**Rapid Evidence Assessment (REA) Commission – Identification of Key Drivers**

# Purpose of analysis:

Identifying key drivers is an important first step to inform development of exploratory scenarios (i.e. of external factors which could impact target feasibility), and normative scenarios for delivery of targets (i.e. what policy actions should be implemented to deliver the targets). Following the REA the sub-group will be in a better position to decide;

* A common framework for developing exploratory and normative scenarios
* The focus and complexity of scenarios (including their scope, granularity, timescale)
* Where we need to align scenarios across policy areas

# What does success look like?

* ***Identify the key drivers for each target area***. Each team should consider the ‘STEEP’[[1]](#footnote-2) drivers for their targets. The number of drivers will depend on the number and breath of targets however we expect 3-6 drivers to be a useful amount to explore for each priority area. This could involve drivers important to individual targets or global drivers that affect multiple targets. .
* ***Identify likely effects over time.*** Members should gather available evidence to understand the relationship between a driver and target (the cause and effect), its trend and the timeframe we expect driver effects to occur (Historical, current, and future (near-term, medium-term, long-term). Note that drivers could interact with each other and could have direct or indirect effects (or both) on the target area.
* ***Assess the importance and uncertainty which exists on drivers*** Given the evidence developed on the driver, what rating do we give for its importance for the target area; and the uncertainty around its outcome.

**Table 1: Identification of key drivers**

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| **Scope of Target;**  *(e.g. “PM2.5 concentrations” or “Resource Productivity”)* | **Name of Driver**  *(e.g. “Climate Change”, or “Land use change”)* | **Driver Importance with respect to target**  **(1=Low, 5=High)** | **Driver Uncertainty with respect to target**  **(1=Low, 5=High)** |
| **TARGET 1:** Resource Productivity (GDP/RMC) | **Metric/Driver 1:** Affluence (per capita GDP and consumption) | 5 | 2 |
| **Metric/Driver 2:** Raw material consumption (RMC) | 5 | 4 |
| **Driver 3:** Population | 3 | 2 |
| **Driver 4:** Final demand structure i.e. change in the basket of commodities which make up final demand | 3 | 4 |
| **Driver 5:** Trade patterns | 3 | 5 |
| **Driver 6:** Production Intensity | 4 | 4 |
| **Driver 7:** Regulation | 3/4 | 3 |
| **Driver 8:** Technology and innovation – digitalisation leading to fewer physical products | 4 | 3 |
| **TARGET 2:** Residual Waste | **Driver 1:** Regulation (e.g. Landfill Tax) | 4 | 2 |
| **Driver 2:** Household expenditure | 3 | 2 |
| **Driver 3:** Household consumption patterns | 3 | 3 |
| **Driver 4:** Waste arisings change | 4 | 2 |
| **Driver 5:** Behaviour/attitude change | 4 | 3 |
| **Driver 6:** Market change (commodity markets, gate fees...) | 4 | 5 |
| **Driver 7:** Available/affordable technology | 3 | 4 |
| **Driver 8:** Economic change (GDP, GVA...) | 4 | 4 |

**Table 2: Resource Productivity**

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| **Name of the driver:** Affluence/Economic Change – (Resource Productivity/Residual Waste) | |
| SECTION A | |
| Description of driver | National gross domestic product (GDP) is a measure of the monetary value of all finished goods and services produced within a country's borders in a specific time period. Change in GDP is the most common metric for measuring development and economic welfare at a national level, being the central measure of the System of National Accounts (SNA). |
| What effects has it had historically and what effects is it having now? | Historic estimates of global GDP (DeLong, 1998) suggest that for the 3 millennia up to 1750, growth in the global economy was minimal, averaging only 0.01% per year on a per capita basis ([Bank of England](https://www.bankofengland.co.uk/knowledgebank/how-has-growth-changed-over-time)). Similarly, in the UK and between the years 1270 and 1650, average incomes (GDP per capita) are thought to have stayed roughly constant at around £1,000 in today’s prices (Roser). Since 1750, global per capita average annual GDP growth was an estimated 1.5%, far higher than in the years prior, while in the UK and between 1650 and today, average incomes grew from £1,000 per person per year to over £30,000 today. Though economic growth has not been constant over the last few centuries, punctuated by, for instance, war or financial crises, it has on average been far greater than in the past. Notwithstanding the impacts of the dot com bubble in the late 1990s and the 2008 financial crash, between 1998 and 2018, average annual GDP growth in England was an estimated 2.2%, or 1.5% on a per capita basis. GDP affects our proposed resource productivity through being one of the two variables which could make up the ratio for calculating the measure, while economic activity is also commonly seen as one of the most important drivers of natural resource use (UNEP, 2016). The influential IPAT hypothesis (Ehrlich and Holdren, 1971) encompasses this perspective and suggests that population, affluence and technology all positively contribute to increasing environmental impact. The Environmental Kuznets Curve (EKC) hypothesis is based on the alternative view that while at early stages of economic growth there exists a tradeoff between growth and environmental quality, beyond a certain level of income, the trend will reverse, with additional increases in economic output falling in their environmental intensity. This dynamic is hypothesized to arise as a result of increasing demand for improved environmental quality being then supplied through the likes of government policy and the free market, changing composition of production/consumption activities and technology e.g. digitalization and altered production techniques. Under this view, economic growth is not logically equivalent to rising output in physical terms, but only in output terms. Nevertheless, today countries with the higher economic output can be seen to tend to have higher material consumption when accounting for upstream material use.  Based on current data, a relative decoupling of GDP from RMC has occurred in the UK since 1990 and in England since 2001, indicating that the strength of the relationship between these variables has nevertheless changed over the period for which we hold data currently. Waste arises in England through productive processes involving labour, capital and materials on one hand and consumption processes on the other. Increasing quantities of goods and services produced and consumed, assuming all other things equal, can be expected to lead to increased waste arisings, as the laws of thermodynamics tell us that eventually all materials extracted from the environment will eventually return to it as waste. The length of time it takes materials entering the economic system to become waste varies with the effluent in question (e.g. gaseous or solid), use of materials e.g. packaging vs. buildings, and their recirculation in the economy. There has been an increase in waste arisings at the national level in the UK and England for the period in we hold comparable data (2010-2018). Nevertheless, an increase in arisings tonnages is not evidence across all waste streams, as, for instance, England household waste arisings remained relatively constant between 2010 and 2018 at 22 million tonnes despite the economy growing. This suggests that there may exist a decoupling of GDP from waste arisings for some waste streams, driven by other factors such as regulation. Waste arisings which are not recycled, reused or remanufactured will then go onto enter the residual waste stream, or in a relatively limited number of cases, enter the natural environment. |
| What effects are expected in the medium term (2030)? | [Projections](https://data.oecd.org/gdp/real-gdp-long-term-forecast.htm) of UK real GDP by the OECD[[2]](#footnote-3) predict steady growth in the size of the UK economy (20% increase 2020-2030). It is uncertain to which extent the impacts of COVID-19 will have on this figure and it may be revised down in due course. The UK economy fell into a recession in 2020 Q2 as GDP dropped by a fifth (20.4%)[[1]](https://ukc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en%252DUS&rs=en%252DGB&wopisrc=https%253A%252F%252Fdefra.sharepoint.com%252Fteams%252FTeam419%252F_vti_bin%252Fwopi.ashx%252Ffiles%252Fbd3db687a8214aa49d6621f255477670&wdenableroaming=1&mscc=1&hid=C9767D9F-00C7-2000-6F40-C9EC6D3E4B5D&wdorigin=Other&jsapi=1&jsapiver=v1&newsession=1&corrid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&usid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&sftc=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected#_ftn1), while PWC anticipate that “UK GDP growth is expected to be around -5% to -10% for 2020”. Though it can be expected that GDP growth rates will again begin to increase as they have done following previous recessions, uncertainty over the longevity of the impacts of the pandemic make it difficult to know how GDP may evolve in the short-to-medium terms. PWC estimates that “the level of GDP may still be around 1% to 7% below pre-crisis trends by the end of next year (2021)”. The impact of future economic growth on future resource use will be moderated by the material intensity of each unit of consumption expenditure, which itself will be a function of the type of products consumed and the material production intensity of their production, strongly influenced by the country/region of production (due to differences in technology and regulation). |
| What effects are expected in the longer-term (2040-2050)? | After the medium-term recovery from the coronavirus pandemic, it is expected that we will see a return to steady increases in GDP notwithstanding the potential for further unanticipated shocks to economic activity. Long-term OECD projections forecast an 83% increase in UK real GDP between 2020 and 2050. Similarly, the assumed UK GDP used in the net-zero analysis by the CCC and calculated based on baseline GDP growth assumptions from the Office for Budgetary Responsibility was in the region of 80% between the time of analysis and 2050. Based on historic trends, increased long-term GDP is likely to be associated with higher levels of resource productivity but also possibly material consumption, though the potential for absolute decoupling is not without basis when incorporating fossil fuels into a measure of RMC and in optimistic scenarios of change in consumption and production efficiency. The same absolute decoupling dynamic may be anticipated for waste arisings too. |
| What is the range of possible outcomes? | GDP by 2030 or 2050 may be higher or lower than forecast. |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

[[1]](https://ukc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en%2DUS&rs=en%2DGB&wopisrc=https%3A%2F%2Fdefra.sharepoint.com%2Fteams%2FTeam419%2F_vti_bin%2Fwopi.ashx%2Ffiles%2Fbd3db687a8214aa49d6621f255477670&wdenableroaming=1&mscc=1&hid=C9767D9F-00C7-2000-6F40-C9EC6D3E4B5D&wdorigin=Other&jsapi=1&jsapiver=v1&newsession=1&corrid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&usid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&sftc=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected#_ftnref1) <https://www.ons.gov.uk/economy/grossdomesticproductgdp/articles/coronavirusandtheimpactonoutputintheukeconomy/june2020#:~:text=After%20experiencing%20a%20significant%20shock,%2C%20which%20fell%20by%202.2%25.&text=For%20more%20details%20please%20see,estimate%2C%20UK%3A%20June%202020>.

