

Aurora Keynote:

# Great Britain's energy transition: the good, the bad, and the ugly



**Emma Woodward**  
Project Leader Advisory,  
Aurora

A U R  R A

## Spring Forum

Oxford 2023

In partnership with:



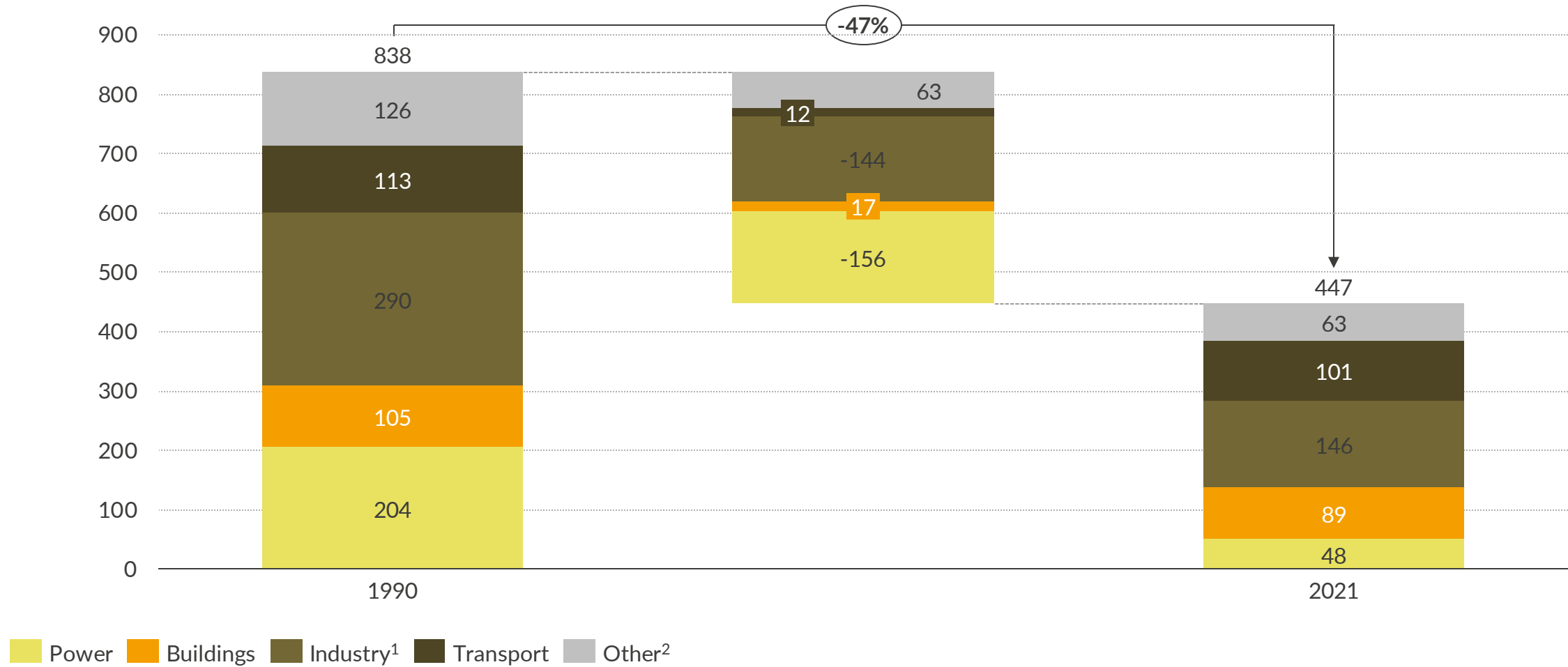
Engineer - Install - Maintain





# Total greenhouse gas emissions in GB have fallen by 47% since 1990, driven by significant reductions in the industrial and power sectors

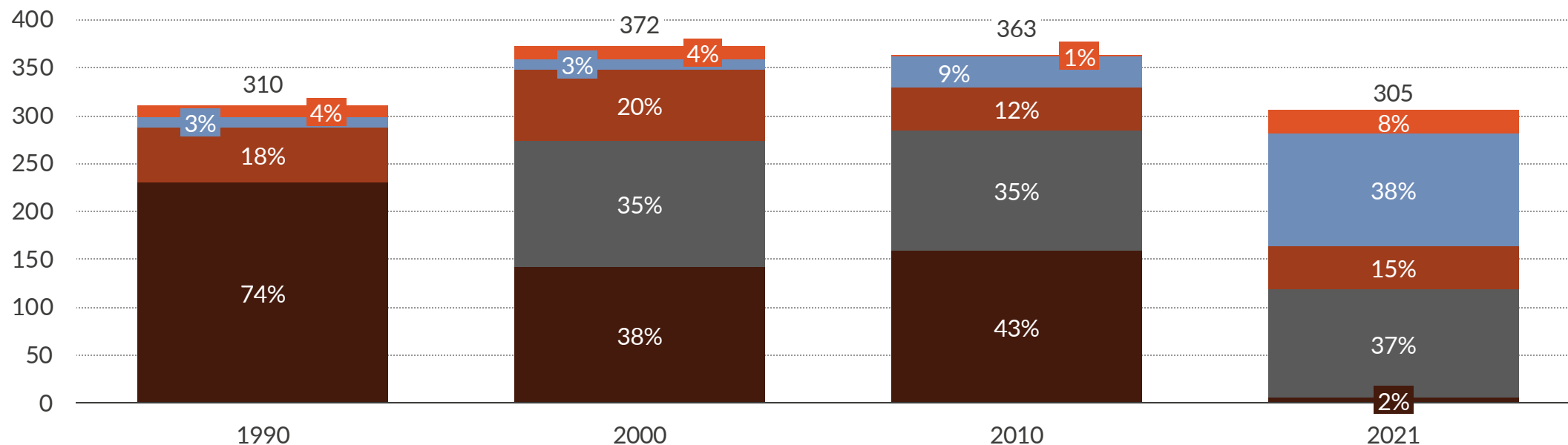
Total emissions by sector (including aviation & shipping)  
MtCO<sub>2</sub>e



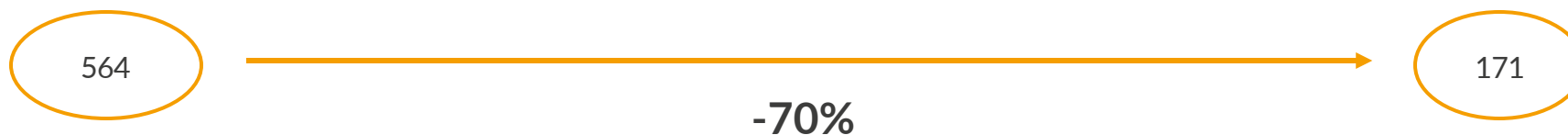
1) Includes agriculture 2) Includes waste F-gases;

# Within the power sector, a near total phase out of coal and increasing renewable generation has seen emissions intensities fall by 70% since 1990

Electricity generation  
TWh



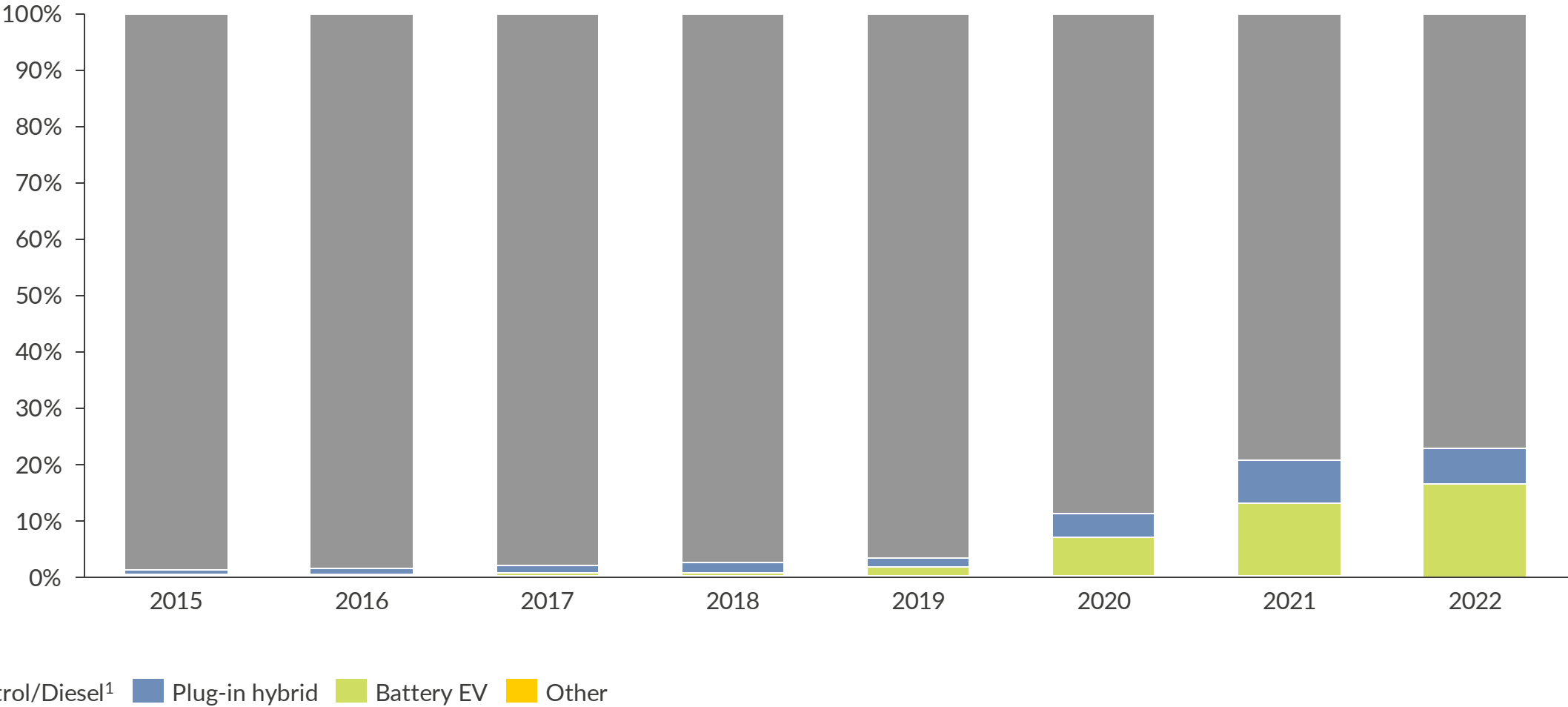
Power sector carbon intensity  
gCO<sub>2</sub>/kWh



