use	Trade and consumption emissions	<p>Implement Government's proposed policy on due diligence of forest-risk commodities and develop a further policy to remove unsustainable legal deforestation from UK supply chains that avoids the risk of resource shuffling.</p> <p>Primary responsibility: Defra Supporting actors: BEIS; COP Unit; FCDO; DIT</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Agriculture & land use; Fuel supply	Biomass	<p>The Biomass Strategy should set out the role that sustainable domestic production of perennial energy crops and short rotation coppice will play to contribute towards Net Zero. The strategy should align with the recommended development of a Government agriculture and land use strategy and outline how land for UK biomass and forestry will be freed up. This should include specific targets to increase the area growing energy crops across the UK to 6,000 hectares per year by 2025, and 30,000 hectares per year by 2035.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2022
Buildings	New buildings	<p>To ensure that the Future Homes Standard will be fully implemented by 2025 and delivers homes with ultra-high energy efficiency standards, low-carbon heating and resilient to climate change impacts, consult on a full technical specification for the new standard in 2023 in order to allow legislation in 2024. Define clear transitional arrangements which will require any buildings which have not meaningfully commenced on site within a year of the implementation date to meet the new standards.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings	New buildings	<p>Ensure that the Future Homes Standard requires low-carbon heating, and mitigation of overheating, in homes which are created through a material change of use to an existing building.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings	New buildings	<p>Consult on a full technical specification for the Future Buildings Standard in 2023. Ensure that the new standards are implemented by 2025, and will deliver new buildings which are resilient to climate change impacts, with ultra-high energy efficiency standards and low-carbon heating.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings	Building standards and enforcement	<p>Implement improvements to the Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP) framework to ensure they drive deployment of the necessary energy efficiency and low-carbon heat measures and also address overheating, ventilation, and moisture-risk. This should be done in coordination with Devolved Administrations.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS; Scotland; Wales; N. Ireland</p>	H1 2023
Buildings	Building standards and enforcement	<p>Publish plans to address enforcement issues for building standards and minimum EPC requirements, including consideration of additional measures to monitor compliance of qualified installers, approved inspectors and EPC assessors, and providing local areas with sufficient resource to undertake assessments.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS; HMT</p>	H1 2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Buildings	Building standards and enforcement	<p>Publish clear plans to move towards in-use performance metrics for buildings, with clear timescales and responsibilities. Consider the case for moving towards Green Buildings Passports.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings	Funding	<p>Recognising that the transition needs to scale up over this decade and that stable funding provides certainty to households, businesses, and public bodies, strongly and credibly signal that the Boiler Upgrade Scheme, Home Upgrade Grant, Local Authority Delivery Scheme, Social Housing Decarbonisation Fund, Energy Company Obligation and public sector decarbonisation will continue to be fully funded as required beyond the spending review period.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Buildings	Finance	<p>Outline a comprehensive vision to leverage private financing for the retrofit of UK homes and businesses. Plans should be designed to operate in tandem with the other enablers needed to unlock home retrofit at scale, such as better buildings data and public engagement. Financial levers to consider include green stamp duty, green mortgages, energy as a service, property-linked finance, and using the UKIB to de-risk retail investment into home retrofit.</p> <p>Primary responsibility: HMT Supporting actors: BEIS</p>	2022
Buildings	Public buildings	<p>To meet ambitious Government targets and show leadership in public sector buildings decarbonisation ensure public sector organisations, including those not captured by the Greening Government Commitments, have the information and support they need to: monitor their energy use, set targets and reduce emissions from their estate over the next five years. Establish proportionate mechanisms which could be put in place to review overall progress and recurring challenges.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: BEIS; Defra</p>	2023
International	Climate finance	<p>Use the remaining COP Presidency and the UK's diplomatic capability to ensure progress is made on developed country climate finance commitments including the delivery of the \$100 billion by 2023 at the latest and the doubling of adaptation finance on 2019 levels by 2025.</p> <p>Primary responsibility: COP Unit; FCDO Supporting actors: BEIS</p>	2022
International	Climate finance	<p>Continue to deliver a broadly 50/50 split between adaptation and mitigation spend under UK International Climate Finance, looking for opportunities that advance both outcomes.</p> <p>Primary responsibility: FCDO Supporting actors: BEIS</p>	Ongoing

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Manufacturing & construction; Buildings; Surface transport	Resource efficiency	<p>Set out a plan to make an assessment of whole-life carbon and material use of public and private construction projects mandatory by 2025, to enable minimum standards to be set. The whole life carbon assessment should be sought at the planning stage to enable efforts to reduce embodied carbon and materials.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS; DfT</p>	2022
Shipping	Demand	<p>Build upon the proposals for the UK Emissions Trading Scheme and the UK MRV regulations to explore options for an activity-based measure of UK shipping emissions. This should include exploring the benefits of changing the emissions accounting approach for international shipping, to ensure that a fair share of emissions for voyages to and from the UK are captured within the UK's inventory even if vessels refuel in other jurisdictions.</p> <p>Primary responsibility: DfT Supporting actors: BEIS</p>	2023
Shipping	Low-carbon fuel	<p>Commit to the UK's first clean maritime cluster(s) operating at commercial scale (supplying at least 2 TWh/year of zero-carbon fuels) by 2030 at the latest.</p> <p>Primary responsibility: DfT Supporting actors: BEIS</p>	2022
Surface transport	Electric vehicle charging infrastructure	<p>Continue to support widespread deployment of charging infrastructure, ensuring that deployment rates accelerate in line with the trajectory required to deliver a minimum of 300,000 public charge points by 2030.</p> <p>Primary responsibility: DfT Supporting actors: BEIS; Ofgem</p>	Ongoing
Surface transport	Electric vehicle charging infrastructure	<p>Review and strengthen rapid charger rollout plans on the major road network out to 2035, to ensure that drivers have the confidence that they can find reliable, available charge points as EV uptake grows.</p> <p>Primary responsibility: DfT Supporting actors: BEIS; Ofgem</p>	Ongoing
Surface transport	Public transport	<p>Work with the public transport sector to run a coordinated campaign to welcome people back to public transport after the pandemic. Work with operators and local transport authorities to avoid detrimental reductions in service provision or increases in fares.</p> <p>Primary responsibility: DfT Supporting actors: BEIS</p>	2022
Waste	Infrastructure	<p>Review planning policies for waste infrastructure to ensure they enable delivery of recycling targets, support future residual waste needs and consider decarbonisation requirements. This includes clarifying siting requirements for incinerators to enable CCS adoption.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2023

Sector	Topic	Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)	Timing
Buildings	Adaptation	<p>Expand overheating requirement in building regulations to cover refurbishments of existing buildings and conversions of non-residential buildings to residential.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2022
Buildings	Adaptation	<p>Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2022

Recommendations for Defra

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Agriculture & land use	Agriculture and land use strategy	<p>Set out a Net Zero delivery strategy for the agriculture and land use sectors that brings together how land can deliver its multiple functions including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, domestic biomass production and wider environmental goals. The strategy must clearly outline the relationships and interactions between the multiple action plans in development (e.g. including those for peat, trees, nature, plant biosecurity and biomass), be spatially and temporally targeted, and aligned with action in the devolved administrations.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023 Priority
Agriculture & land use	Trees and woodland	<p>Ensure that funding and incentives are set at the correct level to meet the UK Government afforestation target of 30,000 hectares per year by 2025, and illustrative Net Zero Strategy targets of 40,000 hectares and 50,000 hectares by 2030 and 2035 respectively. Further clarity is required regarding funding beyond 2025. This should also address wider objectives for land such as climate adaptation and nature conservation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023 Priority
Manufacturing & construction; Waste	Resource efficiency	<p>Publish the Government's ambition for annual abatement from resource efficiency, by year, up to 2030, and clarify or set out the policies to deliver the ambition up until at least 2027.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2022 Priority
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: BEIS; Wales; Scotland; N. Ireland</p>	2023 Priority
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in the Third Climate Change Risk Assessment.</p> <p>Primary responsibility: Defra</p>	2023 Priority
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should report how departments have addressed the top eight priority risks set out in the Third Climate Change Risk Assessment Advice Report for urgent action between 2021 and 2023.</p> <p>Primary responsibility: Defra</p>	2023 Priority
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the Third Climate Change Risk Assessment Technical Report for the period 2023-2028.</p> <p>Primary responsibility: Defra</p>	2023 Priority

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the Third Climate Change Risk Assessment Advice Report.</p> <p>Primary responsibility: Defra</p>	2023 Priority
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: Defra</p>	Ongoing
Cross-cutting	Consumption emissions	<p>The Government should outline the UK's future ambitions on reducing consumption emissions.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	Q1 2023
Cross-cutting	Trade and consumption emissions	<p>The Government should increase investment in, and improve the collection and reporting of, consumption emissions data. This should include (a) establishing a short- and medium-term strategy to improve the underlying methodology to ensure it can capture key improvements in the carbon intensity of imports (b) ensuring the resource to enable annual emissions statistics to be produced promptly each year.</p> <p>Primary responsibility: Defra Supporting actors: ONS</p>	Q1 2024
Agriculture & land use	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: Defra</p>	2022
Agriculture & land use	Agroforestry and hedgerows	<p>Set incentives to support agroforestry and hedgerows on UK farms. Plant trees on 2% of farmland by 2025 while maintaining its primary use, rising to 5% by 2035, and extend hedgerows by 20% by 2035 and better manage existing hedgerows.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	CAP reform	<p>Put in place robust frameworks for monitoring, reporting and verification of post-CAP farm subsidies and agriculture environment schemes to assess their effectiveness in delivering their environmental objectives, including for climate change mitigation and adaptation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	CAP reform	<p>Set out how reform of agricultural subsidies in England under the new Environmental Land Management scheme will be targeted through the "public money for public goods" approach, both regionally and temporally, to incentivise land managers to adopt measures to reduce greenhouse gas emissions alongside delivery for food security, biodiversity and other environmental goals.</p> <p>Primary responsibility: Defra</p>	2022