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| **Name of the driver:** Raw Material Consumption (RMC) | |
| SECTION A | |
| Description of driver | The material flow accounting measure raw material consumption (RMC) is currently being explored as the input variables for measuring resource productivity alongside the aggregate economic output indicator GDP. There are several methodologies available for calculating the material use of a country, the choice of which will affect the final estimate. Raw material consumption (RMC) or the ‘material footprint' is defined as the full amount of raw materials required to meet final demand for goods and services by households, governments and charities in a given geography e.g. England, in one year. It includes an estimate of the materials extracted within a country’s borders to meet final demand, in addition to the full upstream material requirements needed to produce imported goods and services. Hidden flows, or unused extraction are not covered by RMC. There is no internationally standard methodology for estimating RMC but an increasing convergence around the view that a multi-regional input-output (MRIO) approach is most effective. |
| What effects has it had historically and what effects is it having now? | This charts shows estimated UK RMC between 1990 and 2017 broken down by broad material type[[3]](#footnote-4). Between 1990 and 2017, there was a ~30% increase in total UK RMC, though the level of change varied significantly by material across this period. While global non-metallic mineral material (NMMM) extraction attributable to UK consumption increased by around ~70% 1990-2017, fossil fuel use on the same basis fell by rough a fifth (19%). Biomass and metallic ore extraction attributable to domestic consumption increased by around two-fifths (39% and 35% respectively) across the same time. Total RMC during this period peaked in 2007, and against that peak, there have been reductions in the UK’s footprint of metallic ores, non-metallic ores and fossil fuels (by 9%, 10% and 31% between 2007 and 2017, respectively), while biomass extraction increased slightly across the same period. Over the last five years of available data (2012-17) following the economic downturn, growth has been seen across all categories of material, with exception to metallic ores, which have remained roughly constant. As a proportion of total RMC, NMMM made up around half of the footprint in 2017 (46%) by weight, while a quarter of the footprint (26%) consisted of biomass materials (26%), a fifth, fossil fuels (21%), and slightly less than a tenth (7%), metal ores (a similar picture as in 1990 for biomass and metallic ores, though the share of fossil fuels fall from about a third and that of NMMM has increased from 35%).   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Average Annual Material Footprint Growth Rates (UK)** | | | | | |  | **1990-2017** | **1990-2000** | **2001-2010** | **2011-2017** | | NMMM | 2.4% | 4.7% | 0.6% | 1.9% | | Metallic ores | 1.4% | 2.1% | 0.6% | 1.3% | | Biomass | 1.3% | 1.9% | 0.2% | 2.2% | | Fossil Fuels | -0.4% | 0.0% | -0.1% | -1.5% |   ‘Decoupling’ may involve breaking the link between economic growth and resource use (resource decoupling), the link between economic growth and environmental pressure (environmental decoupling) or the link between wellbeing and resource use (wellbeing decoupling). By measuring an aggregate economic output indicator in relation to RMC, a resource productivity target will focus on driving resource decoupling. When comparing the UK/England carbon footprint to GDP, there is evidence of environmental decoupling furthermore. When evaluating decoupling trends, two types of decoupling can be distinguished: relative decoupling, achieved when the growth rate of the economy exceeds that of material use, and absolute decoupling i.e. achieving economic growth while at the same time decreasing overall material use. While both cases entail an increase in resource productivity, only the latter can be seen as a means towards lowering our pressure on the environment.    GDP in England increased between 2001 and 2017, by 37% overall and 2.0%, on average, each year. When excluding fossil fuels, RMC on the other hand increased by 16% in the same period (1.1% p.a. on average), though this figure is only 5% when including fossil fuels (or 0.5% p.a. on average). In both instances, what we have primarily seen is a relative decoupling of GDP from RMC. When incorporating fossil fuels into a measure of productivity however, the effect of the overall decline in fossil fuel use in this period heightens the potential for future absolute decoupling to take place.  **Change in RMC and GDP across nations (1990 – 2013)** Source: [The Material Flow Analysis Portal](http://www.materialflows.net/decoupling-material-use-and-economic-performance/) |
| What effects are expected in the medium term (2030)? | Drivers of resource use vary across stages of economic development e.g. capital investments in infrastructure is usually the primary driver of resource use in emerging economies (Schandle & West, 2010), while in industrial economies, consumer goods dominate final demand (UN, 2019). RMC is made up of different materials, and change in each of these might not only be a function of overlapping drivers e.g. GDP, but also potentially separate drivers too e.g. material-specific regulation. An [EC (2014)](https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/sustainability-services/rmc-bio-by-deloitte.pdf) study which sought to model projections of EU raw material consumption to 2030 concluded that the primary drivers of non-metallic mineral materials are economic growth in industry and construction, and project average pa growth in this material to be 1.3% between 2012 and 2030. The primary drivers of metallic ores were economic growth in industry and construction, linked indirectly to population and demand. The baseline average annual growth for metal ores between 2012 and 2030 is predicted to be 1.8% pa, increasing to 1.9% pa between 2021 and 2030. Both rates are higher than the historical trend due to expectation of increases consumption of metal ores due to planned renewable energy installations and renewal of infrastructure. Trends in growth further varied by metal type. Based primarily on energy trends data, EU level fossil energy resource use was expected to fall by 1.4% on average p.a. between 2012 and 2030. The key drivers of biomass were demographic growth (increasing demand for food and energy) and economic growth, and projected a 0.6% increase in biomass consumption between 2012 and 2030.  In 2019, the United Nations Environment Programme published their [Global Resources Outlook](https://www.resourcepanel.org/sites/default/files/documents/document/media/unep_252_global_resource_outlook_2019_web.pdf), which projects various environmental and resource indicators through to 2060. This can give some indication of anticipated levels of global resource productivity through 2030 and beyond. Because domestic material consumption (DMC) and RMC are equal at the global level, the world average is the most useful indicator, as productivity by quartile will not reflect overseas embedded extraction associated with consumption effectively (being based on DMC). Given historic trends, the Global Resources Outlook projects that resource productivity will increase by 0.4 per cent per year on average through to 2030. This is shown in the figure below. The UK can be considered a high-income country. The Global Resources Outlook also projects a future in which ambitious and broad-based suites of actions by government, business and households improve resource efficiency, decouple economic growth from environmental degradation and promote sustainable production and consumption. These resource efficiency and sustainability policies are projected to achieve substantial relative decoupling of natural resource use from income and essential resource-based service. In this scenario, global resource productivity (measured here as resource extractions per dollar of economic activity) increases by a greater degree. Such a future is thought to be dependent on regulation/legislation, corporate eco-awareness and technological advancement and innovation.  **Resource productivity (dollars GDP per ton of resource extraction), world and three country groups, 2015-2060 (historic trends)** |
| What effects are expected in the longer-term (2040-2050)? | Further work will be required to understand how changes in GDP, trade balance, final demand structure and technology may drive changes in England’s RMC, with uncertainty varying across these drivers to different degree. On current trends and in light of climate change regulation domestically and overseas, it might be expected that fossil fuel usage will decline and work is currently being undertaken by the CCC to understand the extent to which climate regulation will lessen material use. On the basis of historic trends, long-term increases in biomass, NMMM and ores might be expected, though the extent to which production efficiency increases might counteract these potential rises. The projections of resource productivity outlined in the review above extend through to 2060 (see charts). Based on historic trends, global material productivity is predicted to improve marginally from 0.93 US$ per kg of material use in 2015 to 1.14 US$ per kg in 2060. In a scenario that drives towards sustainability, resource efficiency and sustainable consumption slow the growth of resource use significantly without impacting negatively on income. World resource use reaches a level that is 25 percent lower in 2060 than under assuming historical trends. |
| What is the range of possible outcomes? | Future is based on historic trends: England resources and waste legislation remains relatively stable, with little or no changes to existing legislation. Existing targets are implemented but no news ones are accepted. There is some standardisation amongst industry and local authorities. GDP and RMC become relatively decoupled, but not absolutely decoupled. RMC therefore is directly linked to GDP and economic growth, and improvements in resource productivity are limited.  Drive towards sustainability/economic decoupling: There is a strong policy shift towards more legislation. The aim is to provide more targets, more support, and more stringent rules. A host of new domestic targets are developed and implemented. There are high levels of standardisation amongst industry and local authorities. GDP and RMC achieve absolute decoupling, allowing resource productivity to grow without negatively impacting GDP. Resource productivity increases, and meets the set target to double by 2050.  Sustainability is deprioritised/no economic decoupling: There is a strong policy shift towards de-regulation. Existing targets are amended and adjusted wherever possible. No new domestic targets are set. There is little standardisation amongst industry and local authorities. Without regulation to moderate, RMC and GDP are tightly linked. There is no improvement in resource productivity—there may even be a decline. |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? |  |

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| **Name of the driver:** Population | |
| SECTION A | |
| Description of driver | Mid-year population estimates produced by the ONS are the official source of population size estimates between censuses. Population is defined as ‘people who are ‘usually resident’ in the UK for 12 months, excluding short-term migrants and counting students at their term-time addresses’. Population growth adds demand and human capital to an economy, leading to increases in economic output (GDP) and the consumption of products, potentially associated with material inputs and resultant waste. That population has a positive relationship on both GDP[[1]](https://ukc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en%252DUS&rs=en%252DGB&wopisrc=https%253A%252F%252Fdefra.sharepoint.com%252Fteams%252FTeam419%252F_vti_bin%252Fwopi.ashx%252Ffiles%252Fbd3db687a8214aa49d6621f255477670&wdenableroaming=1&mscc=1&hid=D2B37E9F-3035-2000-6F40-CB7029B207E5&wdorigin=Other&jsapi=1&jsapiver=v1&newsession=1&corrid=fa05de15-55d1-424e-a3da-7d0c5049a9c9&usid=fa05de15-55d1-424e-a3da-7d0c5049a9c9&sftc=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected#_ftn1) and RMC might mean that the effect on both variables could nullify one another in terms of their impact on resource productivity, however, it is unlikely that population will affect both to the same degree. |
| What effects has it had historically and what effects is it having now? | The ONS estimates England’s population (mid-year) was 56.3 million in 2019, roughly a fifth greater than the equivalent figure in 1971 (21%). This translates into a 0.4% increase per year on average, though the population growth rate has accelerated over this period. The increase in population across this period owes to high birth rates, net migration and increasing life expectancy.    England’s GDP has increased in recent decades alongside a rising population. There are many factors which affect GDP and it is difficult to know the extent to which economic growth can be attributed to population growth, however it is generally believed that there is a positive relationship. Average annual growth in England’s GDP was over three times higher between 1998 and 2018 than the growth in its population, indicating that rates of economic growth are outstripping those in population. There has been shown to be a link between higher levels of GDP and fertility rates, though due to the potentially effects of migration, this will not necessarily lead to a reduced population. |
| What effects are expected in the medium term (2030)? | The ONS [principal population projections](https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/regionsinenglandtable1) (2020) for England forecast an, on average, 0.4% annual increase in population 2018-30, with a projected population of 59.2 million people in 2030, 5.1% greater than in 2019. This translates into an, on average, 0.4% projected increase each year - a continuation of the 1971-2019 trend, though lower than the average growth rate in the decade prior (2009-19, 0.8% p.a.). It is worth noting that population increases caused by high birth rates (instead of net migration) will likely have a slightly delayed effect on GDP before children come of age and enter the labour pool. |
| What effects are expected in the longer-term (2040-2050)? | There is projected to be steady growth in England’s population in the long-term future in the ONS regional [principal population projections](https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/regionsinenglandtable1). Published population projections anticipate a population of 61.7 million people in England in 2043, 9.7% greater than in 2019. Projecting out to 2050 based on the average growth rate between 2034 and 2043 gives an indicative England population estimate of 63 million in 2050. There is anticipated to be a shift in the age demographics up to 2043, for instance, the proportion aged 85 years and over is projected to almost double over the next 25 years which may dampen some of the effect that the growing population will have on GDP. |
| What is the range of possible outcomes? | Population growth is seen to be fairly predictable however there may be some factors that can alter it. The aftermath of Brexit may affect net migration as migration from the EU is likely to fall unless a freedom of movement law is put in place. It’s also possible that the covid-19 pandemic has an effect on the short-term population growth. The birth/death ratio may affect the previous forecasts as deaths have increased and the uncertain times encourages fewer births. |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