Net Imports Renewables Nuclear Gas Coal

# Progress is being made within the transport sector with more than 23% of new cars registered in 2022 being either Battery EVs or plug-in hybrids

New car registrations by fuel type  
%

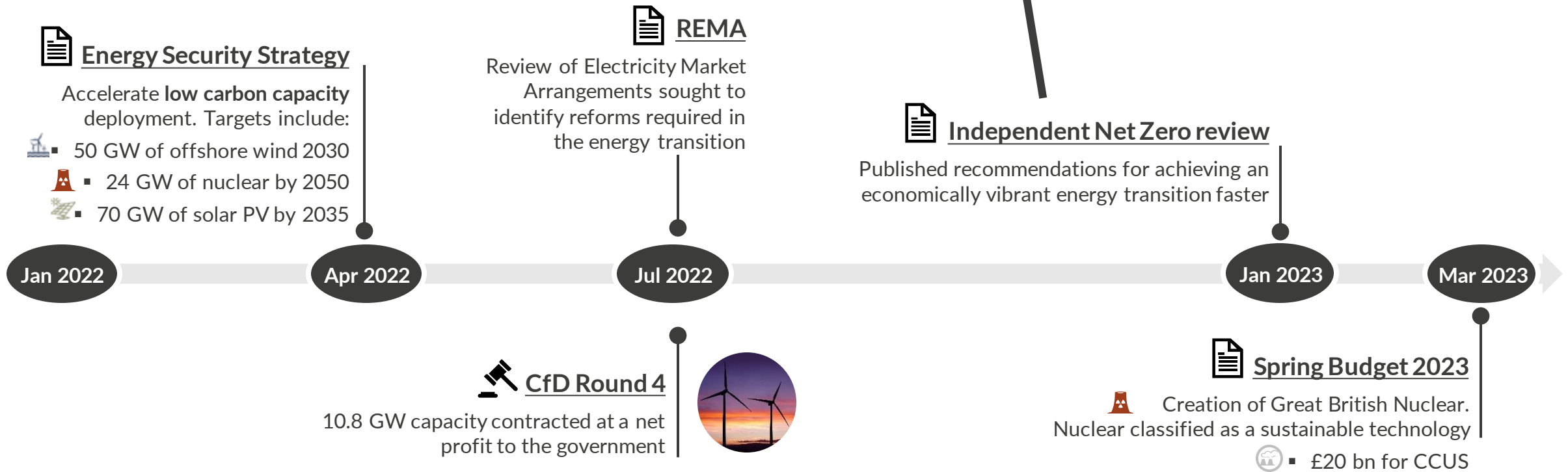


1) Includes self charging hybrids with limited zero emissions electric only modes

# The past 12 months have seen growing public awareness and a number of policy initiatives aimed at supporting the energy transition in the future

“ ...climate change was the second biggest concern facing adults in Great Britain (74%)... ”

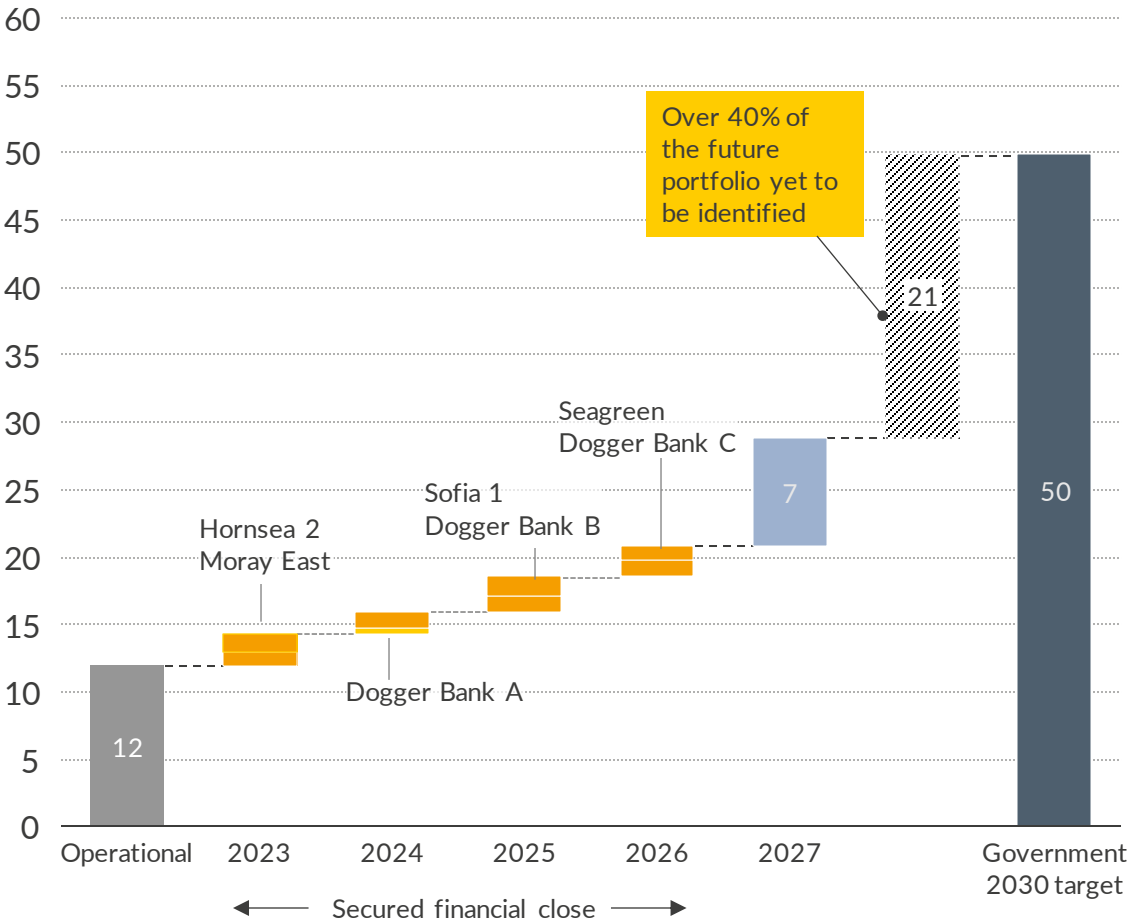
– Mission Net Zero, January 2023



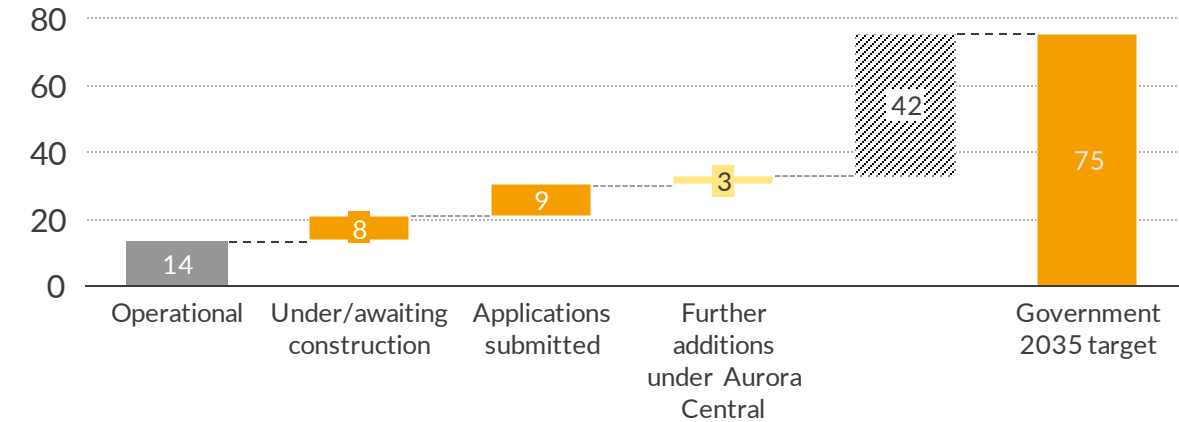


# Despite policy ambition, there remains a significant gap between projects under development and stated renewable deployment targets