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Agriculture & land use	Diet and demand	<p>Set out how the objective in the Government Food Strategy to 'deliver a sustainable, nature positive, affordable food system' will be achieved, including the mechanisms to address the interaction between food systems and other land use needs, climate, nature, and integrated alongside a public shift towards low-carbon diets.</p> <p>Primary responsibility: Defra</p>	Q1 2023
Agriculture & land use	Diet and demand	<p>Take low-cost, low-regret actions to encourage a 20% shift away from all meat by 2030, rising to 35% by 2050, and a 20% shift from dairy products by 2030, demonstrating leadership in the public sector whilst improving health.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Agriculture & land use	Diet and demand	<p>Introduce policy to support the reduction of food waste at the farm, supply chain and household level. Food waste reduction, and its implications, should also be integrated into the recommended Net Zero delivery strategy for the agriculture and land use sectors , as well as in plans for the waste sector.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Finance	<p>Set out how public and private funding for agricultural and land-based measures will be aligned, how opportunities to attract increased private finance for habitat creation and restoration will be developed, and promote the use of existing verifiable standards (such as the Woodland Carbon Code and Peatland Code) whilst also considering the need to develop new ones.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Agriculture & land use	Low-carbon farming	<p>As part of strengthening the regulatory baseline, extend coverage of Nitrate Vulnerable Zones across all of the UK in order to promote best practice in management of inorganic fertilisers and organic manure and slurry.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2024
Agriculture & land use	Low-carbon farming	<p>As part of strengthening the regulatory baseline, introduce regulations under the Clean Air Strategy to reduce enteric methane emissions, specifically under environmental permitting to the dairy and intensive beef sectors and mandating UK feed producers to incorporate methane inhibiting additives.</p> <p>Primary responsibility: Defra</p>	2023
Agriculture & land use	Low-carbon farming	<p>Continue to support research and development into low-carbon farming practices, including behavioural, innovation and productivity measures. The risk of a high dependency on innovation and technology to meet GHG emission reductions should be assessed, and integrated with demand-side measures such as diet change and waste reduction.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Agriculture & land use	Low-carbon farming	<p>Move beyond the voluntary nature of current CAP replacement schemes by setting a strong regulatory baseline that strengthens rules such as those under cross compliance and retains them in UK legislation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Low-carbon farming	<p>Set in place action to overcome financial barriers that prevent take-up and innovation in low-carbon farming practices. This should include management incentives under the ELM scheme and approaches set by devolved administrations, grants for capital items and infrastructure, and support for research and development.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Marine and coastal	<p>Extend the statutory requirements of marine plan policies to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is a significant gap in the protections they are designed to provide.</p> <p>Primary responsibility: Defra</p>	2022
Agriculture & land use	Non-financial barriers	<p>Develop understanding on how the transition to Net Zero in the agriculture and land will affect employment in these sectors, including a timeframe of change and the scale of impact. Set out how the change will be managed to be fair and equitable, ensuring new skills and training are widely available to both support communities, but also to facilitate the meeting of targets in these sectors.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Agriculture & land use	Non-financial barriers	<p>Provide support to tenant farmers to overcome contractual issues that restrict the long-term commitment and investment required to reduce emissions and sequester carbon on the land they manage.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Non-financial barriers	<p>Set in place action to overcome non-financial barriers that prevent adoption of low-carbon farming measures and land-use change to deliver emission reduction and carbon benefits. These include streamlining application processes and providing support for skills, training, and knowledge exchange in order to provide confidence to farmers to take up new measures.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Ensure incentives are set at the correct level to set a trajectory to achieve 58% of peatland restored by 2035, and 79% under restoration by 2050. All upland peat should be under restoration management by 2045.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Agriculture & land use	Peatlands	<p>Implement a comprehensive delivery mechanism to address degraded peatland and extend current restoration ambition set out by the UK government and the devolved administrations beyond existing timeframes. Peat restoration targets include the need to remove all low-productive trees (i.e. less than YC10) from peatland (equivalent to 16,000 hectares by 2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).</p> <p>Primary responsibility: Defra</p>	2024
Agriculture & land use	Peatlands	<p>Introduce baseline regulations to ensure lowland peat soils are not left bare by mandating the use of appropriate vegetation cover.</p> <p>Primary responsibility: Defra</p>	2023
Agriculture & land use	Peatlands	<p>Introduce policy to end rotational burning on peatland before the start of the 2022 burn season.</p> <p>Primary responsibility: Defra</p> <p>Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Agriculture & land use	Peatlands	<p>Introduce the proposed regulations to ban the retail sale of peat in horticulture in England and Wales by 2024. Use by the horticultural sector should also end in 2024, earlier than the currently proposed 2028. Government must work with the horticultural industry achieve this.</p> <p>Primary responsibility: Defra</p> <p>Supporting actors: Wales</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Set out clear timeframes to end domestic and industrial peat extraction across the UK. Provide a mechanism to ensure the peat extraction industries restore extraction sites to protect the peat resource.</p> <p>Primary responsibility: Defra</p> <p>Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Where peat soils remain under agricultural use, set out how they will be managed in a more sustainable way. This should include raising water levels on 8% of lowland grassland by 2025, reaching 25% by 2035, and 12% of arable crops by 2025, reaching 38% by 2035.</p> <p>Primary responsibility: Defra</p> <p>Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Trade and consumption emissions	<p>Develop the option of applying minimum environmental standards to imports of selected agricultural products, either for application via due diligence or at the border.</p> <p>Primary responsibility: Defra</p> <p>Supporting actors: COP Unit; FCDO; DIT</p>	Q1 2023
Agriculture & land use	Trade and consumption emissions	<p>Implement Government's proposed policy on due diligence of forest-risk commodities and develop a further policy to remove unsustainable legal deforestation from UK supply chains that avoids the risk of resource shuffling.</p> <p>Primary responsibility: Defra</p> <p>Supporting actors: COP Unit; FCDO; DIT; BEIS</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Agriculture & land use	Trade and consumption emissions	<p>Improve data collection and standardise methodologies for monitoring of, and reporting on, international land use emissions that arise from UK consumption, particularly from deforestation. The Government should aim to report on these international emissions from deforestation on an annual basis from 2023. This may build on the experimental statistic of the Joint Nature Conservation Committee.</p> <p>Primary responsibility: Defra Supporting actors: ONS</p>	Q1 2023
Agriculture & land use	Trees and woodland	<p>Work with the forestry sector and government agencies to support UK tree nurseries to increase domestic production of trees to meet the planting ambition and reduce reliance on imports, along with the associated risks of pests and disease.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Agriculture & land use; Fuel supply	Biomass	<p>The Biomass Strategy should set out the role that sustainable domestic production of perennial energy crops and short rotation coppice will play to contribute towards Net Zero. The strategy should align with the recommended development of a Government agriculture and land use strategy and outline how land for UK biomass and forestry will be freed up. This should include specific targets to increase the area growing energy crops across the UK to 6,000 hectares per year by 2025, and 30,000 hectares per year by 2035.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2022
Agriculture & land use; Manufacturing & construction	Trees and woodland	<p>Develop a comprehensive plan to increase the production and use of UK sourced timber and support the long-term economic viability of domestic woodlands.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
F-Gas	HFC regulation	<p>For the review of the F-gas Regulation happening this year, match or exceed any increase in ambition in EU F-gas Regulation, which is currently being reviewed.</p> <p>Primary responsibility: Defra</p>	2022
F-Gas	HFC regulation	<p>Pass legislation to reduce hydrofluorocarbon consumption by 85% by 2036 relative to 2011-2013.</p> <p>Primary responsibility: Defra</p>	Q1 2023
F-Gas	International F-gas action	<p>Publicly push for stronger international action on reducing F-gases under the Kigali Amendment to the Montreal Protocol, including making it compatible with reaching Net Zero greenhouse gas emissions, encouraging more countries to ratify the Protocol and the Amendment, improving international monitoring of emissions, supporting the development of more robust estimates of emission metrics, and supporting the reduction of inhaler emissions in other countries' health services.</p> <p>Primary responsibility: Defra Supporting actors: DHSC</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Manufacturing & construction; Buildings; Agriculture & land use	Material Substitution	<p>Publish the timber policy roadmap setting out the policies needed to substantially increase the use of wood in construction.</p> <p>Primary responsibility: Defra</p>	Q1 2023
Manufacturing & construction; Waste	Resource efficiency	<p>Set the 'Resource efficiency and waste reduction' target(s), enabled by the new Environment Act powers, in a way that drives the delivery of emissions abatement from resource efficiency set out in the Resources and Waste Strategy and the Net Zero Strategy. This should recognise the role that raw material extraction and the design, longevity and reuse of materials and products can play in reducing the impacts of new product demand, while realising potential co-benefits.</p> <p>Primary responsibility: Defra</p>	Q1 2023
Waste	Cross-cutting	<p>Set out how industry will be supported in developing advanced technologies to reduce emissions from anaerobic digestion, composting and wastewater.</p> <p>Primary responsibility: Defra</p>	2023
Waste	Cross-cutting	<p>Clarify OFWAT's mandate to enable efforts to decarbonise wastewater treatment in addition to scrutinising companies' business plans ahead of the 2024 Price Review.</p> <p>Primary responsibility: Defra Supporting actors: Ofwat</p>	Q1 2023
Waste	Infrastructure	<p>Review planning policies for waste infrastructure to ensure they enable delivery of recycling targets, support future residual waste needs and consider decarbonisation requirements. This includes clarifying siting requirements for incinerators to enable CCS adoption.</p> <p>Primary responsibility: Defra Supporting actors: BEIS</p>	2023
Waste	Infrastructure	<p>Publish an assessment of residual waste treatment capacity needs through to 2050, consistent with meeting committed and prospective recycling and waste reduction targets, expected resource efficiency improvements and the stated goal to end the landfilling of biodegradable waste by 2028. The findings of this review should inform future incineration/EfW capacity decisions and consider the feasibility of phasing out waste exports by 2030.</p> <p>Primary responsibility: Defra</p>	2022
Waste	Landfill	<p>Set an ambition to improve methane capture and oxidisation rates at landfill sites and review the incentives and broader support necessary to achieve that ambition.</p> <p>Primary responsibility: Defra</p>	2023
Waste	Landfill	<p>Formalise commitment to prevent key biodegradable waste streams (including municipal and non-municipal sources) from going to landfill by 2028 at the latest and clarify details of additional policies needed to achieve this.</p> <p>Primary responsibility: Defra</p>	Q1 2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Waste	Landfill and waste prevention	Clarify details of how £295m capital funding for food waste collections announced in the Net Zero Strategy will be spent to prevent food waste from going to landfill. Primary responsibility: Defra	2022
Waste	Market conditions	Publish a review of incentives across the waste sector to ensure they are appropriate for achieving dual aims of waste reduction and decarbonisation. This should consider pricing of waste management solutions as well as materials. Primary responsibility: Defra Supporting actors: HMT	2023
Waste	Waste prevention	Finalise plans to introduce mandatory business food waste reporting so that it can be phased in from the beginning of 2024. Engage WRAP in providing or brokering consistent methods of measurement and associated data sets. Primary responsibility: Defra	Q1 2023
Waste	Waste prevention	Formally set the proposed target for reducing residual waste (to landfill, incineration or export) by 50% by 2042. Primary responsibility: Defra	Q1 2023
Waste; Agriculture & land use	Waste prevention and public engagement	Consider the findings of the Environment and Climate Change Lords Select Committee inquiry into mobilising action on climate change and fund WRAP to undertake an assessment of the behaviour changes needed to achieve targets for food waste reduction, recycling and improved end user consumption'. Primary responsibility: Defra	Q1 2023
Waste; Manufacturing & construction	Waste prevention	Finalise the Waste Prevention Programme, including by setting out details on additional policies needed to achieve committed recycling and waste reduction targets, including additional Extended Producer Responsibility schemes committed in the draft WPP. Primary responsibility: Defra	2023
Waste; Manufacturing & construction	Waste prevention	Implement initial Extended Producer Responsibility, the Deposit Return Scheme and consistent collections of recycling and food waste without further delay. Complete an independent review of the impact of the schemes within 2 years of implementation (i.e. by 2026). Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland	Q1 2024
Waste; Manufacturing & construction	Waste prevention	Set ambitious post-2035 recycling targets alongside possible policy options for delivering such targets, including increasing investment to deliver long-term infrastructure needs. Primary responsibility: Defra	2023
Agriculture & land use	Adaptation	Make long-term targets for biodiversity, set out under the Environment Bill, and associated timeframes outcome-based and linked directly to the goals set out in the Government's 25-Year Environment Plan. Primary responsibility: Defra	2022

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Agriculture & land use	Adaptation	<p>Make interim targets for biodiversity statutory and link them clearly to the long-term targets set out in the Environment Bill.</p> <p>Primary responsibility: Defra</p>	2022
Agriculture & land use	Adaptation	<p>The commitment in the 25 Year Environment Plan to achieve 75% restoration for terrestrial and freshwater protected sites should be extended to include all priority habitat sites.</p> <p>Primary responsibility: Defra</p>	2022
Agriculture & land use	Adaptation	<p>Set out a clear mechanism to account for the consequences of higher water temperatures and low flows (including drying up) in water bodies for freshwater habitats and species, and for meeting the Water Framework Directive (WFD) targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs).</p> <p>Primary responsibility: Defra</p>	2022
Agriculture & land use	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority Third Climate Change Risk Assessment risks for which Defra has lead responsibility, coordinating work with other relevant departments as necessary: Risks to soil health from increased flooding and drought.</p> <p>Primary responsibility: Defra</p>	2023
Agriculture & land use	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority Third Climate Change Risk Assessment risks for which Defra has lead responsibility, coordinating work with other relevant departments as necessary: Risks to natural carbon stores and sequestration (trees, soils and wetlands) from multiple hazards.</p> <p>Primary responsibility: Defra</p>	2023
Agriculture & land use	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority Third Climate Change Risk Assessment risks for which Defra has lead responsibility, coordinating work with other relevant departments as necessary: Risks to crops, livestock, and commercial trees from multiple hazards.</p> <p>Primary responsibility: Defra</p>	2023
Buildings	Adaptation	<p>Work with the Environment Agency to set out the measures being taken to improve the uptake of property-level flood resilience (PFR) following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.</p> <p>Primary responsibility: Defra</p>	2022
Cross-cutting	Adaptation	<p>The next National Adaptation Programme, due in 2023, should set out the Government's vision for a well-adapted UK, alongside the measurable outcomes that the Government is aiming to achieve by the end of the next National Adaptation Programme period (2023 – 2028).</p> <p>Primary responsibility: Defra</p>	2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Cross-cutting	Adaptation	<p>Make the next round of reporting under the Adaptation Reporting Power (ARP) mandatory.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>Set the deadline for reporting under the Adaptation Reporting Power to allow sufficient time for consideration of all the reports in the Fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>Expand the list of organisations reporting under the Adaptation Reporting Power (ARP) to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>Implement a public engagement programme about national adaptation objectives, acceptable levels of risk, desired resilience standards, how to address inequalities, and responsibilities across society. The findings from the programme should feed into the vision and desired outcomes of the next National Adaptation Programme.</p> <p>Primary responsibility: Defra</p>	2022
Cross-cutting	Adaptation	<p>Fund a programme of work to design and populate the appropriate new priority adaptation indicators for England. These should complement other environmental and social indicators collated by Government. The CCC could be tasked to coordinate this activity in partnership with other relevant organisations such as the Office for Environmental Protection and Environment Agency.</p> <p>Primary responsibility: Defra</p>	Ongoing
Cross-cutting	Adaptation	<p>National Adaptation Programme actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies must be completed.</p> <p>Primary responsibility: Defra Supporting actors: DCMS</p>	Ongoing
Cross-cutting	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years, related to the priority Third Climate Change Risk Assessment risks for which Defra has lead responsibility, coordinating work with other relevant departments as necessary: Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards.</p> <p>Primary responsibility: Defra</p>	2023
Cross-cutting	Adaptation	<p>Work with Port Operators and the British Ports Association to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report, as well as to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.</p> <p>Primary responsibility: Defra</p>	2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), Defra should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: Defra</p>	2023
International	Adaptation	<p>The UK's next Adaptation Communication should include strengthened adaptation policies, backed by quantitative targets where possible, strong cross-government policy to respond to key climate risks and a robust approach to monitoring and evaluation.</p> <p>Primary responsibility: Defra</p>	Ongoing
International	Adaptation	<p>To provide structure, consistency and direction to Adaptation Communications, the UK Government should outline when UK Adaptation Communications will be published in the future and how their timing fits with domestic policy cycles to enable a high impact communication.</p> <p>Primary responsibility: Defra</p>	2022
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals. Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; COP Unit; FCDO; DIT; HMT; DfT</p>	2022 Priority
Manufacturing & construction	Data	<p>Review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting to enable effective monitoring and evaluation, and policy implementation. This will require additional data collection and reporting to allow for effective tracking of energy efficiency, material efficiency, fuel switching, CCS, including progress developing these measures, and more holistic measurement on a product or whole life cycle carbon basis. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; ONS</p>	Q1 2023 Priority
Manufacturing & construction; Fuel supply; Electricity supply	Trade and consumption emissions	<p>The Government should consult on plans to implement, by 2030 or earlier, Carbon Border Adjustment Mechanisms and mandatory minimum climate-related standards on imports of selected manufactured products and energy.</p> <p>Primary responsibility: HMT Supporting actors: Defra; BEIS; DIT</p>	2022 Priority