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| **Name of the driver:** Final Use Structure | |
| SECTION A | |
| Description of driver | The OECD’s Global Material Use Outlook identifies three trends driving material use: 1) socioeconomic trends including population and income per capita; 2) changes in production processes (technical change); and 3) changes in demand patterns. The structure of final use relates to the composition of the basket of commodities that makes up final consumption expenditure. This driver is of relevance as change in the types of things people buy e.g. a shift in expenditure profiles towards services for instance, can reduce the material intensity of each unit of consumption expenditure. Currently published material footprint estimates by Defra produced by the University of Leeds disaggregate England’s material footprint by final use e.g. households vs. local government vs. capital formation, with household consumption further disaggregated by product type based on the consumption expenditure by purpose (COICOP) classification. In conjunction with the material intensity of production (which is highly influenced by the location of production of goods and services consumed in England (import patterns)), the structure of final use determines the material intensity of each £ of consumption expenditure. |
| What effects has it had historically and what effects is it having now? | The graph above shows how the composition of our GDP has transitioned towards a service-based economy. Services made up 79% of UK GDP in 2013, compared to 46% in 1948. This transition is related to the technology and innovation driver as it is likely technological advancement that has driven this consumption shift. This movement away from physical goods towards services drives down our raw material consumption. Furthermore, consumers are becoming more environmentally aware and many will tailor their consumption habits to reduce their environmental footprint. A study by GlobalWebIndex found that consumers are also making substantial efforts to recycle more waste (71%) and reuse products and materials (51%). This increase in awareness has likely acted to reduce raw material consumption. |
| What effects are expected in the medium term (2030)? | One of the reasons as to why the services sector has grown so significantly is due to the loss of international competitiveness in UK manufacturing. This loss of competitiveness drove industry towards service-based industries where the UK has developed high competitiveness relative to other countries – such as the financial services, legal, accounting, management consulting, and public relations services. The type of trade deals that are made in the transition period after Brexit and beyond will likely shape the composition of our economy structure. The EU made up 49% of the UK’s service exports in 2017 so new trade deals with well negotiated terms are necessary to preserve the strong service industry the UK has grown. There are also the consumption patterns that have come about due to the covid-19 pandemic. Extremely high hygiene requirements have seen a significant rise in single use items which puts an upward pressure on raw material consumption. |
| What effects are expected in the longer-term (2040-2050)? | It is expected that technology and innovation will continue to progress, leading to more digitalisation and therefore potentially a higher share of services in the composition of the economy. It is also expected that environmental awareness will continue to increase among consumers and their buying habits will reflect this through purchasing products with less of an environmental footprint, therefore decreasing raw material consumption. Again, following the transition period, trade deals will have established themselves. If strong trade deals are made that protect the strong service exports from the UK, then the industry can continue to thrive and create low levels of raw material consumption. |
| What is the range of possible outcomes? | There are a few uncertainties surrounding the future of the UKs demand structure. First, it is difficult to predict the speed of future technological advancement and digitalisation. If we continue the rapid digitalisation of the economy, then our consumption patterns may grow the services sector even further. Also, the outcome of future trade deals following Brexit may shape the success of some industries, especially as the EU made up such a high proportion of our service exports. There is also uncertainty around the effect that Covid-19 has had on our short-term demand behaviour as single use items demand has increased and excessive panic buying may have led to increased waste. |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

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| **Name of the driver:** Import Patterns | |
| SECTION A | |
| Description of driver | Following Brexit, it is likely that the UK’s import reliance, and in turn, whom it trades with, will change. This is of relevance to GDP because it parameterises potential economic output in terms of the costs of selling UK products/buying imported products. In addition, it can also define RMC, because the production efficiency, that is the materials required to produce goods and services, varies across countries. |
| What effects has it had historically and what effects is it having now? | Domestic extraction of materials accounted for just under a half (47%) of the UK’s material footprint in 1990 but by 2017, this had fallen to just over a fifth (21%). Economic growth can lead to economic development, that is, qualitative change and restructuring in a country’s economy. Structural change in the domestic economy i.e. output mix change, towards services and information-intensive industries and away from manufacturing and primary industries (a dynamic driven by competitive advantages and the availability of relatively cheaper substitute imports), can be associated with new vintage forms of domestic capital with lesser environmental intensity. However, if a population continues to demand manufactured products and primary resources while its domestic economy no longer produces these, imported manufactured and primary goods may become relied on. Improved domestic environmental performance is often critiqued as only being possible due to locational changes in highly-environmentally-intensive production. Changes in import patterns over the last decades are evident. In 1990, China accounted for around 2% of the UK’s material footprint, however by 2017, this had risen to 17%. Similarly, the share of the material footprint from extraction in India rose from 1% to 7% over the same period. This shows the growth in exports that developing countries have experienced as transportation and production costs have decreased. Lower income countries tend to nevertheless have higher material intensity of production. By comparing the value added of countries UK consumption is met by in relation to material extraction data for those countries, we can derive insight into the material intensity of domestic production i.e. the ratio of domestic extraction to the portion of GVA that remains in the country and is associated with domestically produced products bought by domestic consumers, versus the material intensity of imports i.e. a ratio of overseas material extraction by country/region in relation to their contribution to GVA embodied in imported goods and services. We can clearly see that the material intensity of domestic production is significantly lower than the material intensity of imported products. An increasing reliance on imported goods therefore, all other things being equal, will lead to the material intensity of consumption increasing. Technological improvements and regulation in countries we import may work to counterbalance this. |
| What effects are expected in the medium term (2030)? | There is significant medium-term uncertainty around the import patterns of England and the UK, though it is likely that the UK will continue to be a significant importer of (embedded) materials. The EU has historically made up a significant fraction of the UK’s material footprint. As we now enter the transitionary period after Brexit it is unclear how our trade relations with EU members will be affected and whether new trade partners will emerge. One of the most pivotal deals to be made will be with the EU in which an agreement needs to be made by the 15th of October to start on the 1st of January 2021. If no deal is met then the UK and EU will trade under WTO rules, which may mean that the UK becomes less competitive on the international market when exporting to the EU. This outcome may increase raw material consumption as the EU has a relatively high production efficiency and losing a trade deal with them would mean the UK may be forced to trade with countries that are less materially efficient. On the other hand, the UK has also announced a trade agreement with Japan which makes 99% of UK exports to Japan free of tariffs. Japan has a high production efficiency, so this is likely to have a positive impact on RMC, although trade with Japan currently only makes up 2% of UK trade. |
| What effects are expected in the longer-term (2040-2050)? | There is significant long-term uncertainty around the import patterns of England and the UK. If the UK’s services sector continues to grow, we will become further dependent on the international market for products – meaning that the countries we enter trade agreements with could be an important factor in affecting England’s raw material consumption. Furthermore, Brexit could potentially cause a resurgence in UK manufacturing, as barriers to trade are increased on the international market. This has the potential to reduce raw material consumption if UK manufacturing does establish itself as technology and regulation should keep UK production efficiency high. |
| What is the range of possible outcomes? | There is a high level of uncertainty around the future of UK international trade and a wide range of possible outcomes. There is the potential that we find a suitable trade agreement with the EU and we maintain our link with the EU who have a relatively high production efficiency. Even if so, it is likely the general trend of increasing imports from Asia for instance, will continue. On the other hand, exit from the EU could also open the door for the UK to enter trade deals with countries who don’t have deals with the EU such as the U.S, Australia and New Zealand. If a trade deal is not agreed, we may have to trade on WTO terms, thereby reduces the UK’s international competitiveness. This has the potential to spur domestic production, which has shrunk in recent decades as our international competitiveness is manufactured and primary products has declined and our services sector grown. While this may reduce the material intensity of producing goods and services consumed here, it may also negative impact GDP growth. |
| SECTION B | |
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| **Name of the driver:** Production Intensity | |
| SECTION A | |
| Description of driver | Production efficiency refers to the material intensity of producing the goods and services consumed in England. In conjunction with final demand structure, production efficiency determines the material intensity of each £ of consumption expenditure in England. Overall, production efficiency will be a function of where the things people consume in England are produced, in turn, the material intensity of production in that country, with technology, relevant regulation and resource prices, affecting the latter in turn. |
| What effects has it had historically and what effects is it having now? | It is difficult to tease out the relative influence of production efficiency from the material footprint dataset without undertaking structural decomposition analysis. This is because the material intensity of a given country from the perspective of UK consumption is a function of both which types of goods and services we purchased from that country as well as the amount of materials required to produce those goods and services. Nevertheless, the chart below gives an indication of changes in the material intensity of the basket of goods and services purchased from each country throughout the supply chains that satisfy UK consumption. |
| What effects are expected in the medium term (2030)? | Generally, countries adopt cleaner technologies to produce goods (process improvements) as they develop economically. Energy intensity (energy use per unit of production) in many countries has fallen over time, for instance, due to a shift towards higher-quality fuels and electrification (Stern, 2004). Processes of technical development are an area of significant research. A key theory links to the potential of ‘tunnelling’, that is, knowledge transfers and reduced subsidies of environmentally-damaging activities, alongside better methods of regulation pollution, and information, can give rise to swifter adoption of less environmentally damaging production techniques in developing countries than was the pathway for currently industrialised countries. For instance, China is adopted EU standards for car emissions with a 8 to 10 year lag despite its income per capita being ore than 10 years behind that of Western Europe (Gallagher, 2003). Technology and regulation e.g. recycling targets, taxation on natural resources, might be expected to drive improvements in production efficiency in the UK and the countries it trades with. Overall impact uncertain, but will sit alongside trade patterns and final demand structure in defining the material intensity of each unit of England’s consumption. |
| What effects are expected in the longer-term (2040-2050)? | Uncertain at this time. General trend globally towards higher efficiency of production or lesser intensity of production can be offset by changes in sources of production e.g. as new countries develop their industry and trade internationally, competitive advantages may cause the UK to shift consumption towards that country and away from those it previously traded with, thereby leading to the production intensity of materials consumed in England to increase. |