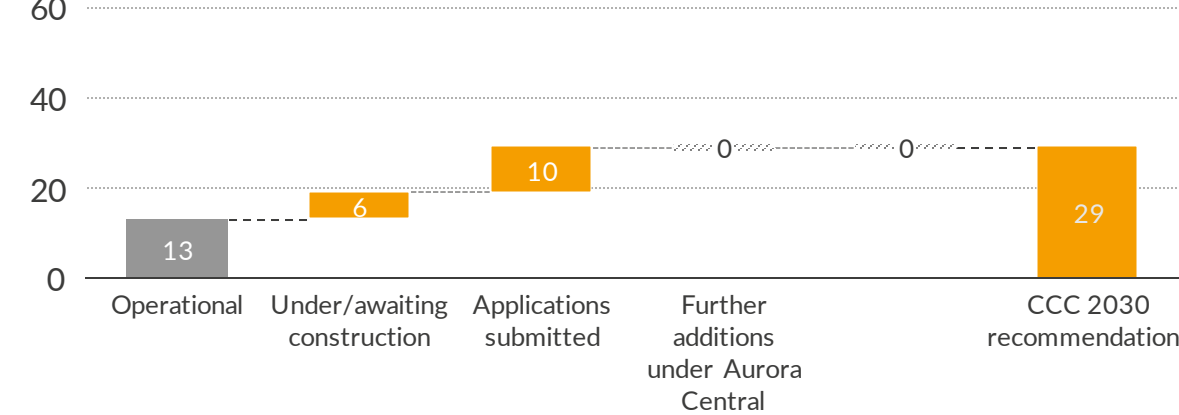
GB offshore wind project pipeline  
GW



GB solar PV project pipeline  
GW




GB onshore wind project pipeline  
GW




1) CCC Balanced pathway

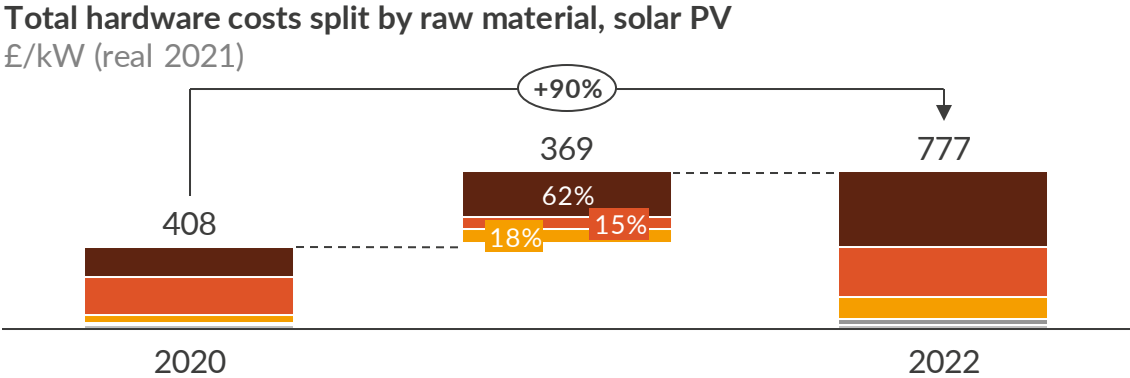



# Increasing costs and WACCs are intensifying the scale of the challenge of bridging the gap

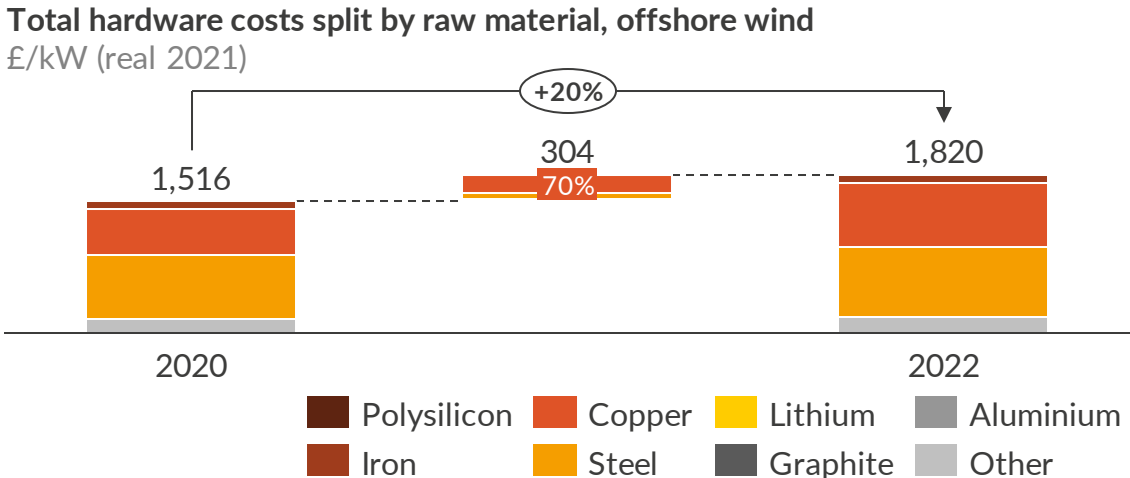
 Inflation, political uncertainty and changes to energy policy are expected to push up WACCs

Inflationary pressure	Higher risk-free rate of returns
Political upheaval	Change in leadership
	Brexit
	Sep-22 mini budget
Energy Policy	Windfall taxes & Electricity Generator Levy
	Onshore wind ban
	REMA consultation

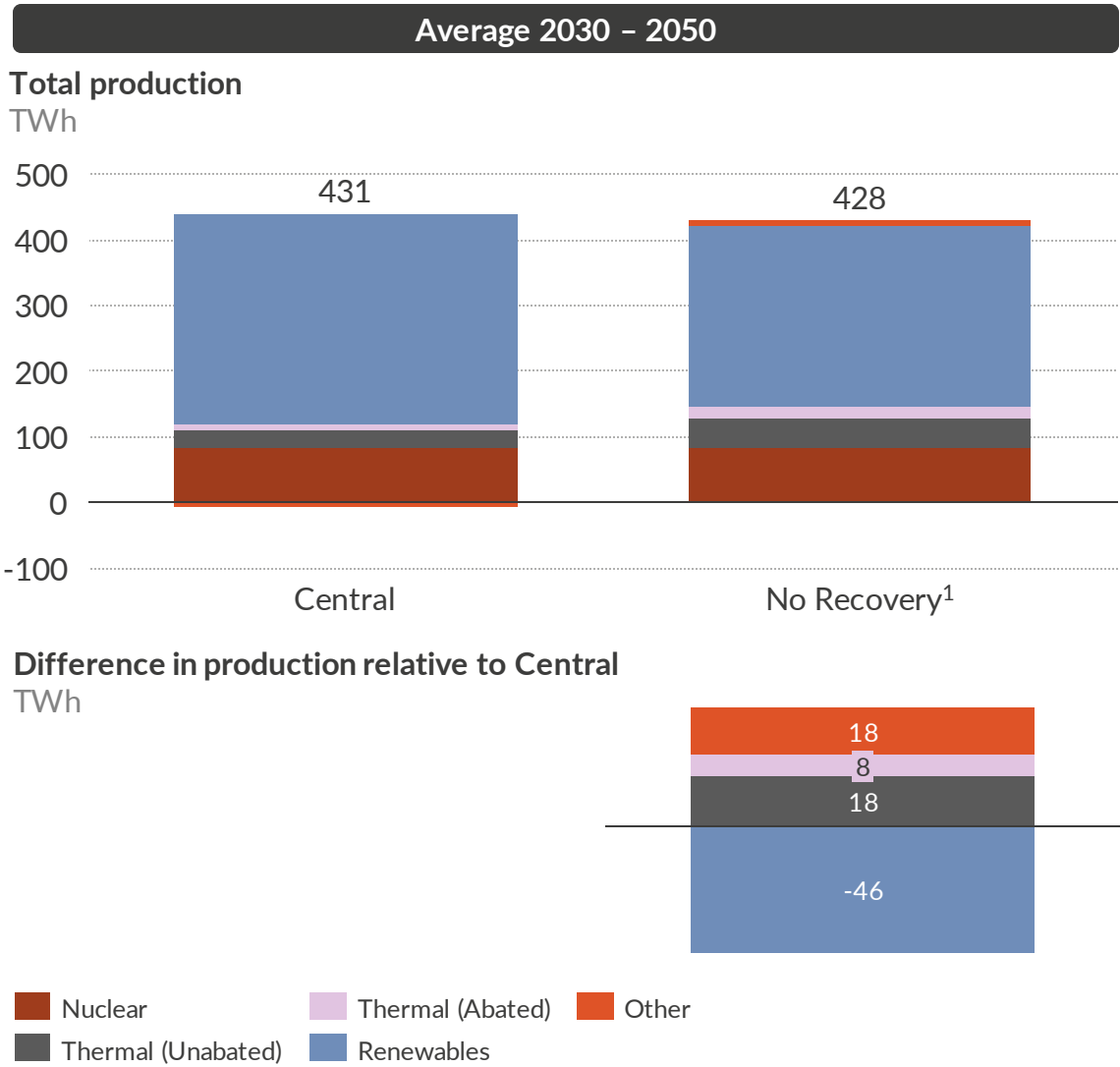
 Solar PV hardware costs increased by 90%, mostly due to the increasing price of polysilicon