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Cross-cutting	Business	<p>Building on the Voluntary Carbon Markets Initiative (VCMI) consultation in summer 2022, the Government should develop concrete proposals for standardising and regulating the claims corporates can make relating to offsets, for ensuring the quality and additionality of offsets on the market, and for directing carbon offsets to the highest quality and impact projects.</p> <p>Primary responsibility: HMT Supporting actors: Defra; BEIS</p>	Q2 2023
International; Cross-cutting	Strategy	<p>Set out the Government's approach to domestically achieving aims of priority sectoral COP26 Pledges before COP27.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; CO & Number 10; DfT; COP Unit; FCDO; DIT</p>	2022
Agriculture & land use	Coastal and marine	<p>Produce a roadmap to inclusion of saltmarsh and seagrass in the greenhouse gas inventory, which specifies a suggested level of inclusion (i.e., Tier 1, 2 or 3), the additional data required to facilitate this, and an indicative timescale to inclusion.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2023
Buildings	Public buildings	<p>To meet ambitious Government targets and show leadership in public sector buildings decarbonisation ensure public sector organisations, including those not captured by the Greening Government Commitments, have the information and support they need to: monitor their energy use, set targets and reduce emissions from their estate over the next five years. Establish proportionate mechanisms which could be put in place to review overall progress and recurring challenges.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Defra; BEIS</p>	2023
Fuel supply, Engineered removals	Bioenergy	<p>Continue to take a global lead on further developing and improving UK and international biomass governance and sustainability criteria.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	Ongoing
Fuel supply; Engineered removals	Bioenergy	<p>The Biomass Strategy needs to set out a best use hierarchy for biomass and address the sustainability of the biomass supply required to support the rapid and sustainable deployment of BECCS (for power and biofuels). The Strategy should consider reducing reliance on imports by increasing domestic biomass supply as part of wider land-use changes (including diet change).</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2022
International	UK pledges and commitments	<p>Set out plans for reducing domestic methane emissions in line with the collective aims of the Global Methane Pledge (a reduction in UK methane emissions of at least 30% from 2020 levels by 2030) and announce an intention to set a longer-term pathway for these emissions in 2023. These plans for contributing to the Global Methane Pledge should be included in the enhanced 2030 NDC the UK resubmits in 2022 for COP27.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2022

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
Manufacturing & construction; Agriculture & land use	Off-road mobile machinery	<p>Set out a strategy for decarbonisation of off-road mobile machinery to set direction for the private sector. The strategy should include policy proposals, which could include the future of emissions standards, and a proposal for how best local authorities can bring off-road mobile machinery into their regulatory framework for construction within urban areas.</p> <p>Primary responsibility: BEIS Supporting actors: Defra; DLUHC; DfT</p>	Q1 2023
Waste	Cross-cutting	<p>Require and facilitate water companies and industrial wastewater facilities to measure and report on emissions, including process emissions. Funding should be made available for monitoring and research to improve process emissions measurement and mitigation.</p> <p>Primary responsibility: Ofwat Supporting actors: Defra</p>	Q1 2023
Waste	Energy from Waste / Incineration	<p>Continue to develop plans for shifting towards an Energy from Waste fleet fitted with CCS from the end of this decade. As part of this set out an assessment of potential viability of existing and future Energy from Waste sites for CCS and implications for decarbonising the sector.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2023
Waste	Energy from Waste / Incineration	<p>Confirm the position of the draft National Planning Statement for Renewables which states that further Energy from Waste plants should only be built where they can be demonstrated to be consistent with residual waste capacity needs and the waste hierarchy, and set out how these assessments will be made. Any new EfW plants (not currently under construction) should also be required to demonstrate readiness for carbon capture deployment.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	Q1 2023
Waste; Manufacturing & construction	Market conditions	<p>Review the impact of the newly introduced plastics tax and consider opportunities to go further, including integrating an escalator on the price of the tax and the recycling threshold to which it applies.</p> <p>Primary responsibility: HMT Supporting actors: Defra</p>	2023
Cross-cutting	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the Third UK Climate Change Risk Assessment for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary: Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT).</p> <p>Primary responsibility: BEIS Supporting actors: Defra; DIT</p>	2023

Sector	Topic	Recommendations for the Department for Environment, Food and Rural Affairs (Defra)	Timing
International	UK NDC and Adaptation	<p>The UK's enhanced 2030 NDC should include language recognising that Net Zero delivery is at risk from climate impacts and that emissions reduction targets cannot be met without actions on adaptation that respond to a warming climate, such as the future proofing of critical energy infrastructure.</p> <p>Primary responsibility: BEIS Supporting actors: Defra</p>	2022

Recommendations for the DfT

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Aviation	Sustainable aviation fuel	Implement the Sustainable Aviation Fuel Mandate as soon as possible this year with a strong set of criteria for the fuels included in the mandate. Primary responsibility: DfT	2022 Priority
Shipping	Demand; Low-carbon fuel	Take a leadership role in pushing for inclusion of a Net Zero 2050 target within the 2023 update of the International Maritime Organisation's initial greenhouse gas strategy. Primary responsibility: DfT Supporting actors: CO & Number 10	2023 Priority
Surface transport	Conventional vehicle efficiency	Introduce regulations to sit alongside the ZEV mandate to ensure that efficiencies of new conventional vehicles continue to improve and manufacturers reverse the trend towards larger vehicles. These need to be suitably ambitious to deliver the efficiency improvements and share of hybrid sales that are required to realise the necessary emissions reductions from these segments of the market. Primary responsibility: DfT	Q1 2023 Priority
Surface transport	Electric cars and vans	Confirm the details of the ZEV mandate in regulation. As set out in the consultation, this should impose targets on manufacturers that are at least as ambitious as those in the Transport Decarbonisation Plan and should drive consistent growth in sales of EV cars and vans through the 2020s to meet the 2030 phase-out date. Primary responsibility: DfT	Q1 2023 Priority
Cross-cutting	Governance	Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks. Primary responsibility: DfT	Ongoing
Aviation	Demand	Commit to monitor seat occupancy in the next few years (3-4) during recovery from the COVID-19 pandemic to ensure that the sector either returns to prior occupancy levels or routes are adjusted to account for low occupancy rates. Consider regulating aircraft occupancy standards if the trends do not return to pre-pandemic levels in the next 12 months. Primary responsibility: DfT	Q1 2023
Aviation	Demand	Assess the Government's airport capacity strategy in the context of Net Zero, as part of the aviation strategy. There should be no net expansion of UK airport capacity unless the carbon-intensity of aviation is in line with or ahead of the Government's pathway and can accommodate the additional demand. A demand management framework will need to be developed by 2023 and be in place by the mid-2020s to annually assess and, if required, control sector GHG emissions and non-CO ₂ effects. Primary responsibility: DfT Supporting actors: DLUHC	2023
Aviation	Sustainable aviation fuel	Continue innovation and show support for sustainable aviation fuel (SAF) technologies, including research into the non-CO ₂ effects. Also, estimate the impact of different sustainable aviation fuel options on other countries' emissions and the opportunity costs for UK land use. Primary responsibility: DfT	2022

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Aviation	Sustainable aviation fuel	<p>Without allowing it to delay the implementation of the Sustainable Aviation Fuel Mandate this year, consider the following criteria for the fuels permitted to be used in the mandate: i) Ensure that all fuels do not have a harmful non-CO₂ impact relative to regular jet fuel, ii) that the life-cycle emissions savings from the fuels are significant relative to jet fuel.</p> <p>Primary responsibility: DfT</p>	2022
Aviation	Sustainable aviation fuel	<p>Without allowing it to delay the implementation of the Sustainable Aviation Fuel Mandate this year, consider whether including high-quality greenhouse gas removals into the SAF mandate could be a more effective way of reducing emissions for the industry, particularly in the short-term, i.e. 5-8 years up to 2030, before the most efficient forms of SAF (e.g. synthetic fuels) are widely commercially available.</p> <p>Primary responsibility: DfT</p>	2023
Aviation	Cross-cutting	<p>Publish the full Jet Zero Strategy as soon as possible in Q3 2022 to provide a clear strategy for the sector to decarbonise and to provide certainty to airlines, airports, and supporting industries.</p> <p>Primary responsibility: DfT</p>	Q3 2022
Aviation	Offsets/removals	<p>Commit to a policy on the UK ETS/Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) interaction as soon as possible, ensuring it is sufficiently environmentally stringent and that no credits from CORSIA are used for flights currently covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability). The interaction should avoid double-compliance.</p> <p>Primary responsibility: DfT</p>	2023
Aviation	International engagement	<p>Use the ICAO General Assembly to protect, strengthen and extend Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) such that all residual emissions in 2050 are covered by near-permanent, sustainable greenhouse gas removals. Commit to increasing the number of airlines opting in and, if strengthening it is not possible, push for an additional policy for countries willing and able to commit to a higher standard of carbon removal for aviation than exists through CORSIA.</p> <p>Primary responsibility: DfT</p>	Q3 2022
Aviation	Non-CO ₂ emissions	<p>Start monitoring non-CO₂ effects of aviation (including through the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) for eligible aeroplane operators), set a minimum goal of no further warming after 2050 from non-CO₂ effects, research mitigation options, and consider how best to tackle non-CO₂ effects alongside UK climate targets without increasing CO₂ emissions.</p> <p>Primary responsibility: DfT</p>	2023
Aviation	Low emission aircraft	<p>Continue innovation and funding for aircraft efficiency measures, hybrid, full electric and hydrogen aircraft development and airspace modernisation.</p> <p>Primary responsibility: DfT</p>	Ongoing

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Shipping	Demand	<p>Build upon the proposals for the UK Emissions Trading Scheme and the UK MRV regulations to explore options for an activity-based measure of UK shipping emissions. This should include exploring the benefits of changing the emissions accounting approach for international shipping, to ensure that a fair share of emissions for voyages to and from the UK are captured within the UK's inventory even if vessels refuel in other jurisdictions.</p> <p>Primary responsibility: DfT Supporting actors: BEIS</p>	2023
Shipping	Demand; Low-carbon fuel	<p>Publish the Course to Zero consultation. This should aim to set an ambitious trajectory to Net Zero for the domestic maritime sector.</p> <p>Primary responsibility: DfT</p>	2022
Shipping	Efficiency and electrification	<p>Build upon the recent call for evidence to develop a plan for deploying shore power and electric recharging infrastructure at all of the UK's major ports. This should include identifying roles and responsibilities for delivery and providing support and incentives to drive investment.</p> <p>Primary responsibility: DfT</p>	Q1 2023
Shipping	Low-carbon fuel	<p>Embed the Course to Zero into the next update of the Clean Maritime Plan. This should present a credible plan for how the trajectory to Net Zero will be delivered.</p> <p>Primary responsibility: DfT</p>	2023
Shipping	Low-carbon fuel	<p>Provide support and incentives to drive private-sector investment in low-carbon maritime fuels, engine technologies, and storage facilities. These should enable zero-carbon fuels to expand to 33% of UK shipping fuel use by 2035.</p> <p>Primary responsibility: DfT</p>	Ongoing
Shipping	Low-carbon fuel	<p>Commit to the UK's first clean maritime cluster(s) operating at commercial scale (supplying at least 2 TWh/year of zero-carbon fuels) by 2030 at the latest.</p> <p>Primary responsibility: DfT Supporting actors: BEIS</p>	2022
Shipping	Low-carbon fuel	<p>Report on progress in identifying green shipping corridors and the actions to implement them, as agreed within the Clydebank Declaration. This should be published ahead of COP28.</p> <p>Primary responsibility: DfT Supporting actors: CO & Number 10</p>	2023
Surface transport	Active travel	<p>Set out, through Active Travel England, guidance for what actions local authorities should take to realise the Transport Decarbonisation Plan's commitment to half of all journeys in towns and cities being walked or cycled by 2030. This should be accompanied by the required funding.</p> <p>Primary responsibility: DfT</p>	2022
Surface transport	Active travel	<p>Publish findings from e-scooter trials and set out a role for these vehicles, alongside e-bikes and bike/scooter sharing schemes, in delivering sustainable local transport systems.</p> <p>Primary responsibility: DfT</p>	2022