| What is the range of possible outcomes? | It is important to recognise that the potentially positive effects of progress in reducing the material intensity of production might be offset by rebound effects, whether direct or indirect. Direct rebound effects arise through efficiency increases leading to lower costs of consumption, thereby leading to increased consumption of that good (substitution effect). Indirect rebound effects arise through the income effect, whether for households or businesses, and involves the potential money saved from efficiency improvements being spent or invested into other goods and services, which themselves are associated with material use, and therefore drive the footprint up. These effects happen at a net-aggregate level. |
| SECTION B | |
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| **Name of the driver:** Regulation/Governance – Resource Productivity | |
| SECTION A | |
| Description of driver | Dasgupta *et al.* (2002) argues that a key variable mediating the relationship between environmental quality/pressure and income is effective environmental regulation. UNEP (2017) argue that although population and per capita economic growth are expected to lead to significant increases in material use up to 2050, there is a substantial potential to reduce material use through policies aimed at resource efficiency. Increasingly, governance dynamics i. non-hierarchical regulation by non-state actors, have driven improvement in the environmental intensity of production, while regulation still plays a key role here. For instance, the UK aggregates tax alongside the landfill tax has been reported to have driven increased levels of secondary NMMM use in the UK, potentially substituting and offsetting raw NMMM extraction. In addition, domestic and global regulation driving energy efficiency improvements and a shift away from fossil fuels may be a key driver in reducing the fossil fuel element of RMC. |
| What effects has it had historically and what effects is it having now? | In 2013, the [Waste Prevention Programme for England](https://www.gov.uk/government/publications/waste-prevention-programme-for-england) outlined its aims to improve the environment and protect human health by supporting a resource efficient economy. Policies included a two-year scheme to support communities taking forward innovative waste prevention, reuse and repair actions; development of a standard for reuse; the promotion of resource efficiency in schools and higher education; the single-use carrier bag charge; and Individual Producer Responsibility. In 2020, Defra commissioned WRAP to conduct a [review](https://wrap.org.uk/node/200992) of the Waste Prevention Programme. WRAP concluded that ‘the evidence available indicates that at least 387,000 tonnes of waste have been prevented in total since 2013 as a result of actions taken by organisations collaborating with Government, including approximately 103,000 tonnes that would not have been prevented in the absence of Government’s intervention. It is projected that actions currently being taken in the context of the Courtauld 2025 agreement will have prevented a further 2.7 million tonnes of waste by end-2019 from 2015, including 624,000 tonnes that would not have been prevented in the absence of the agreement.’ WRAP also found that the sectors in which the Waste Prevention Programme had the most success were those where government and industry worked in partnership. It is difficult to isolate the effect of any one policy or programme. WRAP themselves have initiated several programmes over the years that industry can voluntarily commit to, such as the Sustainable Clothing Action Plan (SCAP). The metrics that the policies hoped to impact have historically been tracked in the [Digest of Waste and Resource Statistics](https://www.gov.uk/government/statistics/digest-of-waste-and-resource-statistics-2018-edition) (last published 2018).  **Index values of Raw Material Consumption (RMC), Gross Domestic Product (GDP, CVM) and RMC per unit (£) GDP (Excluding Fossil Fuels), England, 2001 to 2017:** |
| What effects are expected in the medium term (2030)? | In the [25 Year Environment Plan](https://www.gov.uk/government/publications/25-year-environment-plan), the Government pledged to leave the environment in a better condition for the next generation. The [Resources and Waste Strategy](https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england) and [Circular Economy Package](https://www.gov.uk/government/publications/circular-economy-package-policy-statement) were set out to help meet that commitment. The Resources and Waste Strategy will be supported by a series of consultations on known problem areas, such as packaging waste. The Government aims to become a world leader in using resources efficiently and reducing the amount of waste created as a society, prolonging the lives of materials and goods, and moving away from the inefficient ‘linear’ economic model of ‘take, make, use, throw’. A more circular economy will see resources kept in use as long as possible so that maximum value can be extracted from them. Products and materials should be recovered and regenerated whenever possible, giving them a new lease of life. The Resources and Waste Strategy outlines intentions to introduce policies to discourage excess packaging including Extended Producer Responsibility (EPR) and a tax on plastic packaging with less than 30% recycled plastic; and incentivise consumers to make sustainable purchasing options. Resource productivity is a key focus of the Resources and Waste Strategy—to the point where there is a target to double resource productivity by 2050. Therefore, several of the policies in consultation will—it is hoped—work to increase resource productivity.    The medium term, through to 2030, will see the removal of single-use plastics from the central government estate in 2020, the roll-out of a Deposit Return Scheme\* in 2023, and Extended Producer Responsibility for packaging\* in 2023 as well. In 2030, we will discover whether we have met a target to recycle 75% of packaging waste\*. A [ban](https://www.legislation.gov.uk/uksi/2020/971/contents/made) on the sale of plastic straws, cotton buds and stirrers, subject to certain exemptions, will come into force in England in October 2020. We expect these policies to improve resource productivity, encouraging a move towards a more circular economy through legislation that will incentivise manufacturers to include more recycled material in their packaging, and create products with longer life expectancies. Key uncertainties and dependencies include the results of the consultations around the Circular Economy Package, EPR, and DRS, which may delay roll-out of these policies. A further uncertainty is that the Resources and Waste Strategy will be revised in 2023/24. While we certainly expect the revised Resources and Waste Strategy to continue to prioritise resource efficiency, we have to recognise that any unexpected changes in government policy and broader, international relations may impact the strategy in some way. A further uncertainty around how impactful these policies will be on resource productivity is the degree to which they are welcomed by industry; whether industry does the bare minimum to meet requirements, or whether they feel some ownership of the process and go above and beyond.  \*subject to consultation |
| What effects are expected in the longer-term (2040-2050)? | To our knowledge, there are no policies in consultation or development that will be brought into being beyond 2030. However, the Resources and Waste Strategy has set out several strategic ambitions to drive change across the resources and waste system in England e.g. to eliminate avoidable plastic waste by 2042, avoidable waste of all kinds by 2050 and increase resource productivity. By necessity, meeting these targets will move us towards a more circular economy, and increase resource productivity. We can arguably expect further suites of policies to be developed to drive towards these targets. Longer-term, key uncertainties include changes in government and, consequently, changes in government priorities. Other key uncertainties include public opinion and behaviour, industry cooperation, and technological innovation. |
| What is the range of possible outcomes? | Stable Legislation  England and UK resources and waste legislation remains relatively stable, with little or no changes to existing legislation. Existing targets are implemented, but no new ones are accepted. There is some standardisation amongst industry and local authorities. The impact of regulation on resource productivity remains as-is.  Push for De-Regulation  There is a strong policy shift towards de-regulation. Existing targets are amended and adjusted wherever possible. There are no new domestic targets set. There is little standardisation amongst industry and local authorities. Without regulation to moderate, resource productivity will decrease or increase in line with the other drivers.  More Legislation, More Standardisation  There is a strong policy shift towards more legislation. The aim is to provide more targets, more support, and more stringent rules. A host of new domestic targets are developed and implemented. There are high levels of standardisation amongst industry and local authorities. Driven by increased regulation, resource productivity will increase.  Key dependencies include:   * Cooperation from industry * Political environment and government priorities |
| SECTION B | |
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| **Name of the driver:** Technology and Innovation | |
| SECTION A | |
| Description of driver | Technological development has led to a consumer shift away from physical goods towards digital goods. Furthermore, digitalisation has enabled more efficient processes in companies to help minimise waste, promote longer product life and minimise transaction costs[[2]](https://ukc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en%2DUS&rs=en%2DGB&wopisrc=https%3A%2F%2Fdefra.sharepoint.com%2Fteams%2FTeam419%2F_vti_bin%2Fwopi.ashx%2Ffiles%2Fbd3db687a8214aa49d6621f255477670&wdenableroaming=1&mscc=1&hid=C9767D9F-00C7-2000-6F40-C9EC6D3E4B5D&wdorigin=Other&jsapi=1&jsapiver=v1&newsession=1&corrid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&usid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&sftc=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected#_ftn2). |
| What effects has it had historically and what effects is it having now? | The digitalisation of our economy took off around the turn of the millennium. Wifi broadband was introduced in 1998, allowing the internet to be accessed more easily at home. Cloud storage started to become more popular too which opened up innovation in a variety of industries. Furthermore, the development of smart phones (along with wifi) in the 2000s opened new avenues of consuming media and entertainment.  The graph below shows the strong increase in UK productivity over this time period. This can largely be attributed to technological improvement. Consumers are now more likely to consume digital products over physical than ever before which creates a downward pressure on raw material consumption and residual waste.  UK productivity from 1997 to 2015:  Inserting image... |
| What effects are expected in the medium term (2030)? | The speed of digitalisation doesn’t seem to be slowing. There are new elements of digitalisation in infant stages that are yet to be widely adopted such as autonomous travel and internet of things. Furthermore, technology and innovation can help to aid policy making. For example, the waste tracking system currently being developed can help improve the UK’s resource productivity. Coronavirus may even cause a behavioural shift towards more digitalised communication and working behaviour. This would cause less travelling and on-the-go purchases. The development of the 5G network and its uptake will also allow for further digitalisation – as the faster internet speeds opens new avenues of technology.  The table below gives a glimpse at how the impact of covid-19 has impacted some industries much worse than others. Vehicle markets, food and beverage markets, clothing manufacturing and rail transport markets have been especially hard it by the pandemic, whereas some elements of the economy have seen a boost to trade, such as the postal and courier market.    Source: Office for National Statistics – Index of Production and Index of Services |
| What effects are expected in the longer-term (2040-2050)? | As this digital technology develops so quickly it is hard to give an accurate prediction for how innovation will develop in to the long term. However, its predicted that artificial intelligence and virtual/augmented reality are two technologies that could shape consumer behaviour in the long-term future. Both of which have the potential to decrease raw material consumption and residual waste. It’s also reasonable to expect current technologies to streamline and become more popular such that we see similar trends in areas such as cloud technology, smart devices and digital media (to name a few). |
| What is the range of possible outcomes? | A potential uncertainty is whether England will continue along this trajectory of sustained digitalisation. It is possible that the technological improvement may plateau as the areas where it has been easier to digitalise have already done so. |
| SECTION B | |
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[[2]](https://ukc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en%2DUS&rs=en%2DGB&wopisrc=https%3A%2F%2Fdefra.sharepoint.com%2Fteams%2FTeam419%2F_vti_bin%2Fwopi.ashx%2Ffiles%2Fbd3db687a8214aa49d6621f255477670&wdenableroaming=1&mscc=1&hid=C9767D9F-00C7-2000-6F40-C9EC6D3E4B5D&wdorigin=Other&jsapi=1&jsapiver=v1&newsession=1&corrid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&usid=a67e87a8-7a6e-4e3e-a8bc-7281abcb31f2&sftc=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected#_ftnref2) Antikainen, M., Uusitalo, T. and Kivikytö-Reponen, P., 2018. Digitalisation as an enabler of circular economy. *Procedia CIRP*, *73*, pp.45-49.