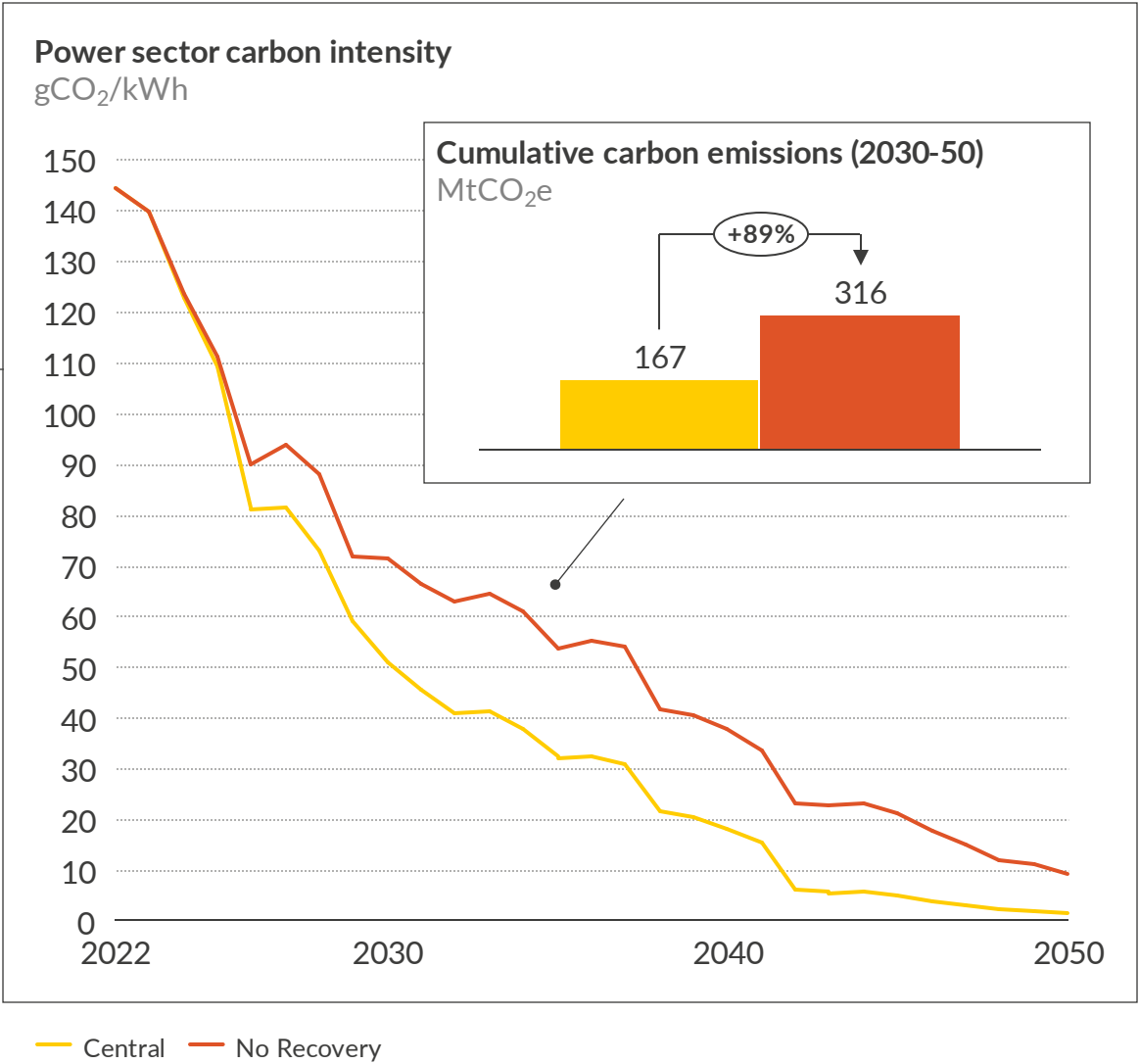
 Raw material price increases yield a 20% hardware cost increase for offshore wind, driven primarily by steel and copper



# The continued prevalence of the current high cost environment could result in 89% higher carbon emissions relative to Aurora’s central forecast

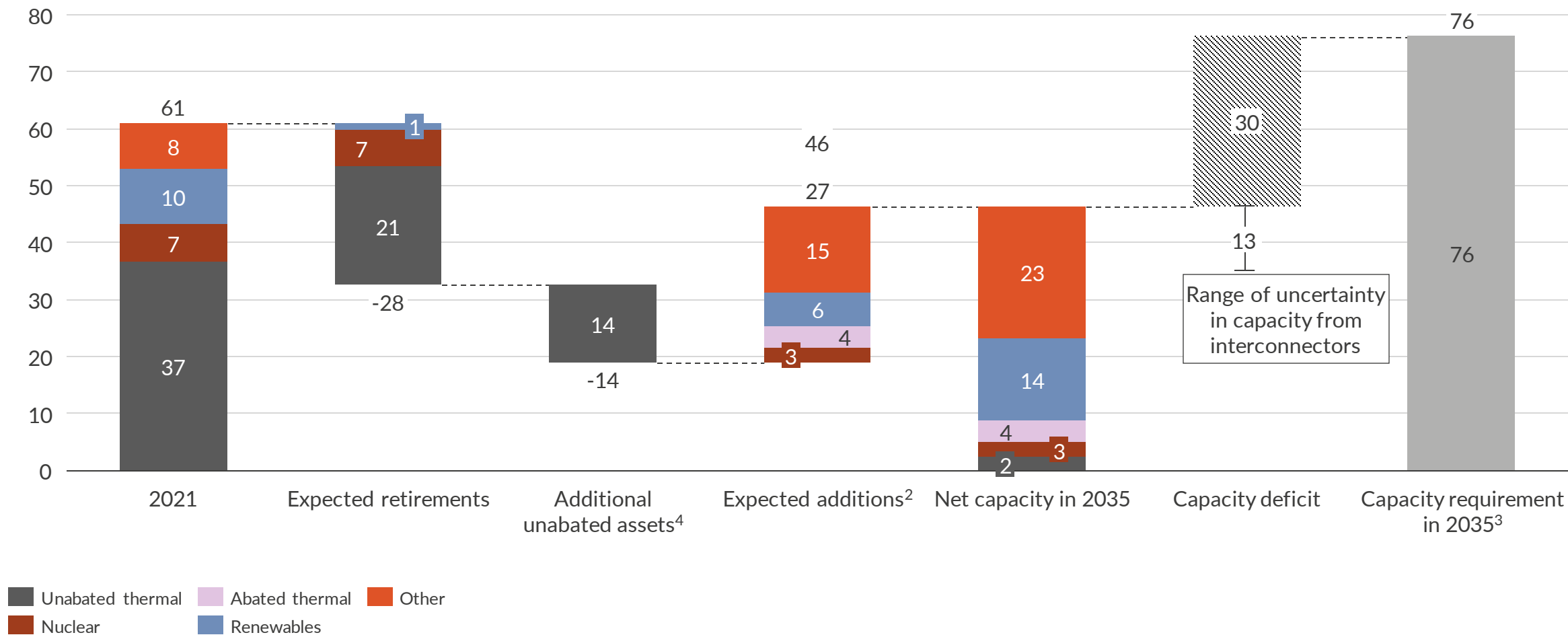


1) WACC assumptions for renewables: 11% in Aurora central, 13% in No recovery



# Net Zero power by 2035 could also result in a 30 GW (de-rated) undersupply of firm capacity, putting security of supply at risk

Expected capacity retirements and additions by 2035<sup>1</sup>  
GW, de-rated

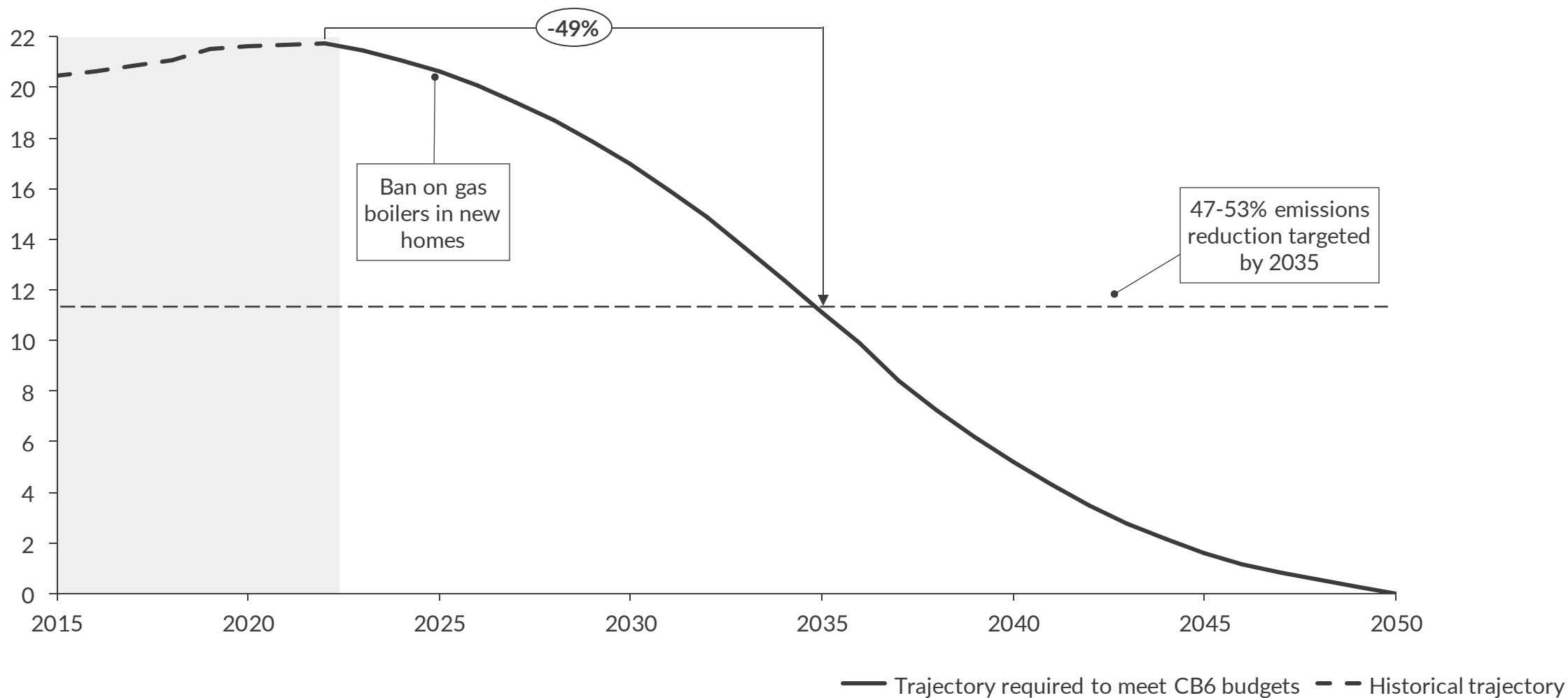


1) Expected retirements reflect publicly announced dates for nuclear plant closures, policy mandated closure of coal assets and retirements of existing CCGTs based on a 30 year technical lifetime. 2) Reflects expected and potential additions based on confirmed and announced projects in the GB pipeline. 3) Estimated capacity requirement in 2035 (de-rated) based on Aurora's Net Zero scenario. 4) Unabated assets that will need to close or be converted to meet 2035 Net Zero targets.  
Sources: Aurora Energy Research, REPD, EDF, Drax

# 49% of gas boilers in residential homes must be replaced by 2035 if CB6 targets are to be met, but installations still outpace low carbon conversions