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Surface transport	Car demand	<p>Set out measurable targets for the contribution that reducing car travel will play in delivering transport's Net Zero pathway.</p> <p>Primary responsibility: DfT</p>	2022
Surface transport	Car demand	<p>In further developing their thinking on Roads Investment Scheme 3, DfT and National Highways must rigorously assess the emissions impacts of these plans and thoroughly consider alternative approaches that could deliver similar benefits with lower emissions. The strategy should not aim to cater for unconstrained growth in road traffic and should be compatible with Net Zero.</p> <p>Primary responsibility: DfT</p>	Q1 2023
Surface transport	Car demand	<p>Reform the Transport Appraisal Guidance to ensure that it enables practitioners to make decisions that are consistent with the Net Zero pathway. DfT should consider whether a "vision and validate" approach to the future transport system might be more appropriate than a "predict and provide" one in this context.</p> <p>Primary responsibility: DfT Supporting actors: HMT</p>	2022
Surface transport	Electric vehicle charging infrastructure	<p>Continue to support widespread deployment of charging infrastructure, ensuring that deployment rates accelerate in line with the trajectory required to deliver a minimum of 300,000 public charge points by 2030.</p> <p>Primary responsibility: DfT Supporting actors: BEIS; Ofgem</p>	Ongoing
Surface transport	Electric vehicle charging infrastructure	<p>Set out clear expectations and targets as to what local authorities should do to develop and implement local charging strategies, along with milestones for the rate at which charge point provision is expected to expand. Ensure that local authorities all have the capacity and capability to develop these strategies and implement the actions required.</p> <p>Primary responsibility: DfT Supporting actors: DLUHC</p>	2022
Surface transport	Electric vehicle charging infrastructure	<p>Enact legislation requiring better reliability, accessibility, interoperability and ease-of-use at public charge points, as committed to in the Government response to the consultation on the consumer experience at public charge points.</p> <p>Primary responsibility: DfT</p>	Q1 2023
Surface transport	Electric vehicle charging infrastructure	<p>Review and strengthen rapid charger rollout plans on the major road network out to 2035, to ensure that drivers have the confidence that they can find reliable, available charge points as EV uptake grows.</p> <p>Primary responsibility: DfT Supporting actors: BEIS; Ofgem</p>	Ongoing
Surface transport	Freight demand	<p>Work with the freight industry to design and implement pilot schemes to explore approaches to reducing van and HGV usage in urban locations.</p> <p>Primary responsibility: DfT</p>	2022

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Surface transport	Public transport	<p>Prioritise delivery of a new, transparent fare structure that offers more affordable and reliable travel, ensuring fairness in relation to more carbon-intensive choices, and a more interlinked public transport system between operators.</p> <p>Primary responsibility: DfT</p>	Q1 2023
Surface transport	Public transport	<p>Publish a comprehensive plan setting out how Government's target of removing diesel trains from the railway by 2040 and achieving a Net Zero rail network by 2050 or earlier will be achieved.</p> <p>Primary responsibility: DfT</p>	2022
Surface transport	Public transport	<p>Work with the public transport sector to run a coordinated campaign to welcome people back to public transport after the pandemic. Work with operators and local transport authorities to avoid detrimental reductions in service provision or increases in fares.</p> <p>Primary responsibility: DfT Supporting actors: BEIS</p>	2022
Surface transport	Zero-emission HGVs	<p>Expand the current Zero-Emission Road Freight trials into full commercial-scale demonstrations of battery-electric, hydrogen, and electric road system technologies on UK roads.</p> <p>Primary responsibility: DfT</p>	2024
Surface transport	Zero-emission HGVs	<p>Develop a comprehensive policy package to deliver the phase-out dates for non-zero-emission buses, HGVs, and other road vehicles. This should build on the emerging findings from the Zero-Emission Road Freight trials, the rollout of zero-emission buses, and the feedback on the details of the ZEV mandate for cars and vans.</p> <p>Primary responsibility: DfT</p>	2023
Surface transport; Electricity supply	Electric vehicle charging infrastructure	<p>Explore ways to reduce the cost of local public charging for drivers who do not access to private off-street parking to make it more comparable to charging at home. This could include reducing VAT on some public charging, requiring residential building owners to install charge points in shared car parks, or offering subsidised charging for local residents.</p> <p>Primary responsibility: DfT Supporting actors: HMT</p>	Q1 2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), DfT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: DfT</p>	2023
International	Strategy	<p>The Government's 2030 Strategic Framework should set out how the international climate and environment capability built up during the UK's COP26 Presidency will be resourced, maintained and further developed to enable delivery of international climate goals. Particular focus should be given to plans for coordination and consistency across departments and the embedding of dedicated climate experts in areas such as trade, security and foreign policy.</p> <p>Primary responsibility: BEIS Supporting actors: DfT; COP Unit; FCDO; DIT; HMT; Defra</p>	2022 Priority

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Surface transport	Car demand	<p>Embed sustainable transport within the upcoming planning reforms in the upcoming Levelling Up and Regeneration Bill. This should recognise the role that place-shaping, active travel, public transport, and shared mobility can combine to play in reducing car dependence and realising a range of co-benefits. These factors should be required to be considered from the outset of all development planning.</p> <p>Primary responsibility: DLUHC Supporting actors: DfT</p>	2022 Priority
International; Cross-cutting	Strategy	<p>Set out the Government's approach to domestically achieving aims of priority sectoral COP26 Pledges before COP27.</p> <p>Primary responsibility: BEIS Supporting actors: DfT; CO & Number 10; Defra; COP Unit; FCDO; DIT</p>	2022
Aviation	Demand	<p>Fiscal policy should be used (e.g. taxation, quotas or a frequent flyer levy), alongside improvements in broadband, to embed positive behaviours that have arisen during the pandemic, replacing business travel with videoconferencing and online collaboration. The price of flying should be raised to the point that it acts as an effective signal to consumers that aviation has high emissions costs.</p> <p>Primary responsibility: HMT Supporting actors: DfT</p>	2022
Aviation	Demand	<p>Demand mitigation measures should be used to address price imbalances between aviation and low-emission forms of surface transport (e.g. rail travel). Taxes should send clearer signals to consumers on the high emissions cost of flying (e.g. by reversing the 2021 cut in Air Passenger Duty). Fair funding mechanisms should be used to ensure alternatives are affordable (e.g. invest in low-emission alternatives for journeys where domestic flights are faster/cheaper than surface transport).</p> <p>Primary responsibility: HMT Supporting actors: DfT</p>	2023
Manufacturing & construction; Agriculture & land use	Off-road mobile machinery	<p>Set out a strategy for decarbonisation of off-road mobile machinery to set direction for the private sector. The strategy should include policy proposals, which could include the future of emissions standards, and a proposal for how best local authorities can bring off-road mobile machinery into their regulatory framework for construction within urban areas.</p> <p>Primary responsibility: BEIS Supporting actors: DfT; DLUHC; Defra</p>	Q1 2023
Manufacturing & construction; Buildings; Surface transport	Resource efficiency	<p>Set out a plan to make an assessment of whole-life carbon and material use of public and private construction projects mandatory by 2025, to enable minimum standards to be set. The whole life carbon assessment should be sought at the planning stage to enable efforts to reduce embodied carbon and materials.</p> <p>Primary responsibility: DLUHC Supporting actors: DfT; BEIS</p>	2022
Shipping	Demand	<p>Consider how to avoid the extension of the UK Emissions Trading Scheme to shipping displacing activity to higher-carbon alternative modes (e.g. road freight).</p> <p>Primary responsibility: BEIS Supporting actors: DfT</p>	2022

Sector	Topic	Recommendations for the Department for Transport (DfT)	Timing
Surface transport	Electric cars and vans	<p>Develop plans for how targeted subsidies and taxation gradients will be used to support delivery of the ZEV mandate targets. These incentivise consumers to choose electric options and ensure that cost does not become a significant barrier to EV adoption.</p> <p>Primary responsibility: HMT Supporting actors: DfT</p>	Q1 2023
Surface transport	Electric cars and vans	<p>Work with the UK car industry to ensure that, where viable, EV supply chains are localised within the UK. This should include support for gigafactories to scale up at the pace required for UK manufacturing capacity to meet the Faraday Institution's recommendation of 140 GWh per year by 2040.</p> <p>Primary responsibility: BEIS Supporting actors: DfT</p>	Ongoing
Surface transport	Electric cars and vans	<p>Consult on regulations requiring EV batteries sold in the UK to be recyclable. These should be coordinated with requirements in other markets to ensure that batteries can be reliably recycled across jurisdictions.</p> <p>Primary responsibility: BEIS Supporting actors: DfT</p>	2022

Recommendations for the DLUHC

Sector	Topic	Recommendations for the Department for Levelling Up, Housing and Communities (DLUHC)	Timing
Surface transport	Car demand	<p>Embed sustainable transport within the upcoming planning reforms in the upcoming Levelling Up and Regeneration Bill. This should recognise the role that place-shaping, active travel, public transport, and shared mobility can combine to play in reducing car dependence and realising a range of co-benefits. These factors should be required to be considered from the outset of all development planning.</p> <p>Primary responsibility: DLUHC Supporting actors: DfT</p>	2022 Priority
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, planning decisions and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: DLUHC</p>	Ongoing
Cross-cutting	Governance	<p>Make clear the importance of ensuring that all developments consider how best to minimise lifetime emissions and adapt to climate change as part of the planning process. This should be achieved by embedding Net Zero alignment as a core requirement within the planning reforms in the upcoming Levelling Up and Regeneration Bill and the supporting frameworks and guidance documents.</p> <p>Primary responsibility: DLUHC Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Buildings	New buildings	<p>To ensure that the Future Homes Standard will be fully implemented by 2025 and delivers homes with ultra-high energy efficiency standards, low-carbon heating and resilient to climate change impacts, consult on a full technical specification for the new standard in 2023 in order to allow legislation in 2024. Define clear transitional arrangements which will require any buildings which have not meaningfully commenced on site within a year of the implementation date to meet the new standards.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings	New buildings	<p>Ensure that the Future Homes Standard requires low-carbon heating, and mitigation of overheating, in homes which are created through a material change of use to an existing building.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings	New buildings	<p>Consult on a full technical specification for the Future Buildings Standard in 2023. Ensure that the new standards are implemented by 2025, and will deliver new buildings which are resilient to climate change impacts, with ultra-high energy efficiency standards and low-carbon heating.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023

Sector	Topic	Recommendations for the Department for Levelling Up, Housing and Communities (DLUHC)	Timing
Buildings	Building standards and enforcement	<p>Implement improvements to the Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP) framework to ensure they drive deployment of the necessary energy efficiency and low-carbon heat measures and also address overheating, ventilation, and moisture-risk. This should be done in coordination with Devolved Administrations.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS; Scotland; Wales; N. Ireland</p>	H1 2023
Buildings	Building standards and enforcement	<p>Publish plans to address enforcement issues for building standards and minimum EPC requirements, including consideration of additional measures to monitor compliance of qualified installers, approved inspectors and EPC assessors, and providing local areas with sufficient resource to undertake assessments.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS; HMT</p>	H1 2023
Buildings	Building standards and enforcement	<p>Publish clear plans to move towards in-use performance metrics for buildings, with clear timescales and responsibilities. Consider the case for moving towards Green Buildings Passports.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2023
Buildings; Surface transport	Government estate	<p>Develop and implement plans to make all public sector buildings and vehicle fleets within the department's remit zero carbon in the long-term, switching to ultra-low emissions vehicles by 2030 and halving emissions from public buildings by 2032.</p> <p>Primary responsibility: DLUHC</p>	H1 2023
Manufacturing & Construction; Buildings; Surface transport	Resource efficiency	<p>Set out a plan to make an assessment of whole-life carbon and material use of public and private construction projects mandatory by 2025, to enable minimum standards to be set. The whole life carbon assessment should be sought at the planning stage to enable efforts to reduce embodied carbon and materials.</p> <p>Primary responsibility: DLUHC Supporting actors: DfT; BEIS</p>	2022
Agriculture & land use	Adaptation	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority Third Climate Change Risk Assessment risks for which DLUHC has lead responsibility, coordinating work with other relevant departments as necessary: Risks to human health, wellbeing and productivity from increased exposure to heat in homes and buildings (with DHSC).</p> <p>Primary responsibility: DLUHC</p>	2022
Buildings	Adaptation	<p>To help improve the information on Sustainable Drainage Systems (SuDS) and surface water flood risk, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences.</p> <p>Primary responsibility: DLUHC</p>	2022