**Table 2: Residual Waste**

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| **Name of the driver: Regulation – Residual Waste** | |
| SECTION A | |
| Description of driver | Government regulation schemes use tax and other monetary incentives to reduce waste arisings and to improve waste treatment methods according to the waste hierarchy. Historically, these schemes have included the landfill tax and Landfill Allowance Trading Scheme (LATS), along with the introduction of the single-use carrier bag charge in 2015 (which is set to double to 10p in 2021). The [Resources and Waste Strategy](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf) highlights more recent measures, including reforms to ‘Extended Producer Responsibility’ (EPR), which is a powerful environmental policy approach through which a producer’s responsibility for a product is extended to the post-use stage. This incentivises producers to design their products to make it easier for them to be reused, dismantled and/or recycled at end of life. Another measure is the ‘Deposit Return Scheme’ (DRS), aimed at increasing the rate of recycling for drinks containers. Other legislations set to be introduced include mandatory food waste collections and a greater consistency in recycling collections. |
| What effects has it had historically and what effects is it having now? | Historically, landfill tax and the Landfill Allowance Trading Scheme (LATS) are the two major fiscal incentive schemes that policy makers have devised to influence the amount of waste being landfilled. With landfill tax rates increasing and authorities’ landfill allowances diminishing, the amount of biodegradable waste sent to landfill had been effectively reduced.  Landfill Tax was introduced on 1 October 1996 to encourage waste producers and the waste management industry to switch to more sustainable alternatives for disposing of material. There is a lower rate of tax, which applies to less polluting qualifying materials, and a standard rate that applies to all other taxable material disposed of at authorised landfill sites. The current lower rate is £3.00/tonne and the standard rate is £94.15/tonne.  In England, LATS were used until 31st March 2013, after this date they were ended with landfill tax alone being utilised to reduce waste sent to landfill.    Figure 2 from [Government Waste Management Statistics](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642373/Waste_management_2016_summary.pdf)  In 2014, over 7.6 billion single-use plastic bags were given to customers by major supermarkets in England, the equivalent of about 61,000 tonnes in total. Despite research showing that the average household already had 40 plastic bags around the home, the number of plastic bags taken from supermarkets [increased for the fifth year running](http://www.wrap.org.uk/2015_carrier_bag_figures) in 2014. Since the introduction of the scheme in 2015, the number of bags used has gone down by more than 80% in England.  UK-wide producer responsibility (PR) schemes are in place for four waste streams, putting a level of financial responsibility on producers for their goods at end-of-life. These are:   * Packaging waste * End-of-life vehicles (ELV) * Batteries and accumulators * Waste electrical and electronic equipment (WEEE)   While these schemes have been broadly successful in meeting recycling targets, they can do more to drive sustainable design decisions, make it easier for consumers to make more sustainable choices, and fully fund the management of products at end of life. |
| What effects are expected in the medium term (2030)? | The Resources and Waste Strategy presents a number of key regulations to be introduced in the coming years, a key one being reforming the EPR. Reforms will explore how we can incentivise producers to redesign products in support of a more circular economy. Packaging reform is the immediate priority. The intention is to legislate by 2021 and to have reforms operational by 2023. The reformed system will match or exceed the revised packaging recycling targets set by the EU for 2025 (65%) and 2030 (75%). Figure 2 shows how the EPR will work. The EPR schemes in WEEE, batteries and end of life vehicles are also set to reviewed and subsequently reformed if necessary by 2021.    Figure 2 from [Resources and Waste Strategy](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf)  The Resources and Waste Strategy also sets out the introduction of a DRS in England for single-use drinks containers in 2023, subject to consultation. The consultation will look at how the scheme might sit alongside other measures to boost recycling and how it would operate. Proposals will ensure that more recycled materials are used, and packaging is reprocessed and recycled more often. A 2018 report into drinks container recycling and litter reduction, commissioned by Defra from the Voluntary and Economic Incentives Working Group, found that plastic drinks bottle collection/recycling in some European countries with a DRS and some form of kerbside/household recycling collections can be as high as 95-98%. It also found that some rates of collection/recycling of aluminium, steel and glass drinks containers in countries with a DRS can be between 87 and 97%. So, we should expect to see the rate of recycling for drinks containers in the UK, which currently sits at around 70%, improve by 2030.  Uncertainty on whether these two schemes will be successful in increasing the rate of recycling, and thus decreasing residual waste tonnages, is minimal. This is because the effects of the measures have already been shown to be effective from analysis of their impact of their introduction in other European countries. We should expect to see similar results in England.  By 2023, it is hoped that there will be mandatory weekly food waste collections, with the Government pledging to reduce food waste by 20% by 2025 and eliminate all food waste from landfill by 2030.  The Resource and Waste Strategy also sets out how Government wants comprehensive and frequent waste collection systems that capture as much material as possible, promote householder and business participation, and ensure that high levels of quality recyclable or compostable materials are available for reprocessing. This will preserve our stock of natural resources by ensuring as much used material as possible gets made into products again. |
| What effects are expected in the longer-term (2040-2050)? | The Resources and Waste Strategy states a target zero avoidable waste in England by 2050. We expect Governments going forward to pursue similar regulations to those being introduced in the Resources and Waste Strategy, and so we expect a continued movement towards a circular economy, by the use of incentives and legislation to drive the desired change up the waste hierarchy.  Of course, many uncertainties are involved by looking this far ahead, the key uncertainty being a change in Government and how Governments of the future will approach issues surrounding waste arising and residual waste. |
| What is the range of possible outcomes? | We expect that Government regulation will be successful, as it has been with landfill tax, at reducing the residual waste tonnages.  Scenario 1 – Expected case, Producers and Consumers become increasingly environmentally aware  The EPR and DRS in particular continue to act as excellent incentives for producers and consumers to act with environmental awareness, leading to an increase in the recycling rate of drinks containers and other single use materials. Changes to recycling and food waste collections minimise ‘barriers’ to successful and efficient recycling behaviours for households and businesses, leading to a fall in the level of residual food waste, and an increase in recycling rate. **This leads to a decrease in residual waste tonnages.**  Scenario 2 – Some producers and consumers choose to follow  Some larger companies decide to start using recyclable packaging for products, however others continue to use alternative cheaper packaging, and decide to pay for its disposal instead. Some consumers don’t change their views on recycling drinks containers and decide the hassle to return the container is not worth their deposit, although many comply with the scheme and the rate of recycling increases. Some households and businesses actively set out to separate their waste for food and recycling, whilst a small number still do not. **The reduction in residual waste is marginal.**  Scenario 3 – Government priorities change  The priorities of the Government change and the EPR and DRS are partially or completely removed, and emphasis is taken away from encouragement to recycle and reduce food waste and placed on other waste disposal methods e.g., energy from waste. **This would lead to a potential increase in residual waste tonnages.** |
| SECTION B | |
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| **Name of the driver:** Household Expenditure | |
| SECTION A | |
| Description of driver | Household Expenditure (HE) encompasses all domestic outlays (by residents and non-residents) for individual needs, including expenditure on goods and services. ONS figures place the average total household expenditure per week in England at £585.60 over the three-year period April 2016 – April 2019 (see [family spending workbook](https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/datasets/familyspendingworkbook3expenditurebyregion)). Figure 1, taken from [ONS data](https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/bulletins/familyspendingintheuk/april2018tomarch2019) on household expenditure, shows that average weekly household spending has stagnated since April 2017, but rose by 9.1% between 2012 and FYE 2019. Figure 1 also shows how in 2019, the figure for average weekly household spending has reached a similar value as that of 2004, due to the economic recession in 2008, causing a sharp decrease. Recreation and culture accounted for the largest share of this increase, followed by household goods and services and transport. [WRAP](https://www.wrap.org.uk/sites/files/wrap/Decoupling%20of%20Waste%20and%20Economic%20Indicators.pdf) (2012) found a correlation between household expenditure and waste arisings, which is in turn correlated with residual waste tonnages (see waste arisings driver).    *Figure 1: Average total Household Expenditure.* |
| What effects has it had historically and what effects is it having now? | Figure 2 below from [WRAP](https://www.wrap.org.uk/sites/files/wrap/Decoupling%20of%20Waste%20and%20Economic%20Indicators.pdf) (2012) shows, by following the orange (HE (total)) and grey (Household waste per capita) lines, from 2005/06 waste rose and fell in line with HE, suggesting a strong link, or coupling, between HE and Household waste arisings, as would be expected. Furthermore, increasing/decreasing household waste leads to increasing/decreasing residual waste.    *Figure 2: Comparison of Household waste arisings and economic indicator trends across England* |
| What effects are expected in the medium term (2030)? | |  | | --- | | An [academic study](https://www.sciencedirect.com/science/article/pii/S0921800912003783#f0005) carried out in 2012 produced forecasts for total household expenditure, in accordance with 3 different scenarios: ‘reference’ (assumptions for the growth represent the ‘most probable’ outcomes), ‘low’ (real household disposable income growth is lower e.g. due to economic recession or higher income tax rates) than in the ‘reference’ scenario), ‘high’ (real household disposable income growth is higher than in the ‘reference’ scenario). Figure 3 presents their forecasts for total household expenditure in all 16 categories for each of the scenarios in terms of actual values. As shown in figure 3, total expenditure is predicted to increase in 2020 by 27% (41%, 15%) and in 2030 by 74% (114%, 42%) compared to 2010 level under the 3 scenarios.  In addition, [ONS data](https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/ihyp/pn2) on economic growth since 1949 shows the economy has been growing on average at +2.6%, coupled with a Defra commissioned forecast by [Z\_Punkt](http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18001) (2011), which states in all four scenarios investigated, that economic growth is forecast to be between +2% and +2.8% p.a. in 2030 which suggests that since the economy is on average growing, then we can expect HE to increase on average also.    *Figure 3: Forecasted Household Expenditure*    Note this data is at UK level not England level.    There are obviously several uncertainties in these forecasts, shown by the fact the study has included 3 potential scenarios, however each scenario shows a relative increase in household expenditure, compared to the data from 2010 and forecast for 2020.  Looking at the ONS data for total household expenditure, and comparing this with the forecast above, the average yearly expenditure between 2017 and 2019, falls slightly above the 2010 figure, but significantly below the 2020 forecast. This is likely to be due to factors including uncertainty around Brexit, austerity, and changing consumer spending patterns. These uncertainties are to carry forward to the 2030 forecast and include additional factors eg COVID-19.  A key dependency for household expenditure is average income. From the [ONS data](https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/householddisposableincomeandinequality/financialyearending2019provisional) available for average income we can see that increases/decreases in average income, are reflected in the graph for household expenditure. See figure 4.    *Figure 4: Average income and average total household expenditure* | |
| What effects are expected in the longer-term (2040-2050)? | We expect household expenditure in the longer-term to continue increasing. There are no current explicit forecasts taking household expenditure up to 2040-2050.    We expect on average the economy to continue growing, so similarly to the mid-term effects, we can expect HE in the long-term to continue growing, albeit perhaps not the case over shorter periods eg periods of recession.    Uncertainties from the 2030 forecasts are all still prevalent in affecting longer-term household expenditure. HE may also be affected by policies to reduce unemployment, since, as stated in the [WRAP](https://www.wrap.org.uk/sites/files/wrap/Decoupling%20of%20Waste%20and%20Economic%20Indicators.pdf) (2012) report, unemployed people produce less waste per capita. |
| What is the range of possible outcomes? | If household expenditure does increase as forecasted over the course of the next 10-30 years, it is likely to lead to an increase in residual waste tonnages and thus have a **negative impact on achieving the target of reducing residual waste.**  However, due to economic decoupling, including household expenditure patterns changing (as highlighted in the following driver) towards increased spending on longer life goods and services, and experiences rather than non-durable goods, another potential outcome may be that increasing household expenditure **leads to a fall in residual and a positive outcome for our target.** This is aligned with the waste Kuznets curve hypothesis, which suggests that, once GDP reaches a certain level, waste arisings will start to reduce (i.e. decoupling of waste from GDP occurs).    In the event of economic recession or higher income tax rates, household expenditure should follow the ‘low’ scenario highlighted in the forecast above, meaning it should have **minimal effect on the levels of waste arisings and residual waste tonnages.** |
| SECTION B | |
| What could push this driver in the opposite direction? | Economic decoupling – likely to mean that increasing household expenditure has minimal effect on increasing waste arising and thus increasing residual waste tonnage.  Household size – trends show in the report from [WRAP](https://www.wrap.org.uk/sites/files/wrap/Decoupling%20of%20Waste%20and%20Economic%20Indicators.pdf) (2012) that larger households produce less waste per capita. |
| What wildcards (low probability events) could disrupt the expected trends? | A key wildcard that will likely affect the forecast available is COVID-19 which was obviously an unknown in 2012 and will have a severe adverse effect on household expenditure. |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