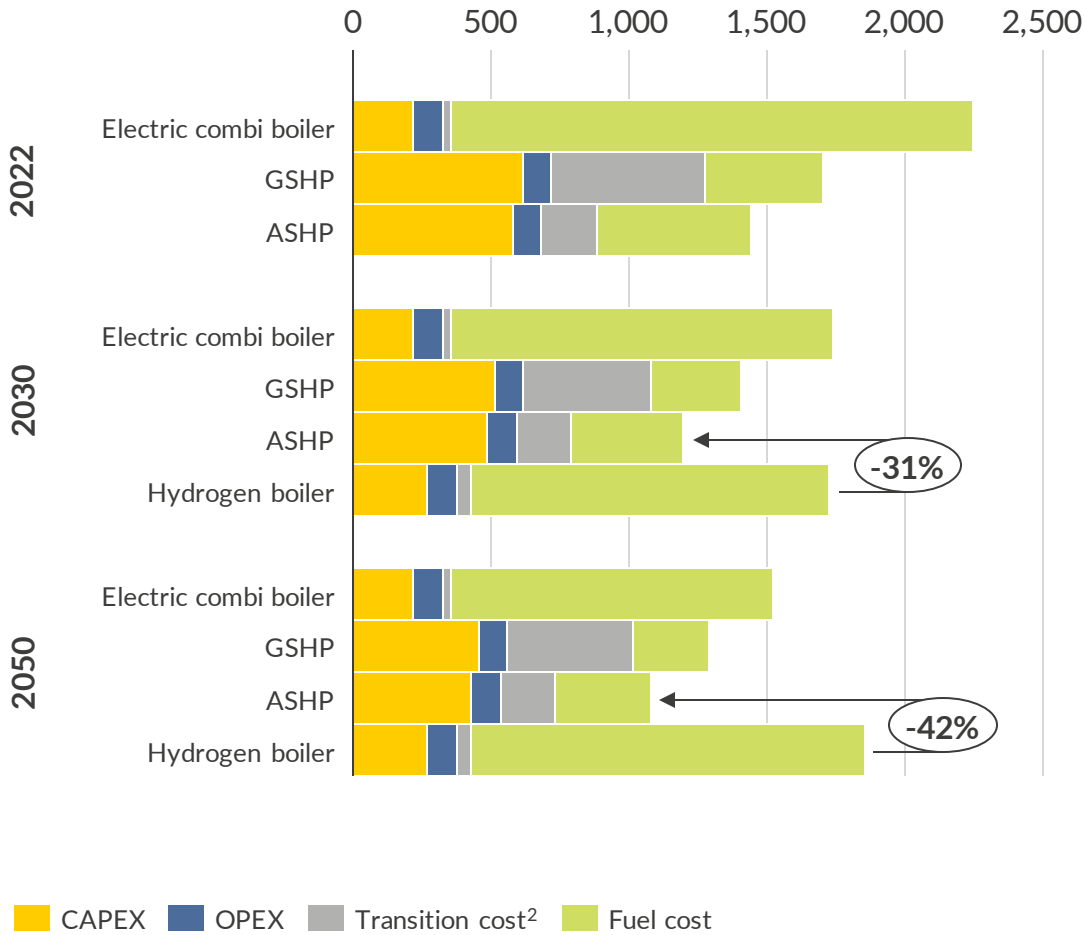
## Installed gas boilers, England

Number of units, million

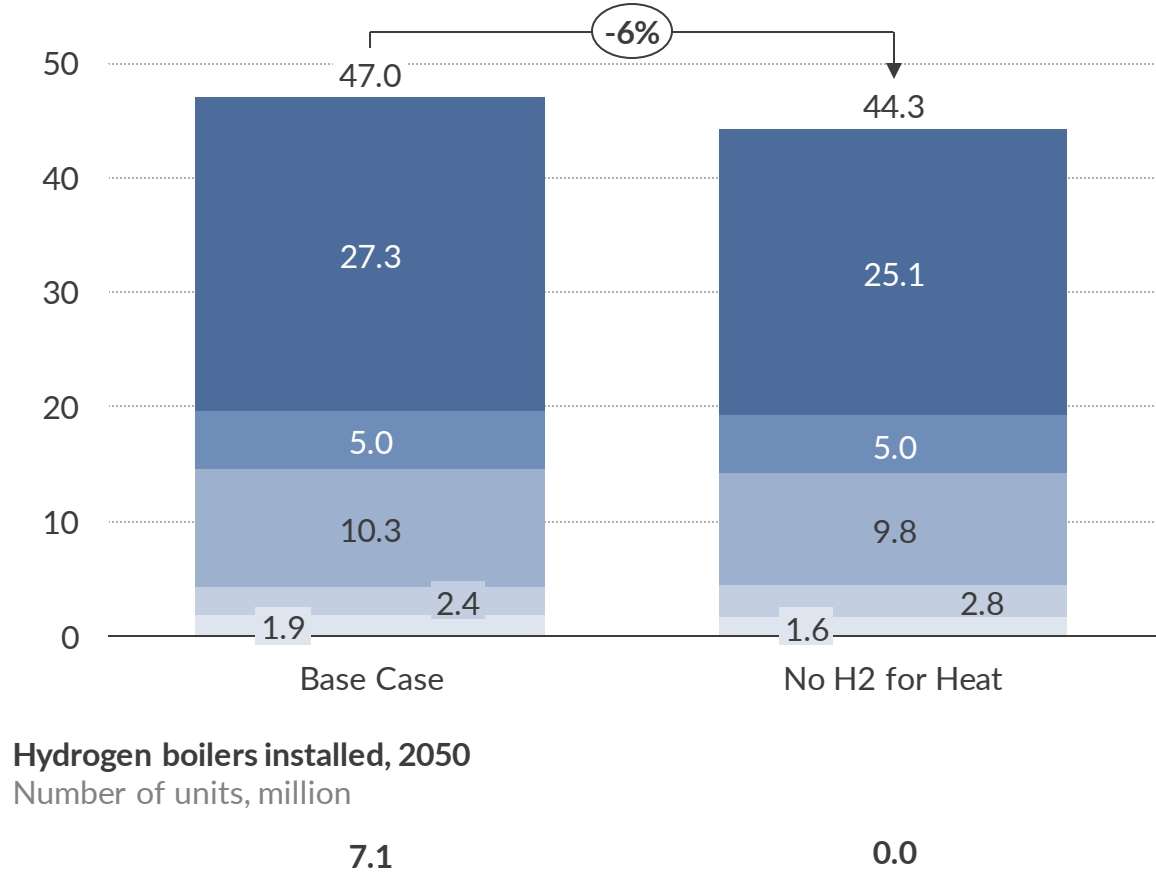


# Electrification will be the most cost effective pathway to the decarbonisation of heating

Annualised cost of new heating technologies, switching from a gas boiler  
£/a (real 2021)