Sector	Topic	Recommendations for the Department for Levelling Up, Housing and Communities (DLUHC)	Timing
Buildings	Adaptation	<p>Expand overheating requirement in building regulations to cover refurbishments of existing buildings and conversions of non-residential buildings to residential.</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2022
Buildings	Adaptation	<p>Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise</p> <p>Primary responsibility: DLUHC Supporting actors: BEIS</p>	2022
Buildings	Adaptation	<p>Ensure that all types of current and future flood risk are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues.</p> <p>Primary responsibility: DLUHC</p>	2022
Buildings	Adaptation	<p>End the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits.</p> <p>Primary responsibility: DLUHC</p>	2022
Buildings	Adaptation	<p>The consultation process for surface water flood risk must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that Local Authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice.</p> <p>Primary responsibility: DLUHC</p>	2022
Buildings	Adaptation	<p>Assessments and management of flood risk in new developments must as a minimum include evidence that the development will be safe over its full lifetime and consider downstream interactions and impacts of new developments. Assessments must as a minimum: consider 2°C and 4°C climate scenarios, the risk of flooding to local infrastructure and include a consideration of better preparedness as set out in the Government's recent FCERM Policy Statement.</p> <p>Primary responsibility: DLUHC</p>	2022
Buildings	Adaptation	<p>Ensure there are properly funded and trained staff in local authorities to assess flood risk.</p> <p>Primary responsibility: DLUHC Supporting actors: HMT</p>	2022
Cross-cutting	Adaptation	<p>Introduce an urban greenspace target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year Plan goals are met.</p> <p>Primary responsibility: DLUHC</p>	2022

Sector	Topic	Recommendations for the Department for Levelling Up, Housing and Communities (DLUHC)	Timing
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), DLUHC should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: DLUHC</p>	2023
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; Scotland; Wales; N. Ireland</p>	2022 Priority
Buildings	Public engagement	<p>Create a public energy advice service to provide households with guidance on decarbonising and adapting their homes to climate change by this summer, as committed in the Energy Security Strategy. This should include an online platform including high-level trusted information and advice (including on Government schemes), a link to local providers who can undertake assessments of home energy performance, and bespoke support for households wishing to undertake more complex retrofits.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022 Priority
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum also addresses the question of local government powers, capability/capacity, and funding to identify gaps and barriers that could hinder the ability of local government to deliver the roles and responsibilities for delivery of Net Zero that have been agreed with central government. This should aim to build a better understanding of the current landscape, so that Government will be able to develop an evidence-based plan for how to enable cost-effective delivery of the actions that are required from local government; and share the insights, lessons and next-steps that the Forum has identified with all relevant authorities.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; HMT</p>	Q1 2023
Cross-cutting	Governance	<p>Develop an agreed, consistent approach to developing local area energy plans. Local authorities should be supported (financially and with appropriate skills and knowledge-sharing) to develop these credible delivery plans, and they should become a condition of receipt of UK Infrastructure Bank and other Net Zero funding.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	Q1 2023
Cross-cutting	Workers and skills	<p>Publish an Action Plan for Net Zero Skills that includes a comprehensive assessment of when, where, and in which sectors there will be skill gaps specific to Net Zero. This should include consideration of particular barriers to labour market entry into occupations needed for the transition and Government plans for action on the skill system to facilitate entry into these occupations.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; DfE; DWP; Home Office</p>	2022

Sector	Topic	Recommendations for the Department for Levelling Up, Housing and Communities (DLUHC)	Timing
Aviation	Demand	<p>Assess the Government's airport capacity strategy in the context of Net Zero, as part of the aviation strategy. There should be no net expansion of UK airport capacity unless the carbon-intensity of aviation is in line with or ahead of the Government's pathway and can accommodate the additional demand. A demand management framework will need to be developed by 2023 and be in place by the mid-2020s to annually assess and, if required, control sector GHG emissions and non-CO₂ effects.</p> <p>Primary responsibility: DfT Supporting actors: DLUHC</p>	2023
Buildings	Public engagement	<p>Support the launch of the energy advice service with a widespread publicity campaign, to ensure awareness of the service reaches millions of households across the UK each year, including those who may not yet have thought about retrofitting their homes.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Public engagement	<p>Monitor and publish data on the reach and effectiveness of the proposed energy advice service, ensuring the information offer to households on required changes to their homes is continuously improved in line with these findings, and results in genuine carbon savings.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	Ongoing
Buildings	Workers and skills	<p>Clearly set out how plans to grow and upskill the workforce will support the Government's pathways for low-carbon heat and energy efficiency and fill the skills gap identified in the Heat and Buildings Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; DfE; DWP; Home Office</p>	2022
Manufacturing & construction; Agriculture & land use	Off-road mobile machinery	<p>Set out a strategy for decarbonisation of off-road mobile machinery to set direction for the private sector. The strategy should include policy proposals, which could include the future of emissions standards, and a proposal for how best local authorities can bring off-road mobile machinery into their regulatory framework for construction within urban areas.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC; Dft; Defra</p>	Q1 2023
Surface transport	Electric vehicle charging infrastructure	<p>Set out clear expectations and targets as to what local authorities should do to develop and implement local charging strategies, along with milestones for the rate at which charge point provision is expected to expand. Ensure that local authorities all have the capacity and capability to develop these strategies and implement the actions required.</p> <p>Primary responsibility: DfT Supporting actors: DLUHC</p>	2022
Buildings	Adaptation	<p>Conduct further research to understand when overheating occurs in existing homes, including ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and the number of homes currently adapted.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022

Sector	Topic	Recommendations for the Department for Levelling Up, Housing and Communities (DLUHC)	Timing
Buildings	Adaptation	<p>Develop and publish new guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behavioural options and the measures that can be installed to reduce internal temperatures.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	2022
Buildings	Adaptation	<p>Encourage retrofit of passive cooling measures. Consider how policies can ensure that when energy efficiency retrofit is carried out, overheating is considered and mitigated against if necessary.</p> <p>Primary responsibility: BEIS Supporting actors: DLUHC</p>	Ongoing

Recommendations for the DCMS

Sector	Topic	Recommendations for the Department for Digital, Culture, Media and Sport (DCMS)	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: DCMS</p>	Ongoing
Cross-cutting	Adaptation	<p>DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.</p> <p>Primary responsibility: DCMS</p>	Ongoing
Cross-cutting	Adaptation	<p>Resilience standards for the digital sector must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed.</p> <p>Primary responsibility: DCMS</p>	2022
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: DCMS</p>	2023
Cross-cutting	Adaptation	<p>Standards for digital infrastructure operators should include requirements to: assess climate risks under both 2°C and 4°C global climate scenarios; consider interdependencies with other critical infrastructure; and set out actions to reduce risk and monitor progress.</p> <p>Primary responsibility: DCMS</p>	2022
Cross-cutting	Adaptation	<p>National Adaptation Programme actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies must be completed.</p> <p>Primary responsibility: Defra Supporting actors: DCMS</p>	Ongoing

Recommendations for the DfE

Sector	Topic	Recommendations for the Department for Education (DfE)	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: DfE</p>	Ongoing
Buildings	Adaptation	<p>DfE should publish an assessment of the specific vulnerability of publicly-owned schools and other educational facilities to the effects of climate change, in particular overheating and flooding.</p> <p>Primary responsibility: DfE</p>	2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), DfE should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the one risk in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: DfE</p>	2023
Cross-cutting	Workers and skills	<p>Publish an Action Plan for Net Zero Skills that includes a comprehensive assessment of when, where, and in which sectors there will be skill gaps specific to Net Zero. This should include consideration of particular barriers to labour market entry into occupations needed for the transition and Government plans for action on the skill system to facilitate entry into these occupations.</p> <p>Primary responsibility: BEIS Supporting actors: DfE; DWP; DLUHC; Home Office</p>	2022
Buildings	Workers and skills	<p>Clearly set out how plans to grow and upskill the workforce will support the Government's pathways for low-carbon heat and energy efficiency and fill the skills gap identified in the Heat and Buildings Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: DfE; DWP; DLUHC; Home Office</p>	2022

Recommendations for the DWP

Sector	Topic	Recommendations for the Department for Work and Pensions (DWP)	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: DWP</p>	Ongoing
Buildings; Surface transport	Government estate	<p>Publish the completed carbon and water management plan and the sustainability management plan that is under development. The plan should include clear pathways for reaching Greening the Government Commitment targets, switching to ultra-low emissions vehicles by 2030 and halving emissions from public buildings by 2032</p> <p>Primary responsibility: DWP</p>	H1 2023
Cross-cutting	Workers and skills	<p>Publish an Action Plan for Net Zero Skills that includes a comprehensive assessment of when, where, and in which sectors there will be skill gaps specific to Net Zero. This should include consideration of particular barriers to labour market entry into occupations needed for the transition and Government plans for action on the skill system to facilitate entry into these occupations.</p> <p>Primary responsibility: BEIS Supporting actors: DWP; DfE; DLUHC; Home Office</p>	2022
Buildings	Workers and skills	<p>Clearly set out how plans to grow and upskill the workforce will support the Government's pathways for low-carbon heat and energy efficiency and fill the skills gap identified in the Heat and Buildings Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: DWP; DfE; DLUHC; Home Office</p>	2022
Buildings	Fuel poor homes	<p>Publish plans to improve the targeting of support for fuel poor households to retrofit their homes, including through clear steps and timelines to facilitate data sharing between Government departments.</p> <p>Primary responsibility: BEIS Supporting actors: DWP; HMRC</p>	2023
Manufacturing & construction	Workers and skills	<p>Design industrial decarbonisation policies to support and create jobs, especially in regions with reliance on industrial jobs.</p> <p>Primary responsibility: BEIS Supporting actors: DWP</p>	Ongoing

Recommendations for the DHSC

Sector	Topic	Recommendations for the Department of Health and Social Care (DHSC)	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: DHSC</p>	Ongoing
Cross-cutting	Health	<p>Deliver climate policy that also has health benefits, such as active travel, access to green spaces, air quality, better buildings and healthier diets. This could be done by reviewing ways in which DHSC public guidelines could integrate messages that strengthen and make more evident the co-benefits of good nutrition and exercise for both health and for the environment.</p> <p>Primary responsibility: DHSC</p>	Ongoing
Cross-cutting	Health	<p>Publicly commit to providing additional, ringfenced funding to NHS England to fund the entirety of the delivery of its Net Zero plan.</p> <p>Primary responsibility: DHSC</p>	Q1 2023
F-Gas	F-gas technology replacement	<p>Publicly set targets to end the use of Metered Dose Inhalers (MDIs) for all patients where alternatives can be used, by the mid-2020s, for all NHS and private healthcare services across the four nations of the UK. For patients where MDIs are necessary, end the use of MDIs that use propellant gases with 100 year Global Warming Potentials above 200 times that of carbon dioxide. Publish a plan setting out how the Government will meet these targets.</p> <p>Primary responsibility: DHSC</p>	Q1 2023
Buildings	Adaptation	<p>DHSC should publish an assessment of the specific vulnerability of publicly-owned hospitals and other health and care facilities to the effects of climate change, in particular overheating and flooding.</p> <p>Primary responsibility: DHSC</p>	2023
Buildings	Adaptation	<p>Assess health sector vulnerability to existing and future climate risks, particularly for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from DHSC, CQC, PHE, NHS, MHCLG and local level public health bodies.</p> <p>Primary responsibility: DHSC</p>	2022
Cross-cutting	Adaptation	<p>Fund the strengthening and widening of vector and pathogen surveillance and early-warning mechanisms, due to the increasing risk of disease spread as a result of climate change and other factors.</p> <p>Primary responsibility: DHSC</p>	2022
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), DHSC should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: DHSC</p>	2023

Sector	Topic	Recommendations for the Department of Health and Social Care (DHSC)	Timing
F-Gas	International F-gas action	<p>Publicly push for stronger international action on reducing F-gases under the Kigali Amendment to the Montreal Protocol, including making it compatible with reaching Net Zero greenhouse gas emissions, encouraging more countries to ratify the Protocol and the Amendment, improving international monitoring of emissions, supporting the development of more robust estimates of emission metrics, and supporting the reduction of inhaler emissions in other countries' health services.</p> <p>Primary responsibility: Defra Supporting actors: DHSC</p>	Q1 2023

Recommendations for the MoJ

Sector	Topic	Recommendations for the Ministry of Justice (MoJ)	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: MoJ</p>	Ongoing
Buildings; Surface transport	Government estate	<p>Publish MoJ's Net Zero Carbon Strategy. The strategy should include clear pathways for reaching Greening the Government Commitment targets, switching to ultra-low emissions vehicles by 2030 and halving emissions from public buildings by 2032</p> <p>Primary responsibility: MoJ</p>	H1 2023
Cross-cutting	Adaptation	<p>For the coming five-year period (2023-2028), MoJ should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the Third Climate Change Risk Assessment for which it is the lead department (see 2021 Adaptation Progress Report annex).</p> <p>Primary responsibility: MoJ</p>	2023