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| **Name of the driver:** Household consumption patterns | |
| **SECTION A** | |
| Description of driver | Household consumption patterns categorise the total household expenditure, with the key trends dating back to 01/02 shown in the ONS data (Figure 1). The breakdown of weekly household expenditure into consumption areas over the three-year period April 2016 – April 2019 can be found in the [family spending workbook](https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/datasets/familyspendingworkbook3expenditurebyregion). Transport, housing and recreation and culture were the largest components of household spending, together accounting for 44% of total household expenditure in FYE 2019.    *Figure 1: Household expenditure at FYE 2018 prices, by Classification of individual consumption by purpose category, UK, FYE 2002 to FYE 2018*  [WRAP](https://www.wrap.org.uk/sites/files/wrap/Decoupling%20of%20Waste%20and%20Economic%20Indicators.pdf) (2012) stated that it is generally believed the design of products contribute to waste arisings. Products that are cheap, disposable or with short life times and not repairable limit the potential for reuse and encourage greater levels of consumption. |
| What effects has it had historically and what effects is it having now? | Figure 1 above shows us the key trends in household consumption. With no real linkage of each of these categories to waste arisings and therefore residual waste tonnages, we can look at the commission from [Z\_Punkt](http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18001) (2011), which gives a short definition of types of goods:   * **Non-Durable Goods:** have a lifespan of less than 1 year, typical examples are: food, fuel, cosmetics, drugs, shoes, and services. * **Semi-Durable Goods:** typical lifespan 1-3 years (neither perishable nor long-lasting), typical examples are: clothing, some types of furniture * **Durable Goods:** items which should continue to be serviceable for at least 3 years and that are not consumed or destroyed in a single usage, typical examples: cars, refrigerators, appliances, business equipment, electronic equipment, home furnishings and fixtures, household goods and accessories, photographic equipment, recreational goods, sporting goods, toys and games.   As we can see from these definitions and examples, the key categories in which consumption is rising are transport, recreational goods and communication which all fall within the durable goods definition, thus an increase in the categories associated with the lowest levels of waste arisings and therefore residual waste tonnages. |
| What effects are expected in the medium term (2030)? | Similarly to household expenditure above, the [academic study](https://www.sciencedirect.com/science/article/pii/S0921800912003783#f0005) carried out in 2012 produced forecasts for household expenditure in 2030, they also produced individual graphs (Figure 2) indicating a forecast for how HE would be spread amongst 16 consumption categories. Note: these categories vary slightly from the 13 employed by ONS. The academic study forecasts 3 potential scenarios explained above. We have already highlighted that the study shows increasing HE, but we should highlight specifically that it forecasts the largest increases in household consumption on recreation and culture and communication. Thus, the study predicts consumer spending patterns are tending towards increased spending on experiences and durable goods.  https://ars.els-cdn.com/content/image/1-s2.0-S0921800912003783-gr1r1.jpg https://ars.els-cdn.com/content/image/1-s2.0-S0921800912003783-gr1r2.jpg  *Figure 2: Forecasts of Household Consumption*  Uncertainties surrounding household consumption patterns, follow a similar line to those affecting HE since HE is a key dependency for consumption. Further uncertainty lies with COVID-19, since spending on recreation and culture was forecast to be one of the highest rising categories, however with current restrictions, this desire for consumption may not be possible.  Another key dependency for household consumption patterns is behaviours and attitudes (see next driver), where consumers are able to make conscious decisions to purchase products based on their environmental impact. |
| What effects are expected in the longer-term (2040-2050)? | Like HE, with no forecasts stretching as far as 2050, we expect the trend to remain. Especially as technology advances and goods continue to have longer life spans, we expect to see the trend continue further towards increased spending on services and durable goods.  The uncertainties from the medium term forecasts remain. |
| What is the range of possible outcomes? | In a Defra commissioned forecast by [Z\_Punkt](http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18001) (2011), a number of key forecasted scenarios for consumption trends were investigated:  **Scenario 1 – Increase in Sustainable Consumption**  Both the level of concern for the environment and income levels increase substantially. Consumers increasingly make conscious choices about which products and services they consume and how they consume these. The level of consumption of non-durable goods continues to fall. Consumption of semi-durable and durable goods remains relatively stable, but consumers favour high quality products with low environmental impacts. Use of reusable and refillable products and services increases substantially. The volume of material intensive products purchased is significantly reduced. Consumption expenditure increases significantly, but **with a strong focus on sustainable products and tangible services that reduce residual waste.**  **Scenario 2 – Good Attitudes but Wasteful Behaviour (reference)**  Both the level of concern for the environment and the amount of disposable income continue to increase. With more money to spend, consumption of non-durable goods increases. Demand for semi-durable and durable goods show a proportionate decline, while demand for tangible and intangible services increases. People are evidently aware of the environmental impact their lifestyles are having but are unable to translate this concern into tangible actions. Overall, the UK society’s appetite for material possessions continues to grow, with low levels of product re-use. **The reduction in residual waste per capita is limited.**  **Scenario 3 – Low environmentally Conscious Behaviour, Low buying Power**  UK disposable income and real consumption expenditure are in decline. Limited buying power causes a proportionate increase in the consumption of non-durable goods and services. Consumer choices are predominantly driven by price and cost, not quality. The level of concern over the environment does not increase. Durable goods sold are more waste-intensive as suppliers aim to provide lost-cost products. The volume of material intensive products purchased is dominated by demand for low-cost, low-quality products. **There is no reduction in residual waste per capita—there may even be an increase.**  It’s clear to see from these three scenarios that the key dependencies for household consumption patterns are:   * Disposable income, shown particularly in scenario 3, with low disposable income consumers will always look for the cheapest option, whether environmentally friendly or not. * Behaviour and attitudes, in the 3 scenarios a key factor in determining the levels of residual waste is whether or not households are environmentally aware and want to consume goods and services with lower environmental impacts. |
| SECTION B | |
| What could push this driver in the opposite direction? | As discussed above – a fall in disposable income would lead to reduced buying power, and force household to choose goods and services based on price, leading to an increase in the consumption of cheaper non-durable goods. |
| What wildcards (low probability events) could disrupt the expected trends? | Again COVID-19 may have had an adverse effect on consumption patterns moving towards experiences over goods, since with restrictions experiences are not possible in the current climate. |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |
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| **Name of the driver:** Waste Arisings | |
| SECTION A | |
| Description of driver | Total waste arisings refer to the total amount of waste generated, including waste sent for recycling/composting and waste sent for residual treatment. Tonnages of waste arisings are linked to tonnages of residual waste.  The calculation used to determine a recycling rate, for example, is as follows:    Where the remainder could, in the simplest terms, arguably be assumed to be residual waste.  Even in countries with high recycling rates, therefore, an increase in the tonnage of total waste arisings will be linked to an increase in the tonnage of residual waste except in cases where the increase is solely an increase in materials sent for recycling and the recycling rate sufficiently increases as well. Therefore, in most cases, an increase in waste arisings will also lead to an increase in residual waste per capita (kg). |
| What effects has it had historically and what effects is it having now? | Figure 1 shows total waste generated in England between 2010 and 2016, as well as the total waste sent to incineration or landfill. ***These are indicative figures only; the methods used to derive both figures were not designed to be used together in such a way.***  **Figure 1: Total waste generated and total waste sent to landfill or incineration (million tonnes), 2010-2016, England**  Source: [UK Waste Statistics](https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management)  The waste streams that waste was generated from in the UK in 2016 (and their proportioned contribution to the total) is shown in Figure 3.  **Figure 3: Waste generation split by source, UK, 2016**  A pie chart showing the UK's total waste generation split by source in 2016. It shows that C, D & E contributed 62%, C&I contributed 18%, Households contributed 12%, and Other contributed 8% to UK waste generation.  Source: [UK Waste Statistics](https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management)  The residual waste target has yet to be defined. We are still considering which waste streams it will include in its scope. This is important as different waste streams are made up of different materials and have different recycling rates. For example, construction, demolition and excavation (C,D&E) waste has a much higher rate of recovery (91% of non-hazardous C&D waste was recovered in 2016) than household waste (the [local authority waste stats notice](https://www.gov.uk/government/statistics/local-authority-collected-waste-management-annual-results) reported a 43.7% household waste recycling rate in 2016/17).  Therefore, while we would still expect higher tonnages of waste arisings to be associated with higher tonnages of residual waste per capita, the extent to which an increase in arisings would translate to an increase in residual waste would be dependent on material and waste stream.  A key uncertainty is around the historical data. The current [Reconcile](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/873328/Commercial_and_Industrial_Waste_Arisings_Methodology_Revisions_Oct_2018_contact_details_update_v0.2.pdf) method that the Defra waste statistics team use to calculate total waste arisings for England was introduced in 2014, with estimates for 2010 and 2012 figures. Figures have not been backdated further. Additionally, these waste arisings figures are produced for every other year only as part of WStatR reporting requirements. |
| What effects are expected in the medium term (2030)? | Several companies and associations have forecast their expectations for waste arisings through to 2030 (such as [Suez](https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjvlZjNt5HsAhWBShUIHZ6fBngQFjAAegQIBBAB&url=https%3A%2F%2Fwww.suez.co.uk%2F-%2Fmedia%2Fsuez-uk%2Ffiles%2Fpublication%2Fmindthegap20172030-1709-web.pdf&usg=AOvVaw1tKT2VWL7k5Gou0rw7Xa1u) and [ESA](https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjvlZjNt5HsAhWBShUIHZ6fBngQFjADegQIAhAB&url=https%3A%2F%2Fwww.circularonline.co.uk%2Fwp-content%2Fuploads%2F2017%2F11%2FUK-Residual-Waste-Capacity-Gap-Analysis.pdf&usg=AOvVaw3DggXWxtgAy5BbpYwhblEp)). Suez identifies three drivers of waste arisings: population growth, economic performance, and the efficacy of awareness drives such as ‘love food hate waste’.  These forecasts predict growth for household waste arisings:    Source: [Tolvik](https://www.circularonline.co.uk/wp-content/uploads/2017/11/UK-Residual-Waste-Capacity-Gap-Analysis.pdf) (for ESA)  and ‘municipal-like’ C&I waste arisings:    Source: [Tolvik](https://www.circularonline.co.uk/wp-content/uploads/2017/11/UK-Residual-Waste-Capacity-Gap-Analysis.pdf) (for ESA)  Change in C,D&E waste through to 2030 is likely to be driven by economic performance. Most forecasts focus on household and/or municipal waste (including some C&I waste sources but not all), and this is a key uncertainty.  Based on the projections that total municipal waste arisings will grow between now and 2030, we expect to see growth in total residual waste tonnages as well. Whether this translates into an increase in residual waste per capita, as per the target, will depend largely on other drivers such as regulation, public attitudes and behaviours, household expenditure, household consumption patterns, and market change (see tables for those drivers). |
| What effects are expected in the longer-term (2040-2050)? | Note: to our knowledge, no forecasts have been conducted into expected waste arisings in the longer-term.  We expect to see population growth, economic performance, and public knowledge/awareness continue to drive waste arisings, and for this to continue to have an effect on residual waste tonnages.  As with forecasts until 2030, we expect this to depend heavily on the other drivers described in this report. |
| What is the range of possible outcomes? | Outcomes range from:  Residual waste tonnages closely linked to waste arisings  Regulations and awareness campaigns either fail to launch/pass into legislation or have no effect on public attitudes and recycling behaviours. The recycling rate remains the same or decreases. Companies and manufacturers have no incentives to improve the recyclability of their products and do not improve their corporate eco-awareness. Individuals do not feel it’s their responsibility to buy green or prioritise more durable products. As waste arisings increase, not only do residual waste tonnages increase, but so does residual waste per capita.  Nothing changes  Waste arisings increase in line with an increasing population. The recycling rate stays the same. Residual waste per capita neither increases nor decreases.  Residual waste tonnages begin to separate from waste arisings  Regulations and awareness campaigns provide incentives/infrastructure for the public to improve their recycling behaviours. Companies and manufacturers redesign their products to include more easily recycled materials. The recycling rate increases. Individuals are more likely to buy recyclable products or products that they expect to reuse. While total waste arisings continue to increase alongside an increasing population, residual waste per capita decreases.  Key dependencies are:   * Regulation/legislation * Attitudes and behaviours (public and corporate) |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * + *How we think about the world and people’s relationships to it and to each other?*   + *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