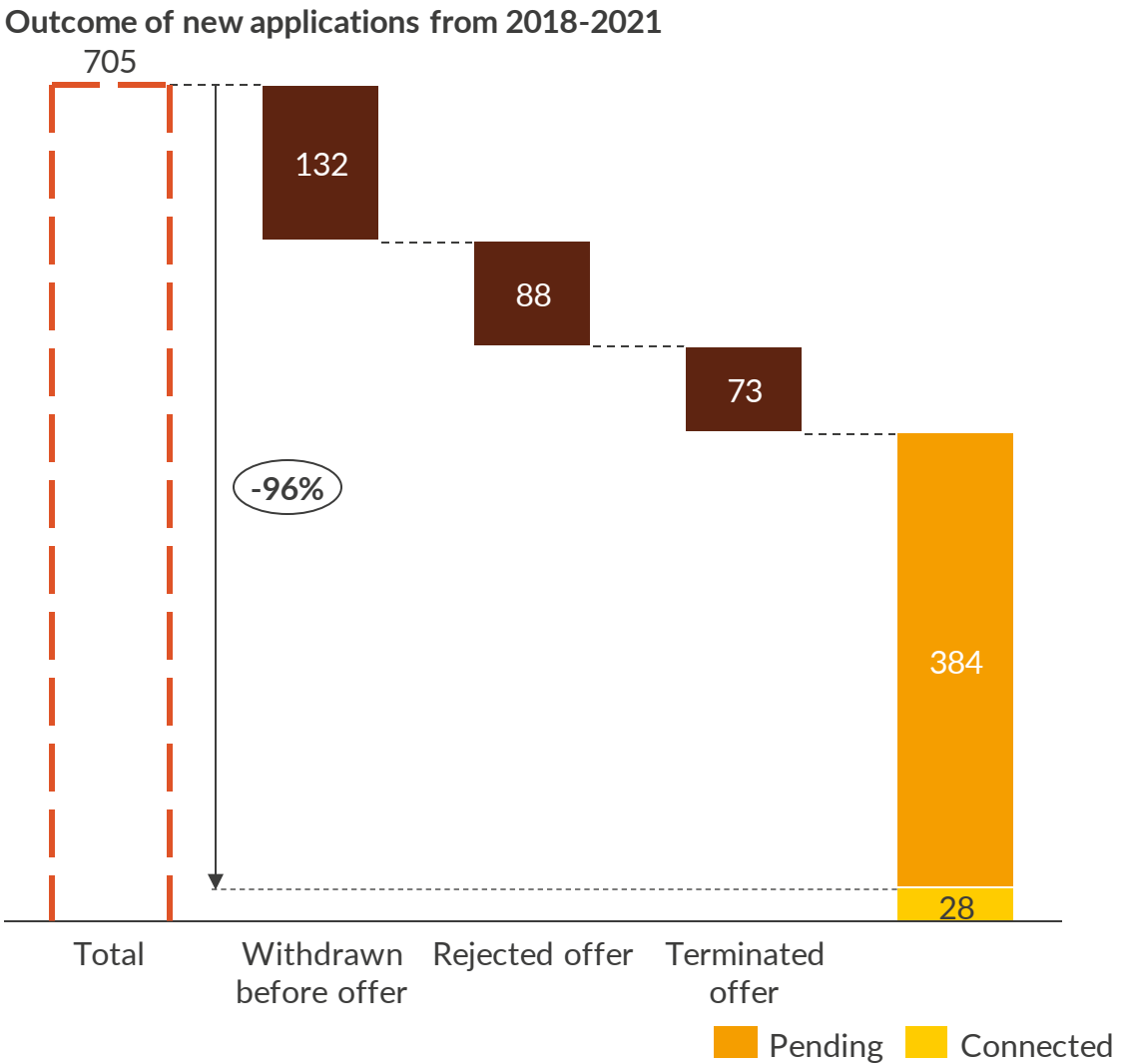
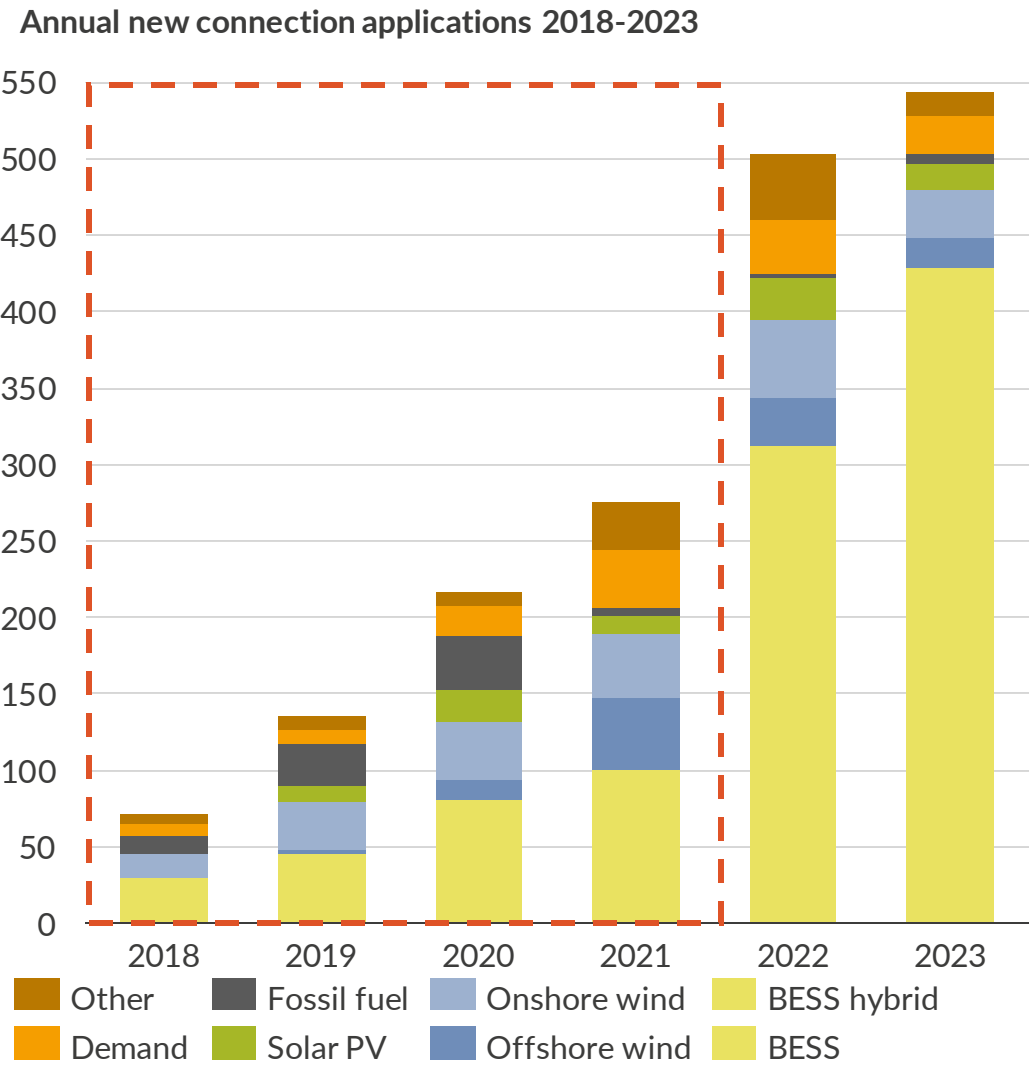


Average annual system costs (2025 – 2050), excluding hydrogen network costs  
£ billion (real 2021)



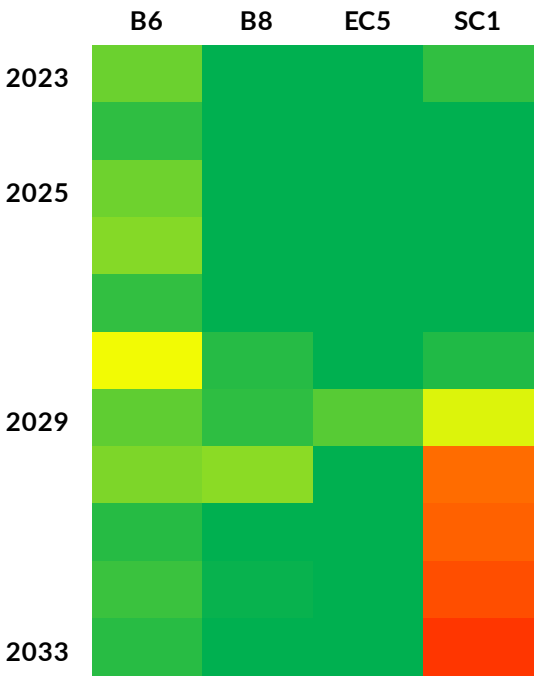


# Only 4% of grid connection applications made from 2018-2021 have so far resulted in a connection

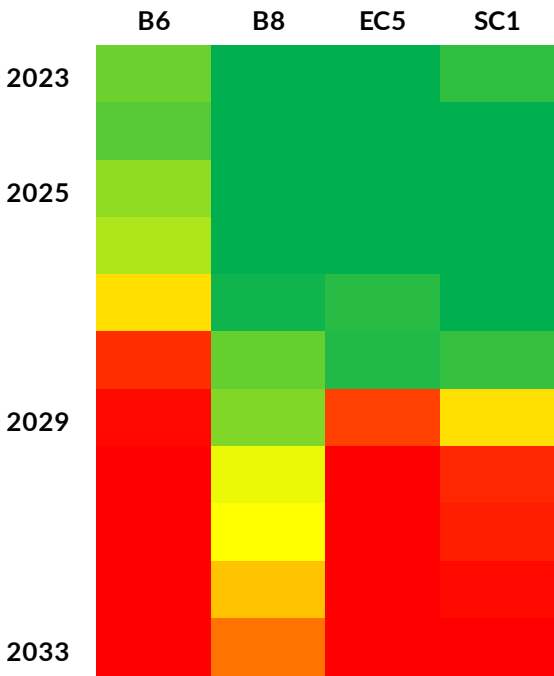


# Expanding boundary transfer capacity will be key to keeping up with increased flows from areas of newly concentrated generation...