Recommendations for the Home Office

Sector	Topic	Recommendations for the Home Office	Timing
Buildings; Surface transport		<p>Building on findings from the Home Office's studies into net zero technologies and Electric Vehicle Charge Points, publish a net zero carbon strategy for the Home Office. The strategy should include clear pathways for reaching Greening the Government Commitment targets, switching to ultra-low emissions vehicles by 2030 and halving emissions from public buildings by 2032</p> <p>Primary responsibility: Home Office</p>	H1 2023
Cross-cutting	Workers and skills	<p>Publish an Action Plan for Net Zero Skills that includes a comprehensive assessment of when, where, and in which sectors there will be skill gaps specific to Net Zero. This should include consideration of particular barriers to labour market entry into occupations needed for the transition and Government plans for action on the skill system to facilitate entry into these occupations.</p> <p>Primary responsibility: BEIS Supporting actors: Home Office; DfE; DWP; DLUHC</p>	2022
Buildings	Workers and skills	<p>Clearly set out how plans to grow and upskill the workforce will support the Government's pathways for low-carbon heat and energy efficiency and fill the skills gap identified in the Heat and Buildings Strategy.</p> <p>Primary responsibility: BEIS Supporting actors: Home Office; DfE; DWP; DLUHC</p>	2022

Recommendations for the MoD

Sector	Topic	Recommendations for the Ministry of Defence (MoD)	Timing
Cross-cutting	Governance	<p>Ensure all of the department's own policy decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: MoD</p>	Ongoing
Buildings; Surface transport	Government estate	<p>Develop and implement plans to make all public sector buildings and vehicle fleets within the department's remit zero carbon in the long-term, switching to ultra-low emissions vehicles by 2030 and halving emissions from public buildings by 2032.</p> <p>Primary responsibility: MoD</p>	H1 2023

Recommendations for Ofgem

Sector	Topic	Recommendations for the Office of Gas and Electricity Markets (Ofgem)	Timing
Cross-cutting	Governance	<p>Ensure all regulatory decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: Ofgem</p>	Ongoing
Electricity supply	Networks	<p>Publish a strategic framework identifying the network requirements for Net Zero, and the changes needed to ensure investments in resilient infrastructure are identified, planned, consented and built in sufficient time to accommodate increased demand and generation.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022 Priority
Electricity supply	Networks	<p>Publish a strategy to coordinate the development of interconnectors and connections for offshore wind farms to the onshore network, taking prompt action to ensure efficient implementation of the detailed regulatory and legislative changes necessary for their timely delivery.</p> <p>Primary responsibility: BEIS Supporting actors: Ofgem</p>	2022 Priority
Surface transport	Electric vehicle charging infrastructure	<p>Continue to support widespread deployment of charging infrastructure, ensuring that deployment rates accelerate in line with the trajectory required to deliver a minimum of 300,000 public charge points by 2030.</p> <p>Primary responsibility: DfT Supporting actors: Ofgem; BEIS</p>	Ongoing
Surface transport	Electric vehicle charging infrastructure	<p>Review and strengthen rapid charger rollout plans on the major road network out to 2035, to ensure that drivers have the confidence that they can find reliable, available charge points as EV uptake grows.</p> <p>Primary responsibility: DfT Supporting actors: Ofgem; BEIS</p>	Ongoing

Recommendations for Ofwat

Sector	Topic	Recommendations for the Water Services Regulation Authority (Ofwat)	Timing
Cross-cutting	Governance	<p>Ensure all regulatory decisions, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p> <p>Primary responsibility: Ofwat</p>	Ongoing
Waste	Cross-cutting	<p>Require and facilitate water companies and industrial wastewater facilities to measure and report on emissions, including process emissions. Funding should be made available for monitoring and research to improve process emissions measurement and mitigation.</p> <p>Primary responsibility: Ofwat Supporting actors: Defra</p>	Q1 2023
Waste	Cross-cutting	<p>Clarify OFWAT's mandate to enable efforts to decarbonise wastewater treatment in addition to scrutinising companies' business plans ahead of the 2024 Price Review.</p> <p>Primary responsibility: Defra Supporting actors: Ofwat</p>	Q1 2023

Recommendations for the ONS

Sector	Topic	Recommendations for the Office for National Statistics (ONS)	Timing
Cross-cutting	Data	<p>Work with Government departments to fill the data gaps identified by CCC in the Monitoring Framework document accompanying this report.</p> <p>Primary responsibility: ONS</p>	Ongoing
Manufacturing & construction	Resource efficiency	<p>Invest to progress the National Materials Datahub to track materials and products to share information on their quantity and quality for reuse and repurposing to retain materials at their highest value for as long as possible.</p> <p>Primary responsibility: ONS</p>	Q1 2023
Manufacturing & construction	Data	<p>Review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting to enable effective monitoring and evaluation, and policy implementation. This will require additional data collection and reporting to allow for effective tracking of energy efficiency, material efficiency, fuel switching, CCS, including progress developing these measures, and more holistic measurement on a product or whole life cycle carbon basis. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry.</p> <p>Primary responsibility: BEIS Supporting actors: ONS; Defra</p>	Q1 2023 Priority
Cross-cutting	Trade and consumption emissions	<p>The Government should increase investment in, and improve the collection and reporting of, consumption emissions data. This should include (a) establishing a short- and medium-term strategy to improve the underlying methodology to ensure it can capture key improvements in the carbon intensity of imports (b) ensuring the resource to enable annual emissions statistics to be produced promptly each year.</p> <p>Primary responsibility: Defra Supporting actors: ONS</p>	Q1 2024
Agriculture & land use	Trade and consumption emissions	<p>Improve data collection and standardise methodologies for monitoring of, and reporting on, international land use emissions that arise from UK consumption, particularly from deforestation. The Government should aim to report on these international emissions from deforestation on an annual basis from 2023. This may build on the experimental statistic of the Joint Nature Conservation Committee.</p> <p>Primary responsibility: Defra Supporting actors: ONS</p>	Q1 2023

Recommendations for the Scottish Government

Sector	Topic	Recommendations for the Scottish Government	Timing
Cross-cutting	Delivery	<p>Scale up action to deliver targets across all sectors in line with the ambition set out in the recent Climate Change Plan update.</p> <p>Primary responsibility: Scotland</p>	Ongoing
Cross-cutting	Governance	<p>Publish the analysis that supports the total and sectoral pathways set out in the Scotland's Climate Change Plan update.</p> <p>Primary responsibility: Scotland</p>	2022
Agriculture & land use	CAP reform	<p>Provide detail on how post-CAP agricultural subsidies and schemes in Scotland will target incentives and delivery for climate mitigation alongside wider environmental goals such as climate change adaptation and biodiversity.</p> <p>Primary responsibility: Scotland</p>	2022
Aviation	Demand	<p>Seek to address price imbalances between aviation and surface transport, once aviation taxation is devolved to Scotland, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists.</p> <p>Primary responsibility: Scotland</p>	2023
Buildings	Progress monitoring and data	<p>Publish more detail on the modelled pathway for low-carbon heat, and planned breakdown of funding announced in the Scotland Heat in Buildings Strategy.</p> <p>Primary responsibility: Scotland</p>	2022
Surface transport	Car demand; Active travel	<p>Publish a strategy setting out how the Scottish Government will achieve a 20% reduction in car-kilometres by 2030 and deliver 20-minute neighbourhoods. This should be supported by: (1) continuing to strengthen schemes to support walking, cycling, and public transport, (2) investment in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand (e.g. home-working), and (3) supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</p> <p>Primary responsibility: Scotland</p>	2022
Surface transport	Electric vehicle charging infrastructure	<p>Continue to support the expansion of Scotland's public EV charge point network, to ensure the EV transition works for all road users in Scotland.</p> <p>Primary responsibility: Scotland</p>	Ongoing
Waste	Energy from Waste / Incineration	<p>Start reporting emissions from Energy from Waste as a separate source within the Scottish greenhouse gas inventory.</p> <p>Primary responsibility: Scotland</p>	Q1 2023
Waste; Manufacturing & construction	Waste prevention	<p>Legislate the Circular Economy Bill and set targets to reduce waste and improve recycling rates beyond 2025, ensuring these are more ambitious than existing targets.</p> <p>Primary responsibility: Scotland</p>	2023

Sector	Topic	Recommendations for the Scottish Government	Timing
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: Scotland; DLUHC; Wales; N. Ireland</p>	2022 Priority
Agriculture & land use	Agriculture and land use strategy	<p>Set out a Net Zero delivery strategy for the agriculture and land use sectors that brings together how land can deliver its multiple functions including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, domestic biomass production and wider environmental goals. The strategy must clearly outline the relationships and interactions between the multiple action plans in development (e.g. including those for peat, trees, nature, plant biosecurity and biomass), be spatially and temporally targeted, and aligned with action in the devolved administrations.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023 Priority
Agriculture & land use	Trees and woodland	<p>Ensure that funding and incentives are set at the correct level to meet the UK Government afforestation target of 30,000 hectares per year by 2025, and illustrative Net Zero Strategy targets of 40,000 hectares and 50,000 hectares by 2030 and 2035 respectively. Further clarity is required regarding funding beyond 2025. This should also address wider objectives for land such as climate adaptation and nature conservation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023 Priority
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; BEIS; Wales; N. Ireland</p>	2023 Priority
Cross-cutting	Governance	<p>Make clear the importance of ensuring that all developments consider how best to minimise lifetime emissions and adapt to climate change as part of the planning process. This should be achieved by embedding Net Zero alignment as a core requirement within the planning reforms in the upcoming Levelling Up and Regeneration Bill and the supporting frameworks and guidance documents.</p> <p>Primary responsibility: DLUHC Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Cross-cutting	Governance	<p>Ensure that all policies, funding, and delivery mechanisms are properly aligned to the pace of transition required and work together constructively towards Net Zero, for example through introduction of a Net Zero Test.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Scotland; BEIS; HMT; Wales; N. Ireland</p>	Q1 2023

Sector	Topic	Recommendations for the Scottish Government	Timing
Cross-cutting	Governance	<p>Extend the delivery of climate skills training across the Civil Service and wider public sector. Consider what wider supporting skills (delivery, coordination, legal, financial) will be needed in the public sector to enable effective delivery of the transition to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Scotland; BEIS; Wales; N. Ireland</p>	Ongoing
Cross-cutting	Governance	<p>Review how effective existing mechanisms for coordinating delivery with the devolved administrations (including the Inter-Ministerial Group, the Nations Board, and departmental-level engagement) have been at securing input to the design of and buy-in to implementation of recent major strategies relating to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Cross-cutting	Governance	<p>Increase transparency around Government's expected pathways to Net Zero. This should involve publishing more details on the assumptions that underpin these pathways and how the abatement set out in the Net Zero Strategy will be achieved by planned policies, setting out the quantified abatement expected to be achieved by each policy.</p> <p>Primary responsibility: BEIS Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Agroforestry and hedgerows	<p>Set incentives to support agroforestry and hedgerows on UK farms. Plant trees on 2% of farmland by 2025 while maintaining its primary use, rising to 5% by 2035, and extend hedgerows by 20% by 2035 and better manage existing hedgerows.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	CAP reform	<p>Put in place robust frameworks for monitoring, reporting and verification of post-CAP farm subsidies and agriculture environment schemes to assess their effectiveness in delivering their environmental objectives, including for climate change mitigation and adaptation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Diet and demand	<p>Take low-cost, low-regret actions to encourage a 20% shift away from all meat by 2030, rising to 35% by 2050, and a 20% shift from dairy products by 2030, demonstrating leadership in the public sector whilst improving health.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Agriculture & land use	Diet and demand	<p>Introduce policy to support the reduction of food waste at the farm, supply chain and household level. Food waste reduction, and its implications, should also be integrated into the recommended Net Zero delivery strategy for the agriculture and land use sectors , as well as in plans for the waste sector.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023

Sector	Topic	Recommendations for the Scottish Government	Timing
Agriculture & land use	Finance	<p>Set out how public and private funding for agricultural and land-based measures will be aligned, how opportunities to attract increased private finance for habitat creation and restoration will be developed, and promote the use of existing verifiable standards (such as the Woodland Carbon Code and Peatland Code) whilst also considering the need to develop new ones.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Agriculture & land use	Low-carbon farming	<p>As part of strengthening the regulatory baseline, extend coverage of Nitrate Vulnerable Zones across all of the UK in order to promote best practice in management of inorganic fertilisers and organic manure and slurry.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2024
Agriculture & land use	Low-carbon farming	<p>Continue to support research and development into low-carbon farming practices, including behavioural, innovation and productivity measures. The risk of a high dependency on innovation and technology to meet GHG emission reductions should be assessed, and integrated with demand-side measures such as diet change and waste reduction.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Agriculture & land use	Low-carbon farming	<p>Move beyond the voluntary nature of current CAP replacement schemes by setting a strong regulatory baseline that strengthens rules such as those under cross compliance and retains them in UK legislation.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Low-carbon farming	<p>Set in place action to overcome financial barriers that prevent take-up and innovation in low-carbon farming practices. This should include management incentives under the ELM scheme and approaches set by devolved administrations, grants for capital items and infrastructure, and support for research and development.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Non-financial barriers	<p>Develop understanding on how the transition to Net Zero in the agriculture and land will affect employment in these sectors, including a timeframe of change and the scale of impact. Set out how the change will be managed to be fair and equitable, ensuring new skills and training are widely available to both support communities, but also to facilitate the meeting of targets in these sectors.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Agriculture & land use	Non-financial barriers	<p>Provide support to tenant farmers to overcome contractual issues that restrict the long-term commitment and investment required to reduce emissions and sequester carbon on the land they manage.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023