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| **Name of the driver:** Behaviour and Attitudes | |
| SECTION A | |
| Description of driver | The ‘behaviour and attitudes’ driver refers to public attitudes towards recycling and reuse, and the affect these may have on an individual’s intention to recycle or reuse materials. It also refers to recycling and reuse behaviour such as whether the individual places materials in the correct recycling bin or prioritises buying a product that can be recycled or reused.  The [Theory of Planned Behaviour](https://www.sciencedirect.com/science/article/abs/pii/074959789190020T) (TPB) suggests that an individual's intention to perform a behaviour is driven by positive evaluation of the behaviour (attitude), social pressure encouraging the behaviour (subjective norm) and perceived ease of performing such behaviour (perceived behavioural control).  It is therefore expected that individuals with a positive attitude towards recycling and reuse will be more likely to display these behaviours. These behaviours will also be more likely in cultures where recycling and reuse is encouraged and seen as the norm, and where infrastructure is in place to make recycling and reuse (and the purchase of fully-recyclable products) easily accessible for the individual.  In context of the target, these are desired behaviours: recycling and/or reusing materials to a higher degree and more efficiently will increase the recycling rate and decrease the amount of waste sent for residual treatment. |
| What effects has it had historically and what effects is it having now? | Since 2004, WRAP have conducted an [annual survey](https://www.wrap.org.uk/content/recycling-tracker-report-0) investigating behaviours, attitudes and awareness around recycling in the UK. Key conclusions are:   * Recycling advanced from innovation to social norm between 2008 and 2013. It has remained a social norm since. WRAP has found that social norms have a strong positive correlation with recycling behaviour. * Even since 2018, there has been an increase in positive environmental attitudes. * In 2020, 77% of UK households identified at least one ‘barrier’ that led them to put items in general rubbish rather than recycling, including a lack of knowledge and infrastructure. WRAP also found that lower performing recyclers were significantly more likely to cite service-based barriers around a lack of recycling capacity or the frequency of recycling collections.   Despite being the largest and longest-running of its kind, the WRAP survey does not draw causational conclusions from its work—it’s difficult to isolate the effect that attitudes have had on waste arisings and recycling. This in itself is a key uncertainty. There are further uncertainties related to methodology, including survey-related limitations such as participant bias; and that the survey was conducted on a UK-level.  Other uncertainties relate to the affect that attitudes may have on waste streams other than household waste, such as commercial & industrial (C&I) waste. |
| What effects are expected in the medium term (2030)? | To note: to our knowledge, there have been no forecasts conducted specific to public attitudes and behaviours towards recycling and/or reuse.  However, we expect that the medium term effects of behaviour on the target will broadly continue: positive attitudes and social norms will remain positively correlated with recycling/reuse behaviours, and therefore be linked to lower tonnages of residual waste per capita.  Key indirect drivers of recycling/reuse behaviour according to WRAP’s research appear to be:   * Recycling/reuse as a social norm * Positive attitudes towards the environment * Collection scheme factors (fewer items are disposed of incorrectly by households who have services with restricted residual waste capacity, higher numbers of materials collected for recycling, and multi-stream recycling schemes) * Sociodemographic variables (age, urbanisation…)   We therefore expect that public attitude and behaviour towards recycling/reuse will become more positive following key changes in legislation such as the aim to introduce consistent collection schemes across England, the Deposit Return Scheme, and reforming packaging producer responsibility ([currently in consultation](https://www.gov.uk/government/consultations/waste-and-recycling-making-recycling-collections-consistent-in-england/outcome/consistency-in-recycling-collections-in-england-executive-summary-and-government-response)).  It is expected that the introduction of mandatory separate food waste collections across England from 2023 will move food waste recycling towards being perceived as a social norm.  These pieces of legislation/infrastructure change are key uncertainties and dependencies. Other uncertainties will be media attention affecting public attitude, and the launch of any campaigns to educate the public on recycling and environmental issues such as Recycle Now. |
| What effects are expected in the longer-term (2040-2050)? | To note: to our knowledge, there have been no forecasts conducted specific to public attitudes and behaviours towards recycling and/or reuse.  However, as with the previous answer, we expect that the longer term effects of behaviour on the target will broadly continue: positive attitudes and social norms will remain positively correlated with recycling/reuse behaviours, and therefore be linked to lower tonnages of residual waste per capita.  In the long-term (and perhaps mid-term as well), we expect there to be a greater range of fully-recyclable products available for purchase, further lowering ‘barriers’ towards recycling behaviour. We expect this to be driven by producer responsibility reforms, and consumer attitudes having a circular effect on manufacturer standards and values.  A key dependency is industry and manufacturer choice and cooperation in product design. |
| What is the range of possible outcomes? | In 2010, Defra commissioned a [waste arisings forecast](http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18001) from The Foresight Company. This outlines several scenarios relating to public attitudes and behaviours including:  Scenario 1: Good attitudes, wasteful behaviour  People are aware of the environmental impact their lifestyles are having, but are unable to translate this concern into tangible actions. Individual consumption decisions continue to be driven by price, brand, or quality, while recycling and composting rates remain largely stable.  Scenario 2: Strong increase in sustainable consumption  Use of reusable and refillable products and services increases substantially. The volume of material intensive products purchased is significantly reduced. Consumption expenditure increases significantly, but with a strong focus on sustainable products and tangible services that reduce waste.  Scenario 3: Steady buying power, conscious choices  People are fully aware of the environmental impact their lifestyles are having. Use of reusable and refillable products and tangible services increases substantially as more people try to reduce the impact of their purchases. Households recycling and composting rates are at a historic high.  Scenario 4: Low consumption and low environmentally conscious behaviour  Recycling and composting rates are high where this offers a financial return. The level of concern over the environment does not increase. In surveys, only a minority regularly expresses concern about the environment as one of their main worries.  Scenario 5: High consumption and low environmentally conscious behaviour  The level of concern over the environment and sustainability decreases. Waste-reducing behaviours are limited to where this is fashionable and provides status. Consumption of consumer goods increases rapidly. Recycling, re-use, and composting rates are low.  In the scenarios with desired outcomes, though supported by societal awareness, strict and direct policy interventions remain the key to driving this change. In these scenarios, behavioural change is facilitated by targeted pressure on industry to improve resource efficiency and to shift use towards more biodegradable and recyclable materials. |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * + *How we think about the world and people’s relationships to it and to each other?*   + *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

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| **Name of the driver:**Market Change | |
| SECTION A | |
| Description of driver | The market change driver refers to commodity markets and gate fees, which may influence and/or incentivise waste management companies to dispose of their waste in specific ways. This would also relate to key pieces of regulation and policy such as the Landfill Tax.  It is assumed that waste management companies, unless otherwise incentivised, will be more likely to dispose of their waste through the cheapest and/or most profitable options available to themselves.  It is therefore expected that low commodity prices for dry recyclate materials and high gate fees at MRFs, for example, will increase residual waste per capita; and that high commodity prices for dry recyclate materials and low gate fees at MRFs will encourage higher levels of recycling and thus reduce residual waste per capita. |
| What effects has it had historically and what effects is it having now? | The charts below show price indicators and trade volume for waste glass, paper and cardboard, and plastic between 2004 and 2020. The final chart compares price indicators for high quality and low quality waste paper for the same time range. The source for all charts is [Eurostat](https://ec.europa.eu/eurostat/statistics-explained/index.php/Recycling_%E2%80%93_secondary_material_price_indicator).  [File:Price indicator and trade volume for waste glass, EU-27.png](https://ec.europa.eu/eurostat/statistics-explained/images/e/e2/Price_indicator_and_trade_volume_for_waste_glass,_EU-27.png)[File:Price indicator and trade volume for paper and paperboard waste, EU-27, 2004 to December 2019.png](https://ec.europa.eu/eurostat/statistics-explained/images/b/b4/Price_indicator_and_trade_volume_for_paper_and_paperboard_waste,_EU-27,_2004_to_December_2019.png)  [File:Price development for low and high quality waste paper, EU-27, (2004-2020).png](https://ec.europa.eu/eurostat/statistics-explained/images/9/93/Price_development_for_low_and_high_quality_waste_paper,_EU-27,_(2004-2020).png)[File:Price indicator and trade volume for waste plastic, EU-27.png](https://ec.europa.eu/eurostat/statistics-explained/images/f/fb/Price_indicator_and_trade_volume_for_waste_plastic,_EU-27.png)  These charts give an indicative view of overall market prices only as there are several obvious limitations: they are limited to EU-27 markets and do not account for changes in global trends; similarly yet conversely, tonnages are not limited to materials exported or imported by England; and they do not account for other variables that may be influencing tonnages, such as changes in regulation.  A representative of the Local Government Association (LGA) said in [January 2020](https://www.letsrecycle.com/news/latest-news/waste-bills-to-rise-as-costs-jump/), “The ban by China and other countries on imported paper and plastic waste has led to some councils’ recycling costs increasing significantly over the past year, which risks limiting councils’ ability to recycle. Government plans to extend the ban to countries outside the Organisation for Economic Co-operation and Development will lead to new costs for councils as it will restrict where they can send recyclable material.”  A representative from Suez also said, “Continually increasing landfill tax, combined with current and expected taxes from the Netherlands and Sweden on RDF imports, are likely to see the cost of residual waste treatment continue to rise.”  Average gate fees for different waste streams are [published by WRAP](https://www.wrap.org.uk/collections-and-reprocessing/recovered-materials-markets/reports/gate-fee-reports) on an annual basis. |
| What effects are expected in the medium term (2030)? | To note: to our knowledge, there have been no forecasts conducted specific to commodity prices through to 2030.  Market prices for most, if not all, recycled materials tend to follow expansions and contractions in the overall world or national economy such as major economic recessions and market crashes. The chart below shows a long-term forecast of real GDP through to 2030.  **Forecast of Real GDP (World, Euro area, and United Kingdom), 2020-2030, OECD**    Source: [OECD](https://data.oecd.org/gdp/real-gdp-long-term-forecast.htm#indicator-chart)  The OECD forecasts a global growth in GDP from 103 million USD in 2020 to 137 million USD in 2030. We, therefore, may expect market prices of recycled materials to increase between 2020 and 2030. Taken simplistically, we therefore may expect to see recycled materials continue to be sent overseas, and minimal recyclable material being diverted to residual waste. However, there are a lot of associated uncertainties, and average growth in GDP may be stalled by recessions or the impact of COVID-19 on the economy.  Further, there is not a direct link between economic performance and market prices. There are other uncertainties and dependencies such as:   * Regulation on export/import (either domestic or foreign, such as China’s National Sword policies) * Domestic regulation—incentives and legislation * Demand in developing countries (e.g., for paper in India) * Emergent technologies improving the quality of recycled materials * Price markets for raw materials * Public recycling behaviours (minimising contaminated materials) * Domestic capacity for landfill/incineration * Domestic gate fees   Domestic gate fees and market prices are interrelated—a key driver of gate fees at MRFs is commodity prices for recycled materials ([WRAP](https://wrap.org.uk/sites/files/wrap/WRAP%20gate%20fees%20report%202019.pdf)). |
| What effects are expected in the longer-term (2040-2050)? | To note: to our knowledge, there have been no forecasts conducted specific to commodity prices through to 2050.  We expect market prices for most, if not all, recycled materials to continue to follow expansions and contractions in the overall world or national economy such as major economic recessions and market crashes. The chart below shows a long-term forecast of real GDP from 2030 to 2060.  **Forecast of Real GDP (World, Euro area, and United Kingdom), 2030-2060, OECD**    Source: [OECD](https://data.oecd.org/gdp/real-gdp-long-term-forecast.htm#indicator-chart)  The OECD forecasts a global growth in GDP from 137 million USD in 2030 to 268 million USD in 2060. We, therefore, may expect market prices of recycled materials to increase between 2020 and 2030. Taken simplistically, we therefore may expect to see recycled materials continue to be sent overseas, and minimal recyclable material being diverted to residual waste. However, the key uncertainties and dependencies have not changed, and we would expect to see the same covariates in 2040-2050 as outlined and described in the medium-term outlook to 2030 (see previous question). |
| What is the range of possible outcomes? | In 2010, Defra commissioned a [waste arisings forecast](http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18001) from The Foresight Company. This outlines several scenarios relating to market change including:  Scenario 1: Steadily increasing prices  Global demand for key commodities – in particular energy resources, minerals, metals, and food – continues to rise. This, coupled with a limited expansion of supplies, leads to steadily increasing prices on world commodity markets. With higher prices for raw materials, demand for and prices of recyclates also increase.  Scenario 2: Open markets and stable supplies  Global demand for key commodities – in particular energy resources, minerals, metals, and food – increase only slightly. This, coupled with a strong expansion of supplies, leads to stable and in some cases decreased prices on world commodity markets. With stable prices for raw materials, demand for and prices of recyclates stagnate.  Scenario 3: High prices and strong volatility  Global demand for key commodities – in particular energy resources, minerals, metals, and food – rapidly increases. This, coupled with a limited expansion of supplies, leads to a strong increase in prices on world commodity markets.  Demand for and prices of recyclates are highly seasonal and volatile depending on price developments in commodity markets.  Scenario 4: Closed markets and protectionism  Global demand for key commodities – in particular energy resources, minerals, metals, and food – rapidly increases. This, coupled with a limited expansion of supplies, leads to a strong increase in prices on world commodity markets. Demand for and prices of recyclates increase rapidly as industries look for substitutes to dwindling global commodity supplies.  Scenario 5: Price drop  Global demand for key commodities falls. This, coupled with a continued expansion of supplies, leads to a strong decrease in prices on world commodity markets. With low prices for raw materials, demand for and prices of recyclates decrease significantly.  Key uncertainties and dependencies are:   * Global demand for key commodities * Raw material prices and supply * Open versus closed markets. |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect :*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