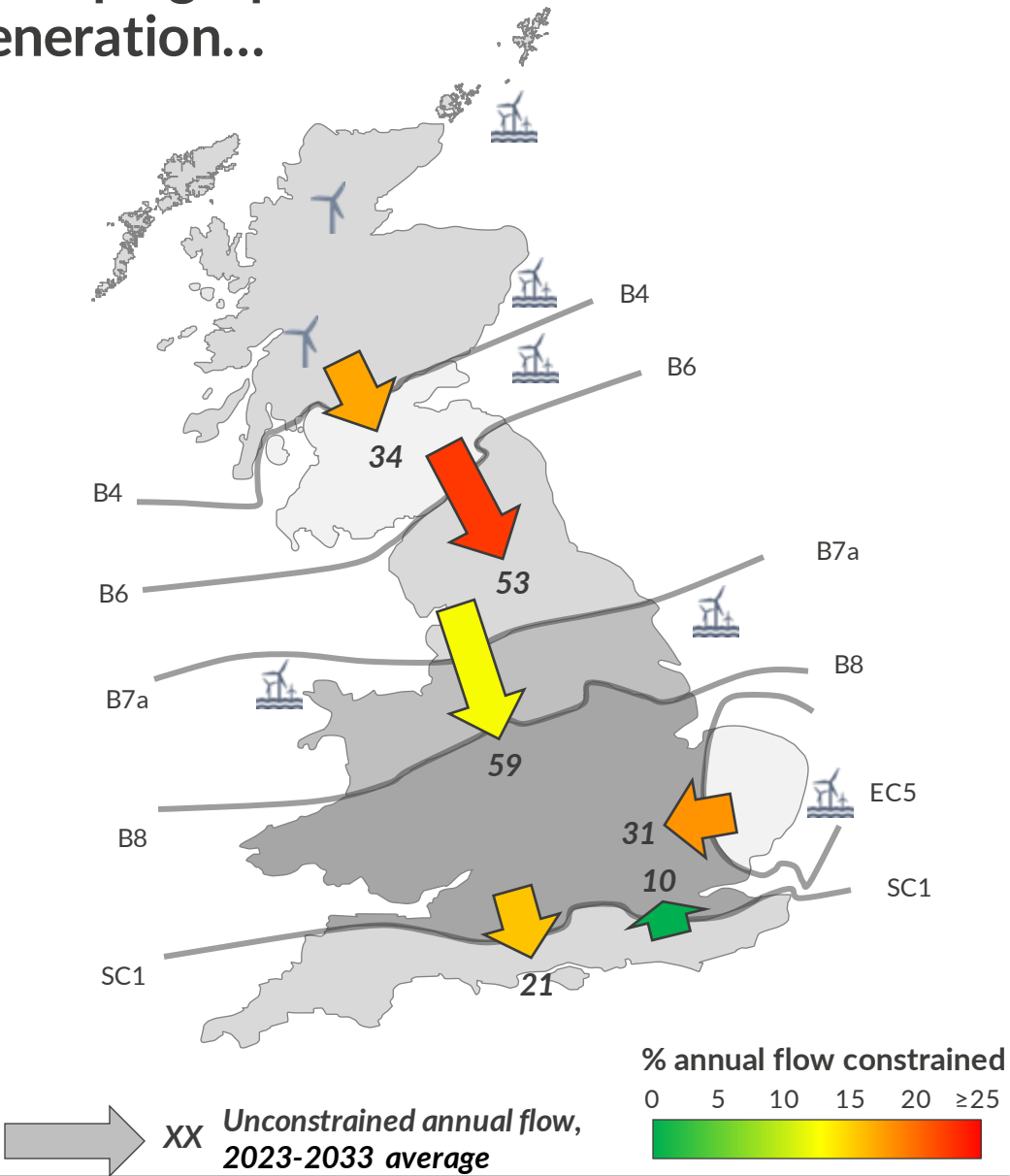
Annual flow in TWh constrained  
%



Network expanded per ETYS  
2022



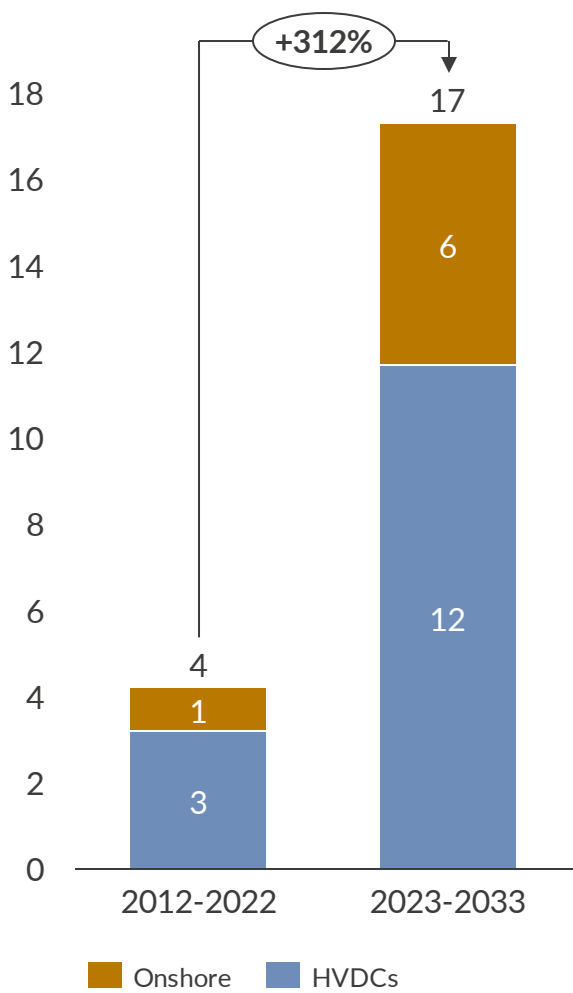
Network not expanded



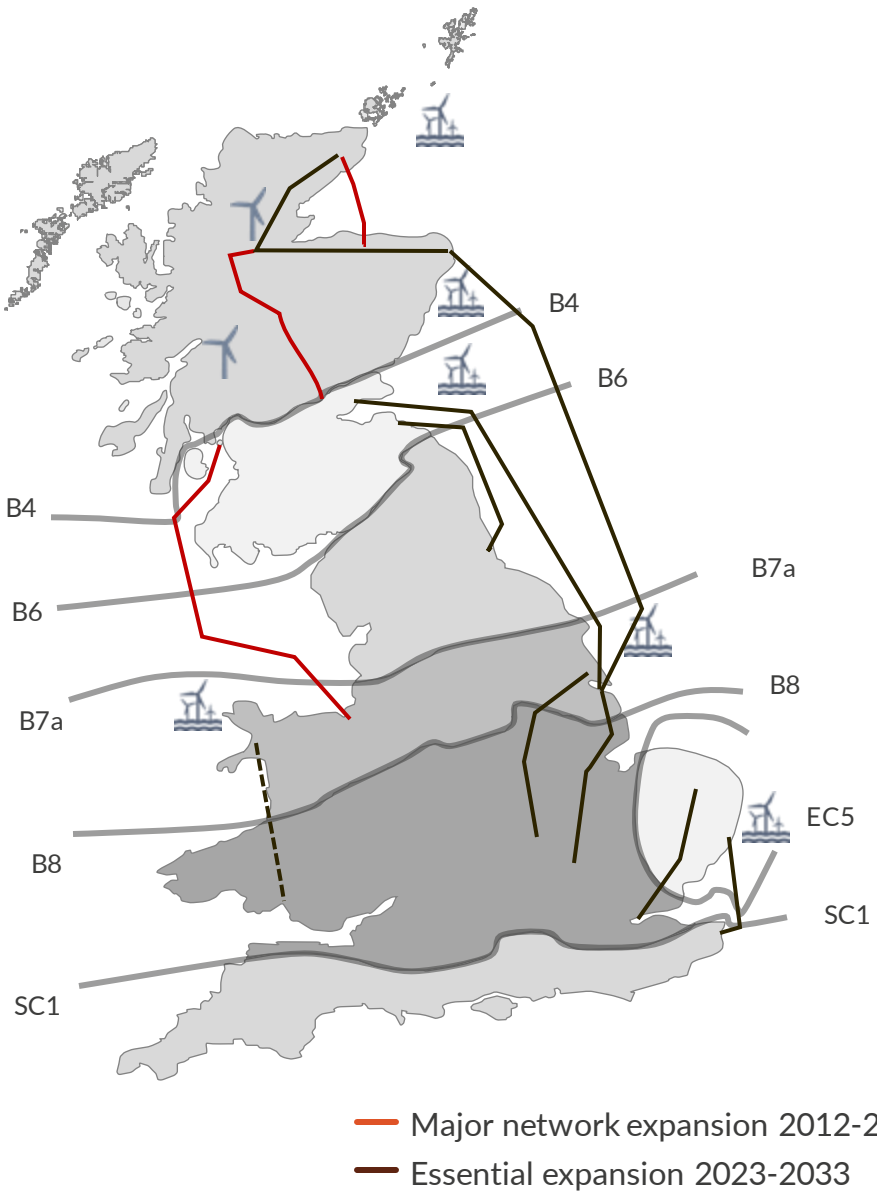
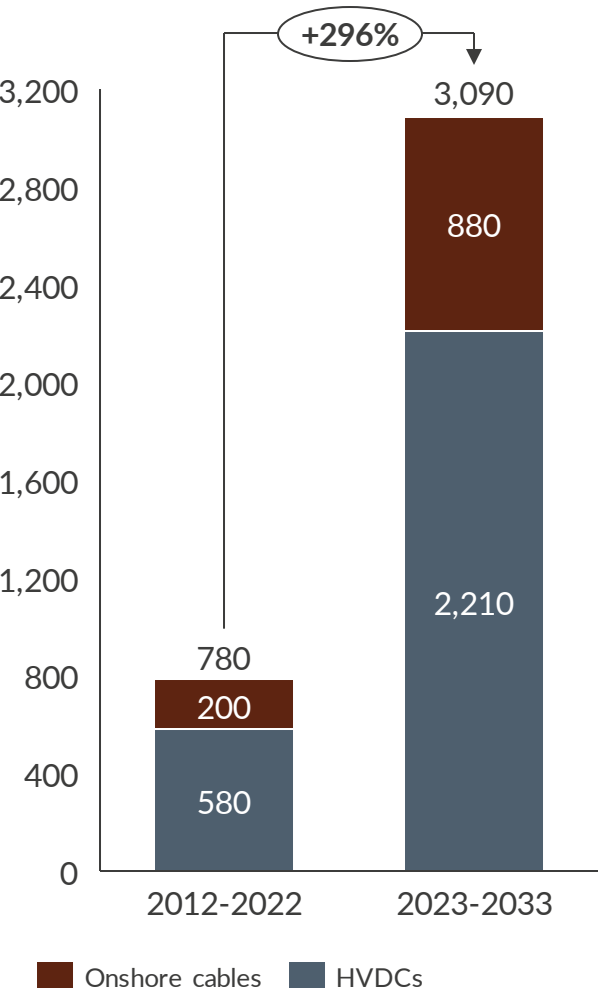