Sector	Topic	Recommendations for the Scottish Government	Timing
Agriculture & land use	Non-financial barriers	<p>Set in place action to overcome non-financial barriers that prevent adoption of low-carbon farming measures and land-use change to deliver emission reduction and carbon benefits. These include streamlining application processes and providing support for skills, training, and knowledge exchange in order to provide confidence to farmers to take up new measures.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Ensure incentives are set at the correct level to set a trajectory to achieve 58% of peatland restored by 2035, and 79% under restoration by 2050. All upland peat should be under restoration management by 2045.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Introduce policy to end rotational burning on peatland before the start of the 2022 burn season.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2022
Agriculture & land use	Peatlands	<p>Set out clear timeframes to end domestic and industrial peat extraction across the UK. Provide a mechanism to ensure the peat extraction industries restore extraction sites to protect the peat resource.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Where peat soils remain under agricultural use, set out how they will be managed in a more sustainable way. This should include raising water levels on 8% of lowland grassland by 2025, reaching 25% by 2035, and 12% of arable crops by 2025, reaching 38% by 2035.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Agriculture & land use	Trees and woodland	<p>Work with the forestry sector and government agencies to support UK tree nurseries to increase domestic production of trees to meet the planting ambition and reduce reliance on imports, along with the associated risks of pests and disease.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	2023
Agriculture & land use; Manufacturing & construction	Trees and woodland	<p>Develop a comprehensive plan to increase the production and use of UK sourced timber and support the long-term economic viability of domestic woodlands.</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2023
Buildings	Building standards and enforcement	<p>Implement improvements to the Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP) framework to ensure they drive deployment of the necessary energy efficiency and low-carbon heat measures and also address overheating, ventilation, and moisture-risk. This should be done in coordination with Devolved Administrations.</p> <p>Primary responsibility: DLUHC Supporting actors: Scotland; BEIS; Wales; N. Ireland</p>	H1 2023

Sector	Topic	Recommendations for the Scottish Government	Timing
Engineered removals	Governance	<p>Work with the Interministerial Group for Net Zero, Energy and Climate Change to publish a joint position on the contribution of engineered removals and CCS to meeting UK-wide and DA targets to 2030.</p> <p>Primary responsibility: BEIS Supporting actors: Scotland; N. Ireland</p>	2023
Waste; Manufacturing & construction	Waste prevention	<p>Implement initial Extended Producer Responsibility, the Deposit Return Scheme and consistent collections of recycling and food waste without further delay. Complete an independent review of the impact of the schemes within 2 years of implementation (i.e. by 2026).</p> <p>Primary responsibility: Defra Supporting actors: Scotland; Wales; N. Ireland</p>	Q1 2024

Recommendations for the Welsh Government

Sector	Topic	Recommendations for the Welsh Government	Timing
Cross-cutting	Governance	<p>Publish the analysis that supports the total and sectoral pathways set out in the Second Welsh Carbon Budget.</p> <p>Primary responsibility: Wales</p>	2022
Agriculture & land use	CAP reform	<p>Provide detail on how post-CAP agricultural subsidies and schemes in Wales will target incentives and delivery for climate mitigation alongside wider environmental goals such as climate change adaptation and biodiversity.</p> <p>Primary responsibility: Wales</p>	2022
Buildings	Low-carbon heat	<p>Building on the plans set out in Net Zero Wales Carbon Budget 2, publish a long-term strategy, setting out a pathway up until 2050 for decarbonising buildings with key policy milestones and targets for low-carbon heating and energy efficiency roll-out. This should include policies to support low-carbon heating across all of the building stock, including how Wales will transition away from fossil fuel heating and ensure local actors are able to conduct spatial planning for heat networks</p> <p>Primary responsibility: Wales</p>	2023
Buildings	Fuel poor homes	<p>Drawing on the recommendations of the Auditor General for Wales, publish plans for future iterations of the Warm Homes Programme to tackle fuel poverty and decarbonise homes, addressing the scheme's reliance on fossil fuel heating and slow roll-out.</p> <p>Primary responsibility: Wales</p>	2023
Surface transport	Car demand; Active travel	<p>Deliver on the priorities set out in Llbwyr Newydd to reduce demand for higher-carbon travel. This includes: (1) delivering a better, more integrated, decarbonised bus system, (2) developing a network of connected local routes for walking and cycling, (3) investing in infrastructure connectivity to enable delivery of the ambition for 30% of the workforce to work remotely on a regular basis, and (4) supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</p> <p>Primary responsibility: Wales</p>	2022
Surface transport	Electric vehicle charging infrastructure	<p>Support delivery of a charging network that meets the ambition set out in the Electric Vehicle Charging Strategy, to ensure the EV transition works for all road users in Wales.</p> <p>Primary responsibility: Wales</p>	Ongoing
Waste	Infrastructure	<p>Publish an assessment of residual waste treatment capacity needs through to 2050, consistent with meeting committed and prospective recycling and waste reduction targets, expected resource efficiency improvements and the stated goal to end the landfilling of biodegradable waste by 2025. The findings of this review should inform future incineration/EfW capacity decisions and consider the feasibility of phasing out waste exports by 2030.</p> <p>Primary responsibility: Wales</p>	2022
Waste; Manufacturing & construction	Waste prevention	<p>Set ambitious recycling targets for 2030 and beyond, improving on the 70% target for 2025.</p> <p>Primary responsibility: Wales</p>	Q1 2023

Sector	Topic	Recommendations for the Welsh Government	Timing
Waste; Manufacturing & construction	Waste prevention	<p>Set out and implement additional policies necessary to achieve waste reduction and recycling targets, as part of delivering the Beyond Recycling Strategy more broadly.</p> <p>Primary responsibility: Wales</p>	2023
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: Wales; DLUHC; Scotland; N. Ireland</p>	2022 Priority
Agriculture & land use	Agriculture and land use strategy	<p>Set out a Net Zero delivery strategy for the agriculture and land use sectors that brings together how land can deliver its multiple functions including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, domestic biomass production and wider environmental goals. The strategy must clearly outline the relationships and interactions between the multiple action plans in development (e.g. including those for peat, trees, nature, plant biosecurity and biomass), be spatially and temporally targeted, and aligned with action in the devolved administrations.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023 Priority
Agriculture & land use	Trees and woodland	<p>Ensure that funding and incentives are set at the correct level to meet the UK Government afforestation target of 30,000 hectares per year by 2025, and illustrative Net Zero Strategy targets of 40,000 hectares and 50,000 hectares by 2030 and 2035 respectively. Further clarity is required regarding funding beyond 2025. This should also address wider objectives for land such as climate adaptation and nature conservation.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2023 Priority
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: Wales; BEIS; Scotland; N. Ireland</p>	2023 Priority
Cross-cutting	Governance	<p>Make clear the importance of ensuring that all developments consider how best to minimise lifetime emissions and adapt to climate change as part of the planning process. This should be achieved by embedding Net Zero alignment as a core requirement within the planning reforms in the upcoming Levelling Up and Regeneration Bill and the supporting frameworks and guidance documents.</p> <p>Primary responsibility: DLUHC Supporting actors: Wales; Scotland; N. Ireland</p>	2022

Sector	Topic	Recommendations for the Welsh Government	Timing
Cross-cutting	Governance	<p>Ensure that all policies, funding, and delivery mechanisms are properly aligned to the pace of transition required and work together constructively towards Net Zero, for example through introduction of a Net Zero Test.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Wales; BEIS; HMT; Scotland; N. Ireland</p>	Q1 2023
Cross-cutting	Governance	<p>Extend the delivery of climate skills training across the Civil Service and wider public sector. Consider what wider supporting skills (delivery, coordination, legal, financial) will be needed in the public sector to enable effective delivery of the transition to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Wales; BEIS; Scotland; N. Ireland</p>	Ongoing
Cross-cutting	Governance	<p>Review how effective existing mechanisms for coordinating delivery with the devolved administrations (including the Inter-Ministerial Group, the Nations Board, and departmental-level engagement) have been at securing input to the design of and buy-in to implementation of recent major strategies relating to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: Wales; Scotland; N. Ireland</p>	2022
Cross-cutting	Governance	<p>Increase transparency around Government's expected pathways to Net Zero. This should involve publishing more details on the assumptions that underpin these pathways and how the abatement set out in the Net Zero Strategy will be achieved by planned policies, setting out the quantified abatement expected to be achieved by each policy.</p> <p>Primary responsibility: BEIS Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Agroforestry and hedgerows	<p>Set incentives to support agroforestry and hedgerows on UK farms. Plant trees on 2% of farmland by 2025 while maintaining its primary use, rising to 5% by 2035, and extend hedgerows by 20% by 2035 and better manage existing hedgerows.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	CAP reform	<p>Put in place robust frameworks for monitoring, reporting and verification of post-CAP farm subsidies and agriculture environment schemes to assess their effectiveness in delivering their environmental objectives, including for climate change mitigation and adaptation.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Diet and demand	<p>Take low-cost, low-regret actions to encourage a 20% shift away from all meat by 2030, rising to 35% by 2050, and a 20% shift from dairy products by 2030, demonstrating leadership in the public sector whilst improving health.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2022

Sector	Topic	Recommendations for the Welsh Government	Timing
Agriculture & land use	Diet and demand	<p>Introduce policy to support the reduction of food waste at the farm, supply chain and household level. Food waste reduction, and its implications, should also be integrated into the recommended Net Zero delivery strategy for the agriculture and land use sectors , as well as in plans for the waste sector.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Finance	<p>Set out how public and private funding for agricultural and land-based measures will be aligned, how opportunities to attract increased private finance for habitat creation and restoration will be developed, and promote the use of existing verifiable standards (such as the Woodland Carbon Code and Peatland Code) whilst also considering the need to develop new ones.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2022
Agriculture & land use	Low-carbon farming	<p>As part of strengthening the regulatory baseline, extend coverage of Nitrate Vulnerable Zones across all of the UK in order to promote best practice in management of inorganic fertilisers and organic manure and slurry.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2024
Agriculture & land use	Low-carbon farming	<p>Continue to support research and development into low-carbon farming practices, including behavioural, innovation and productivity measures. The risk of a high dependency on innovation and technology to meet GHG emission reductions should be assessed, and integrated with demand-side measures such as diet change and waste reduction.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2023
Agriculture & land use	Low-carbon farming	<p>Move beyond the voluntary nature of current CAP replacement schemes by setting a strong regulatory baseline that strengthens rules such as those under cross compliance and retains them in UK legislation.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Low-carbon farming	<p>Set in place action to overcome financial barriers that prevent take-up and innovation in low-carbon farming practices. This should include management incentives under the ELM scheme and approaches set by devolved administrations, grants for capital items and infrastructure, and support for research and development.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Non-financial barriers	<p>Develop understanding on how the transition to Net Zero in the agriculture and land will affect employment in these sectors, including a timeframe of change and the scale of impact. Set out how the change will be managed to be fair and equitable, ensuring new skills and training are widely available to both support communities, but also to facilitate the meeting of targets in these sectors.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2023

Sector	Topic	Recommendations for the Welsh Government	Timing
Agriculture & land use	Non-financial barriers	<p>Provide support to tenant farmers to overcome contractual issues that restrict the long-term commitment and investment required to reduce emissions and sequester carbon on the land they manage.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Non-financial barriers	<p>Set in place action to overcome non-financial barriers that prevent adoption of low-carbon farming measures and land-use change to deliver emission reduction and carbon benefits. These include streamlining application processes and providing support for skills, training, and knowledge exchange in order to provide confidence to farmers to take up new measures.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Ensure incentives are set at the correct level to set a trajectory to achieve 58% of peatland restored by 2035, and 79% under restoration by 2050. All upland peat should be under restoration management by 2045.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Introduce policy to end rotational burning on peatland before the start of the 2022 burn season.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2022
Agriculture & land use	Peatlands	<p>Introduce the proposed regulations to ban the retail sale of peat in horticulture in England and Wales by 2024. Use by the horticultural sector should also end in 2024, earlier than the currently proposed 2028. Government must work with the horticultural industry achieve this.</p> <p>Primary responsibility: Defra Supporting actors: Wales</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Set out clear timeframes to end domestic and industrial peat extraction across the UK. Provide a mechanism to ensure the peat extraction industries restore extraction sites to protect the peat resource.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Where peat soils remain under agricultural use, set out how they will be managed in a more sustainable way. This should include raising water levels on 8% of lowland grassland by 2025, reaching 25% by 2035, and 12% of arable crops by 2025, reaching 38% by 2035.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Agriculture & land use	Trees and woodland	<p>Work with the forestry sector and government agencies to support UK tree nurseries to increase domestic production of trees to meet the planting ambition and reduce reliance on imports, along with the associated risks of pests and disease.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	2023