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| --- | --- |
| **Name of the driver:** Available/affordable technology | |
| SECTION A | |
| Description of driver | The status quo of UK’s recycling and reuse infrastructure and technology is expressed by the processing capacities of the country’s materials recycling facilities (in tonnes) and other recycling supply chains, if possible for materials such as paper, glass, plastics, or textiles. Reuse capacity is expressed by the size of second-hand markets for single product categories. The recycling capacity in the UK has been growing in recent years, but varies according to product, ranging from well-established for glass to almost non-existent for batteries. The UK’s reuse of products is also growing, whereas the exact market size for the total market and/or single product categories is difficult to pin down, due to a lack of available data. Residual waste is predominantly treated in Energy for Waste (EfW) plants, currently the main process used is incineration. Waste burning technologies have become more environmentally friendly and new technologies such as gasification, pyrolysis, and biological processes are being introduced or under development.  In 2016 the majority (76%) of waste treated at energy recovery facilities is ‘Household & Similar Wastes’. Incineration without energy recovery has a different profile with only 38% of the waste accepted being ‘Household & Similar’ and almost half (48%) being classed as ‘Other Wastes’, which includes residues following physical treatment and incineration of waste, residues from industrial processes and sewage.  Figure 1 is a diagram of the waste hierarchy, which tells us that increasing the rates of reuse and recycling is more important than increasing the tonnage of waste treated in EfW infrastructure.  See the source image  Figure 1: Waste Hierarchy |
| What effects has it had historically and what effects is it having now? | Energy from waste has a poor historical image in the UK. We have been very dependent on landfill and many of the early incinerators were disposal-only plants, which simply burned waste to reduce its volume. This historical image is persistent but outdated. The introduction of landfill diversion targets in the mid 1990s helped drive a new generation of energy from waste plants, designed to meet new strict emissions standards, and provide valuable low carbon energy. Figure 2 shows how these landfill diversion targets have been successful in almost halving the landfill input of 2000/01 compared to that in 2016. Figure 3 shows EfW plants are becoming increasingly popular, with the number in the England from 2014 to 2016, increasing from 13 to 23, with capacity almost quadrupling from 2.8 Mt to 7.2 Mt per year, coinciding with policies aimed at diverting waste away from landfill. Energy from waste is generally the best management option for waste that cannot be reused or recycled in terms of environmental impact and getting value from the waste as a resource.  Figure 4 shows the recycling and recovery rate in England has remained relatively constant around 50% for all waste streams. The advancements in technology of MRFs have led to them having a recycling rate of over 90%, although data (capacity, forecasts, etc) is hard to come by, due to the competition between the companies who own them.    Figure 2 from [Government Waste Management Statistics](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642373/Waste_management_2016_summary.pdf)    Figure 3: Number and capacity of permitted final treatment facilities, UK and England, 2014-16 from [UK Statistics on Waste](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918270/UK_Statistics_on_Waste_statistical_notice_March_2020_accessible_FINAL_updated_size_12.pdf)  Figure 4: [Government Statistics](https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management) on Recycling and Recovery Rate in England |
| What effects are expected in the medium term (2030)? | In 2017 [ESA](http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf) carried out a UK Residual Waste: 2030 Market Review, in which they reviewed data and forecasts from a number of reports (Biffa, Suez, Eunomia, FCCE, SLR, Viridor) and produced forecasts for the ‘gap’ between the forecasted capacity of the UK to treat residual waste and the forecasted residual waste tonnages in 2030. In Figure 5 we can see the forecasts for residual waste against 5 different scenarios for recycling rates. Figure 6 shows the effect that this amount of residual waste will have on the current infrastructure available for residual waste treatment. Whilst Figure 7 shows the effect of this level of residual waste against the forecasted capacity of residual waste treatment including RDF export. The ‘Circular Economy’ (CE) target for the recycling rate, forecasts the level of capacity and residual waste to be equal.    Figure 5: Forecasts for residual waste in 2030 from [ESA](http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf)    Figure 6: 2030 Residual Waste Capacity ‘Gap’ (exc Additional EfW and RDF Export) from [ESA](http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf)    Figure 7: 2030 Residual Waste Capacity ‘Gap’ (inc Additional EfW and RDF Export) from [ESA](http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf)  The main uncertainty involved in this forecast, lies with the effect it will have on residual waste tonnages. In a report from [Eunomia](https://www.eunomia.co.uk/reports-tools/residual-waste-infrastructure-review-12th-issue/) in 2017, it is stated that the maximum possible recycling rate for the UK in 2030 is capped at 68% if the projected residual waste treatment infrastructure is all fully employed. However, the uncertainty continues as in the [‘Mind the Gap’](https://www.suez.co.uk/-/media/suez-uk/files/publication/mindthegap20172030-1709-web.pdf) report from Suez in 2017 and the Biffa [‘The Reality Gap’](https://www.biffa.co.uk/-/media/files/download-pdfs/the-reality-gap-2017.ashx) report, also from 2017, a shortcoming of residual waste treatment capacity in 2030 is forecasted. Biffa forecast a gap in EfW capacity of 5.9Mtpa in 2030, whilst Suez have the gap at 2.4Mtpa. Figure 8 shows how Biffa forecast recycling rates in the UK to increase through to 2030.    Figure 8: Forecasted Recycling Rates from [Biffa](https://www.biffa.co.uk/-/media/files/download-pdfs/the-reality-gap-2017.ashx) |
| What effects are expected in the longer-term (2040-2050)? | At present no forecasts reach as far as 2050, but we expect current trends to continue, with Government policies increasing the rate of recycling. We would also expect to see the capacity of EfW infrastructure advance, to meet levels of residual waste.  The main uncertainty, is again, the effect that these advancements will have on residual waste tonnages. EfW treatment will often be an easier alternative for recyclable waste and will become even more readily available as an option as the capacity of the infrastructure grows. So, this may well lead to an increase in the levels of residual waste.  However, Government policies aim to increase the rate of recycling, especially in MRFs, where there is excess capacity available. |
| What is the range of possible outcomes? | In 2011 Defra commissioned [Z\_Punkt](http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18001) to produce a forecasting report on Future Waste Policy, in that report they highlight a number of scenarios surrounding the forecasts for treatment of waste:  **Scenario 1 - HH Waste Dominates Development (Reference Case)** - The expansion of treatment infrastructure and technology for recycling and reuse in the UK develops haphazardly. The waste sector remains fragmented. There is a trend towards more coordinated collection, but also a persistent mismatch between recyclate supply and demand. The type of recycling infrastructure developed and deployed continues to be dominated by household waste with limited use of co-treatment options for plants accepting both HH & C&I streams. There is a limited expansion of domestic plastic recycling capacities, but stronger growth in paper and glass recycling capacities. Recycling capacity for Waste Electrical and Electronic Equipment (WEEE) is lacking. Reuse is mainly driven by services from the third sector, but the overall quantities of WEEE reused continues to decline as the large compliance schemes have no incentive to preserve the quality of WEEE to make reuse possible. Weight and quantity continue to be more important drivers for recycling than the environmental aspects and quality of material collected. The development of the UK’s energy from waste (EfW) capacity and infrastructure is highly diverse. Applications are pre-dominantly small-scale, with high regional variation in capacity and availability. **The reduction in residual waste per capita is limited.**  **Scenario 2 - High-Tech Focus on Commercial and Industrial Waste -** The expansion of treatment infrastructure and technology for recycling and reuse in the UK develops in a coordinated way. The waste sector is increasingly consolidated, leading to a standardisation of collection methods, in particular for C&I waste. New recycling infrastructure deployed is both high-tech and large-scale and balanced for household and C&I waste requirements. There is an increase in domestic plastic and paper recycling capacities, and a slight increase in recycling capacity for Waste Electrical and Electronic Equipment (WEEE). Reuse is driven partly by professional services as well as the third sector. The quality and quantity of material collected are increasingly important. The development of the UK’s energy from waste (EfW) capacity and infrastructure focuses on large-scale applications. Regional capacity and availability is coordinated. Where feasible, waste producers engage in large, long-term contracts with EfW capacity providers. **The reduction in residual waste per capita is likely greater than in Scenario 1 but may be limited by advancements in EfW.**  **Scenario 3 - Low-Tech, Uncoordinated and Diverse** - The expansion of treatment infrastructure and technology for recycling and reuse in the UK develops haphazardly. The waste sector is increasingly fragmented, leading to a further diversification of collection methods. Recycling infrastructure develops uncoordinatedly with high local diversity in terms of treatment processes and capacities. Domestic plastic recycling capacities do not expand significantly, although there is a slight increase in paper and glass recycling capacities. There is a persistent lack of recycling capacity for Waste Electrical and Electronic Equipment (WEEE). Reuse, especially for textiles, is driven by the third sector. Weight and quantity continue to be more important drivers for recycling than the environmental aspects and quality of material collected. **There is no reduction in residual waste per capita—there may even be an increase.** |
| SECTION B | |
| What could push this driver in the opposite direction? |  |
| What wildcards (low probability events) could disrupt the expected trends? |  |
| What responses or indirect effects might emerge in relation to driver? | *How might the evolution of this driver affect:*   * *How we think about the world and people’s relationships to it and to each other?* * *What goods and services are created (and how); and what is stooped, rendered obsolete or actively closed down?* |

1. ‘STEEP’ stands for Social, Technological, Economic, Environmental and Political [↑](#footnote-ref-2)
2. The OECD project national GDP on the basis of macroeconomic trends in technical progress, physical capital, labour (accounting for education, employment demographic trends, labour participation rates and unemployment scenarios), energy demand, and natural resource revenues stemming from extraction and processing of fossil fuels. [↑](#footnote-ref-3)
3. England level data published by Defra for the years 2001-17, however UK level estimates are available for 1990-2017, and these have been used to provide an indication of more historical trends, which are similar for the period in which temporally overlapping data is available, and assumed to be likely to be the case for the period prior to 2001 too. This is because England makes up a substantial proportion of the UK in terms of population. [↑](#footnote-ref-4)