# ...but will require at least 300% more new infrastructure to be built in 2023-2033 compared to 2012-2022

Transfer capacity from major new build  
GW

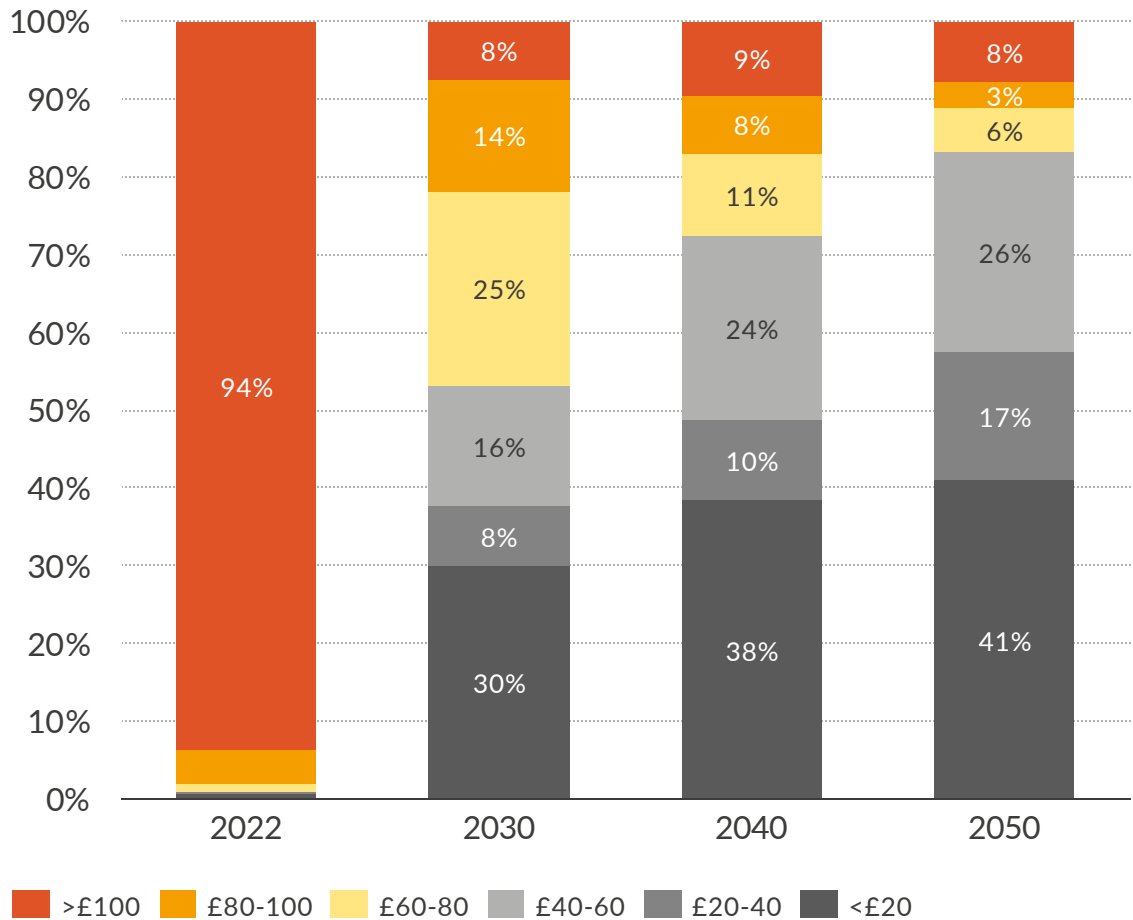


Major new build line length  
km

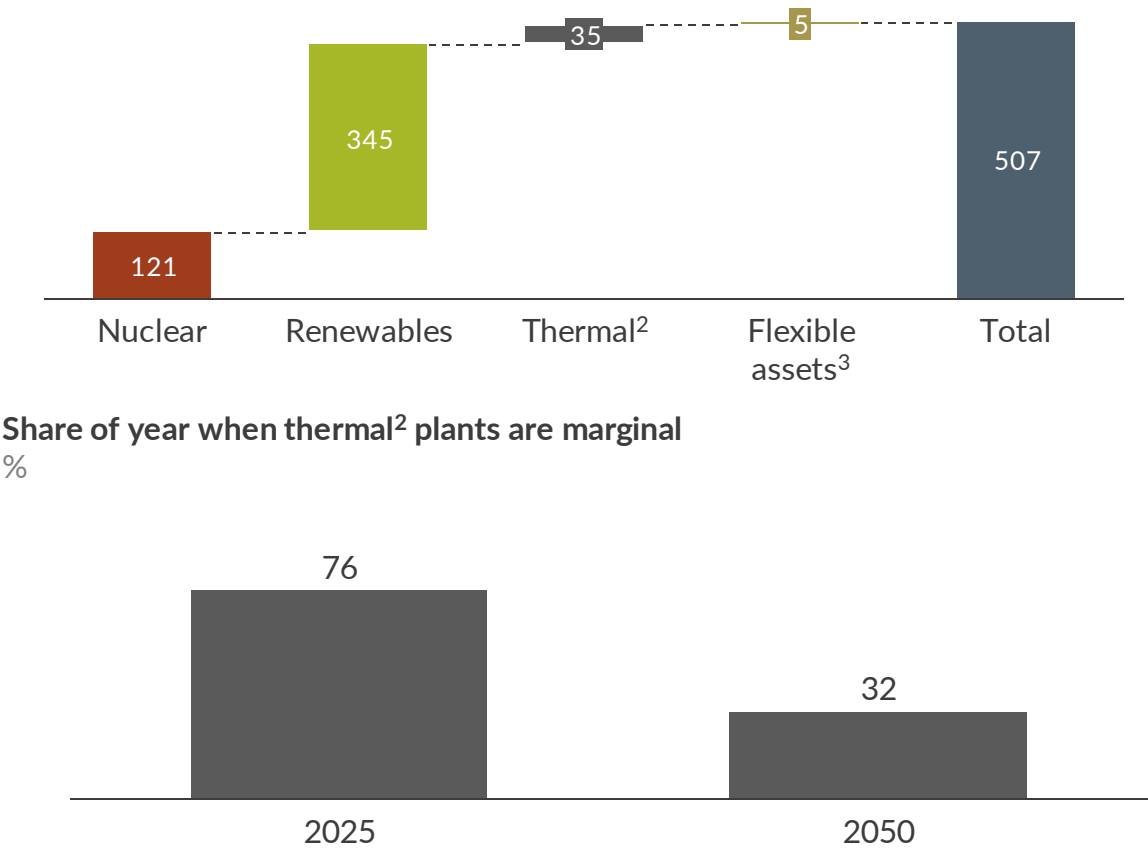


# Market design means wholesale power prices remain coupled with the cost of gas despite growing renewable generation

Frequency distribution of the electricity price<sup>1</sup>  
%



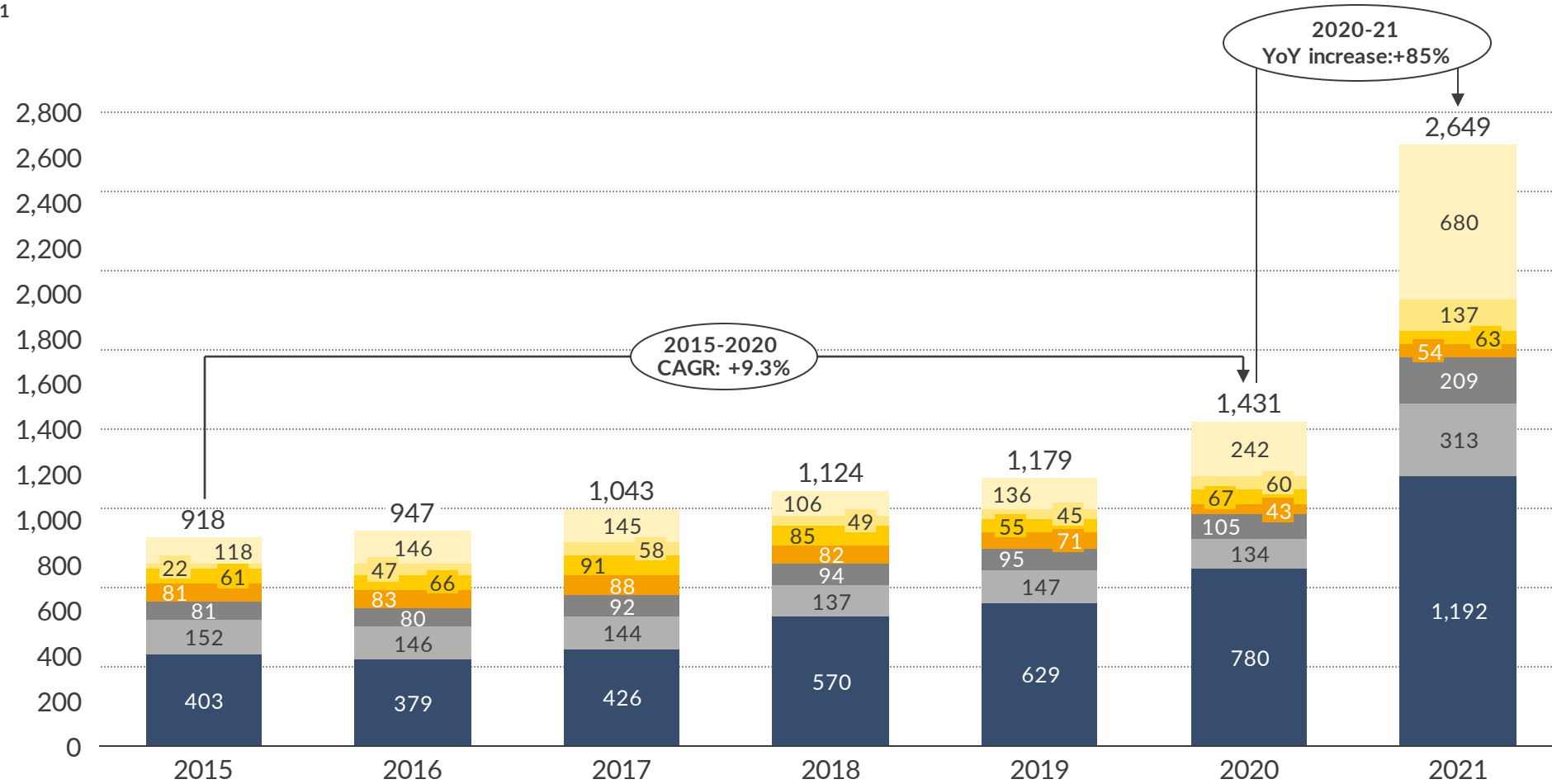
Electricity generation by technology class in 2050<sup>1</sup>  
TWh



1) Aurora Central view 2) Abated and unabated gas CCGTs and OCGTs, hydrogen CCGTs and OCGTs, reciprocating gas engines; 3) Batteries, DSR and interconnection

# An increasingly renewable-based electricity mix is driving up costs of operating the system

Balancing costs<sup>1</sup>  
£million



■ Constraints<sup>2</sup> ■ Fast Reserve ■ Black Start ■ Others<sup>3</sup>  
■ Frequency Response ■ STOR ■ Reactive Power

# Key takeaways

1

The energy transition in GB has arguably been very successful to date, with emissions falling 47% since 1990, driven predominantly by reductions in the industrial and power sectors.

2

There remain significant gaps between policy ambition and deployment rates for both renewable and low carbon dispatchable technologies that will be critical for Net Zero to be reached. Recent changes to the investment landscape in GB are only likely to intensify the magnitude of this gap.

3

Increasing deployment rates of critical technologies may not be possible without fundamental changes to networks and markets, which must be achieved while minimising costs to consumers.

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