Sector	Topic	Recommendations for the Welsh Government	Timing
Agriculture & land use; Manufacturing & construction	Trees and woodland	<p>Develop a comprehensive plan to increase the production and use of UK sourced timber and support the long-term economic viability of domestic woodlands.</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2023
Buildings	Building standards and enforcement	<p>Implement improvements to the Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP) framework to ensure they drive deployment of the necessary energy efficiency and low-carbon heat measures and also address overheating, ventilation, and moisture-risk. This should be done in coordination with Devolved Administrations.</p> <p>Primary responsibility: DLUHC Supporting actors: Wales; BEIS; Scotland; N. Ireland</p>	H1 2023
Waste; Manufacturing & construction	Waste prevention	<p>Implement initial Extended Producer Responsibility, the Deposit Return Scheme and consistent collections of recycling and food waste without further delay. Complete an independent review of the impact of the schemes within 2 years of implementation (i.e. by 2026).</p> <p>Primary responsibility: Defra Supporting actors: Wales; Scotland; N. Ireland</p>	Q1 2024

Recommendations for the Northern Ireland Executive

Sector	Topic	Recommendations for the Northern Ireland Executive	Timing
Agriculture & land use	CAP reform	<p>Provide detail on how post-CAP agricultural subsidies and schemes in Northern Ireland will target incentives and delivery for climate mitigation alongside wider environmental goals such as climate change adaptation and biodiversity.</p> <p>Primary responsibility: N. Ireland</p>	2022
Aviation	Demand	<p>Long-haul air passenger duty, which is devolved to Northern Ireland, should be increased at least in line with UK-wide long-distance air passenger duty, to better reflect the climate change impact of flying.</p> <p>Primary responsibility: N. Ireland</p>	2022
Buildings	Strategy	<p>Publish the Decarbonising Heat Consultation and follow on with a coherent, long-term strategy for heat and energy efficiency in Northern Ireland's homes and other buildings; encompassing regulatory, policy and funding commitments to facilitate delivery.</p> <p>Primary responsibility: N. Ireland</p>	2023
Surface transport	Car demand; Active travel	<p>Strengthen support for and provision of schemes to support walking, cycling and public transport to reduce Northern Ireland's high levels of car-dependence: (1) strengthen schemes to ensure access to local amenities without dependency on cars, (2) invest in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand, e.g. home-working, and (3) support the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</p> <p>Primary responsibility: N. Ireland</p>	2022
Surface transport	Data	<p>Resume collecting and publishing data on vehicle-kilometres travelled by mode in Northern Ireland. This will help identify which actions are effective in encouraging modal shift away from car travel.</p> <p>Primary responsibility: N. Ireland</p>	2022
Surface transport	Electric vehicle charging infrastructure	<p>Support the deployment of public charge points across Northern Ireland, to address the issue that Northern Ireland currently has the fewest EV charge points per capita of any of the UK nations.</p> <p>Primary responsibility: N. Ireland</p>	Ongoing
Waste	Infrastructure	<p>Publish an assessment of residual waste treatment capacity needs through to 2050, consistent with meeting committed and prospective recycling and waste reduction targets, expected resource efficiency improvements and ending the landfilling of biodegradable waste by 2028 at the latest. The findings of this review should inform future incineration/EfW capacity decisions and consider the feasibility of phasing out waste exports by 2030.</p> <p>Primary responsibility: N. Ireland</p>	2022
Waste; Manufacturing & construction	Waste prevention	<p>Finalise the Green Growth Plan and Environment Strategy and ensure it includes targets for waste reduction and recycling out to 2030 and beyond that are more ambitious than existing targets.</p> <p>Primary responsibility: N. Ireland</p>	2023

Sector	Topic	Recommendations for the Northern Ireland Executive	Timing
Waste; Manufacturing & construction	Waste prevention	<p>Set out policies to deliver waste and circular economy objectives of the Green Growth Strategy and Environment Strategy.</p> <p>Primary responsibility: N. Ireland</p>	Q1 2023
Cross-cutting	Governance	<p>Ensure that the Local Net Zero Forum addresses the question of what aspects of Net Zero central and local government are responsible for and how these will be coordinated. As well as sharing local best practice, this should lead to a clearer shared understanding of roles and responsibilities which can be communicated across local government.</p> <p>Primary responsibility: BEIS Supporting actors: N. Ireland; DLUHC; Scotland; Wales</p>	2022 Priority
Agriculture & land use	Agriculture and land use strategy	<p>Set out a Net Zero delivery strategy for the agriculture and land use sectors that brings together how land can deliver its multiple functions including: reducing emissions and sequestering carbon, adapting to climate change, food security, biodiversity, domestic biomass production and wider environmental goals. The strategy must clearly outline the relationships and interactions between the multiple action plans in development (e.g. including those for peat, trees, nature, plant biosecurity and biomass), be spatially and temporally targeted, and aligned with action in the devolved administrations.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023 Priority
Agriculture & land use	Trees and woodland	<p>Ensure that funding and incentives are set at the correct level to meet the UK Government afforestation target of 30,000 hectares per year by 2025, and illustrative Net Zero Strategy targets of 40,000 hectares and 50,000 hectares by 2030 and 2035 respectively. Further clarity is required regarding funding beyond 2025. This should also address wider objectives for land such as climate adaptation and nature conservation.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2023 Priority
Waste	Cross-cutting	<p>Publish a detailed plan to decarbonise the waste sector (including Energy from Waste and wastewater) in line with meeting the Sixth Carbon Budget and Net Zero.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; BEIS; Wales; Scotland</p>	2023 Priority
Cross-cutting	Governance	<p>Make clear the importance of ensuring that all developments consider how best to minimise lifetime emissions and adapt to climate change as part of the planning process. This should be achieved by embedding Net Zero alignment as a core requirement within the planning reforms in the upcoming Levelling Up and Regeneration Bill and the supporting frameworks and guidance documents.</p> <p>Primary responsibility: DLUHC Supporting actors: N. Ireland; Scotland; Wales</p>	2022
Cross-cutting	Governance	<p>Ensure that all policies, funding, and delivery mechanisms are properly aligned to the pace of transition required and work together constructively towards Net Zero, for example through introduction of a Net Zero Test.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: N. Ireland; BEIS; HMT; Scotland; Wales</p>	Q1 2023

Sector	Topic	Recommendations for the Northern Ireland Executive	Timing
Cross-cutting	Governance	<p>Extend the delivery of climate skills training across the Civil Service and wider public sector. Consider what wider supporting skills (delivery, coordination, legal, financial) will be needed in the public sector to enable effective delivery of the transition to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: N. Ireland; BEIS; Scotland; Wales</p>	Ongoing
Cross-cutting	Governance	<p>Review how effective existing mechanisms for coordinating delivery with the devolved administrations (including the Inter-Ministerial Group, the Nations Board, and departmental-level engagement) have been at securing input to the design of and buy-in to implementation of recent major strategies relating to Net Zero.</p> <p>Primary responsibility: CO & Number 10 Supporting actors: N. Ireland; Scotland; Wales</p>	2022
Cross-cutting	Governance	<p>Increase transparency around Government's expected pathways to Net Zero. This should involve publishing more details on the assumptions that underpin these pathways and how the abatement set out in the Net Zero Strategy will be achieved by planned policies, setting out the quantified abatement expected to be achieved by each policy.</p> <p>Primary responsibility: BEIS Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Agroforestry and hedgerows	<p>Set incentives to support agroforestry and hedgerows on UK farms. Plant trees on 2% of farmland by 2025 while maintaining its primary use, rising to 5% by 2035, and extend hedgerows by 20% by 2035 and better manage existing hedgerows.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	CAP reform	<p>Put in place robust frameworks for monitoring, reporting and verification of post-CAP farm subsidies and agriculture environment schemes to assess their effectiveness in delivering their environmental objectives, including for climate change mitigation and adaptation.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Diet and demand	<p>Take low-cost, low-regret actions to encourage a 20% shift away from all meat by 2030, rising to 35% by 2050, and a 20% shift from dairy products by 2030, demonstrating leadership in the public sector whilst improving health.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2022
Agriculture & land use	Diet and demand	<p>Introduce policy to support the reduction of food waste at the farm, supply chain and household level. Food waste reduction, and its implications, should also be integrated into the recommended Net Zero delivery strategy for the agriculture and land use sectors , as well as in plans for the waste sector.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023

Sector	Topic	Recommendations for the Northern Ireland Executive	Timing
Agriculture & land use	Finance	<p>Set out how public and private funding for agricultural and land-based measures will be aligned, how opportunities to attract increased private finance for habitat creation and restoration will be developed, and promote the use of existing verifiable standards (such as the Woodland Carbon Code and Peatland Code) whilst also considering the need to develop new ones.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2022
Agriculture & land use	Low-carbon farming	<p>As part of strengthening the regulatory baseline, extend coverage of Nitrate Vulnerable Zones across all of the UK in order to promote best practice in management of inorganic fertilisers and organic manure and slurry.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2024
Agriculture & land use	Low-carbon farming	<p>Continue to support research and development into low-carbon farming practices, including behavioural, innovation and productivity measures. The risk of a high dependency on innovation and technology to meet GHG emission reductions should be assessed, and integrated with demand-side measures such as diet change and waste reduction.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2023
Agriculture & land use	Low-carbon farming	<p>Move beyond the voluntary nature of current CAP replacement schemes by setting a strong regulatory baseline that strengthens rules such as those under cross compliance and retains them in UK legislation.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Low-carbon farming	<p>Set in place action to overcome financial barriers that prevent take-up and innovation in low-carbon farming practices. This should include management incentives under the ELM scheme and approaches set by devolved administrations, grants for capital items and infrastructure, and support for research and development.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Non-financial barriers	<p>Develop understanding on how the transition to Net Zero in the agriculture and land will affect employment in these sectors, including a timeframe of change and the scale of impact. Set out how the change will be managed to be fair and equitable, ensuring new skills and training are widely available to both support communities, but also to facilitate the meeting of targets in these sectors.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2023
Agriculture & land use	Non-financial barriers	<p>Provide support to tenant farmers to overcome contractual issues that restrict the long-term commitment and investment required to reduce emissions and sequester carbon on the land they manage.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023

Sector	Topic	Recommendations for the Northern Ireland Executive	Timing
Agriculture & land use	Non-financial barriers	<p>Set in place action to overcome non-financial barriers that prevent adoption of low-carbon farming measures and land-use change to deliver emission reduction and carbon benefits. These include streamlining application processes and providing support for skills, training, and knowledge exchange in order to provide confidence to farmers to take up new measures.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Ensure incentives are set at the correct level to set a trajectory to achieve 58% of peatland restored by 2035, and 79% under restoration by 2050. All upland peat should be under restoration management by 2045.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Introduce policy to end rotational burning on peatland before the start of the 2022 burn season.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2022
Agriculture & land use	Peatlands	<p>Set out clear timeframes to end domestic and industrial peat extraction across the UK. Provide a mechanism to ensure the peat extraction industries restore extraction sites to protect the peat resource.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Peatlands	<p>Where peat soils remain under agricultural use, set out how they will be managed in a more sustainable way. This should include raising water levels on 8% of lowland grassland by 2025, reaching 25% by 2035, and 12% of arable crops by 2025, reaching 38% by 2035.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Agriculture & land use	Trees and woodland	<p>Work with the forestry sector and government agencies to support UK tree nurseries to increase domestic production of trees to meet the planting ambition and reduce reliance on imports, along with the associated risks of pests and disease.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	2023
Agriculture & land use; Manufacturing & construction	Trees and woodland	<p>Develop a comprehensive plan to increase the production and use of UK sourced timber and support the long-term economic viability of domestic woodlands.</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Scotland; Wales</p>	Q1 2023
Buildings	Building standards and enforcement	<p>Implement improvements to the Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP) framework to ensure they drive deployment of the necessary energy efficiency and low-carbon heat measures and also address overheating, ventilation, and moisture-risk. This should be done in coordination with Devolved Administrations.</p> <p>Primary responsibility: DLUHC Supporting actors: N. Ireland; BEIS; Scotland; Wales</p>	H1 2023

Sector	Topic	Recommendations for the Northern Ireland Executive	Timing
Engineered removals	Governance	<p>Work with the Interministerial Group for Net Zero, Energy and Climate Change to publish a joint position on the contribution of engineered removals and CCS to meeting UK-wide and DA targets to 2030.</p> <p>Primary responsibility: BEIS Supporting actors: N. Ireland; Scotland</p>	2023
Waste; Manufacturing & construction	Waste prevention	<p>Implement initial Extended Producer Responsibility, the Deposit Return Scheme and consistent collections of recycling and food waste without further delay. Complete an independent review of the impact of the schemes within 2 years of implementation (i.e. by 2026).</p> <p>Primary responsibility: Defra Supporting actors: N. Ireland; Wales; Scotland</p>	Q1 2024

June 2022

Progress in reducing emissions
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