



Load Forecasting

Bringing it all together: Forecasts for National Grid's Future Energy Scenarios

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Hello!



Sagar Depala, CEng

Energy Insights and Analysis

We find answers about the future in a complex energy system

Today: how we forecast load / demand

Secret ingredient: Diverse team and a small army of stakeholders

I've had a long day – can you explain it to me like I'm five?

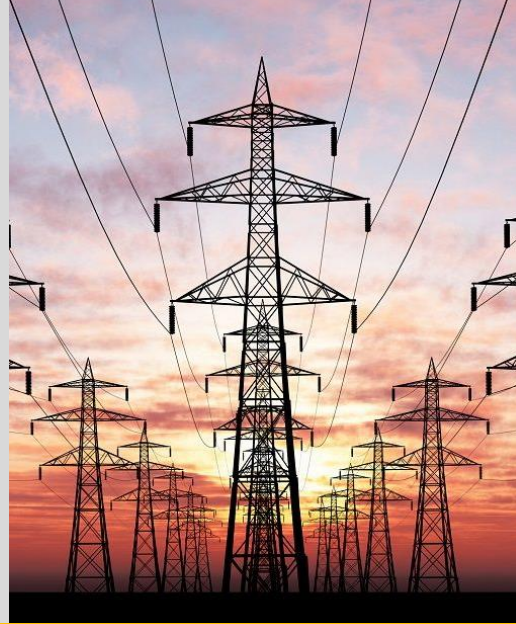


LEADING THE WAY

- Fastest credible decarbonisation
- Significant lifestyle change
- Mixture of hydrogen and electrification for heating

CONSUMER TRANSFORMATION

- Electrified heating
- Consumers willing to change behaviour



We use research and stakeholder engagement...

... to create future scenarios...

...which help Britain decide how to build and operate the energy network...

...in a way which drives BG to Net Zero by 2050...

... in a reliable, fair and affordable way – for everyone



to change behaviour

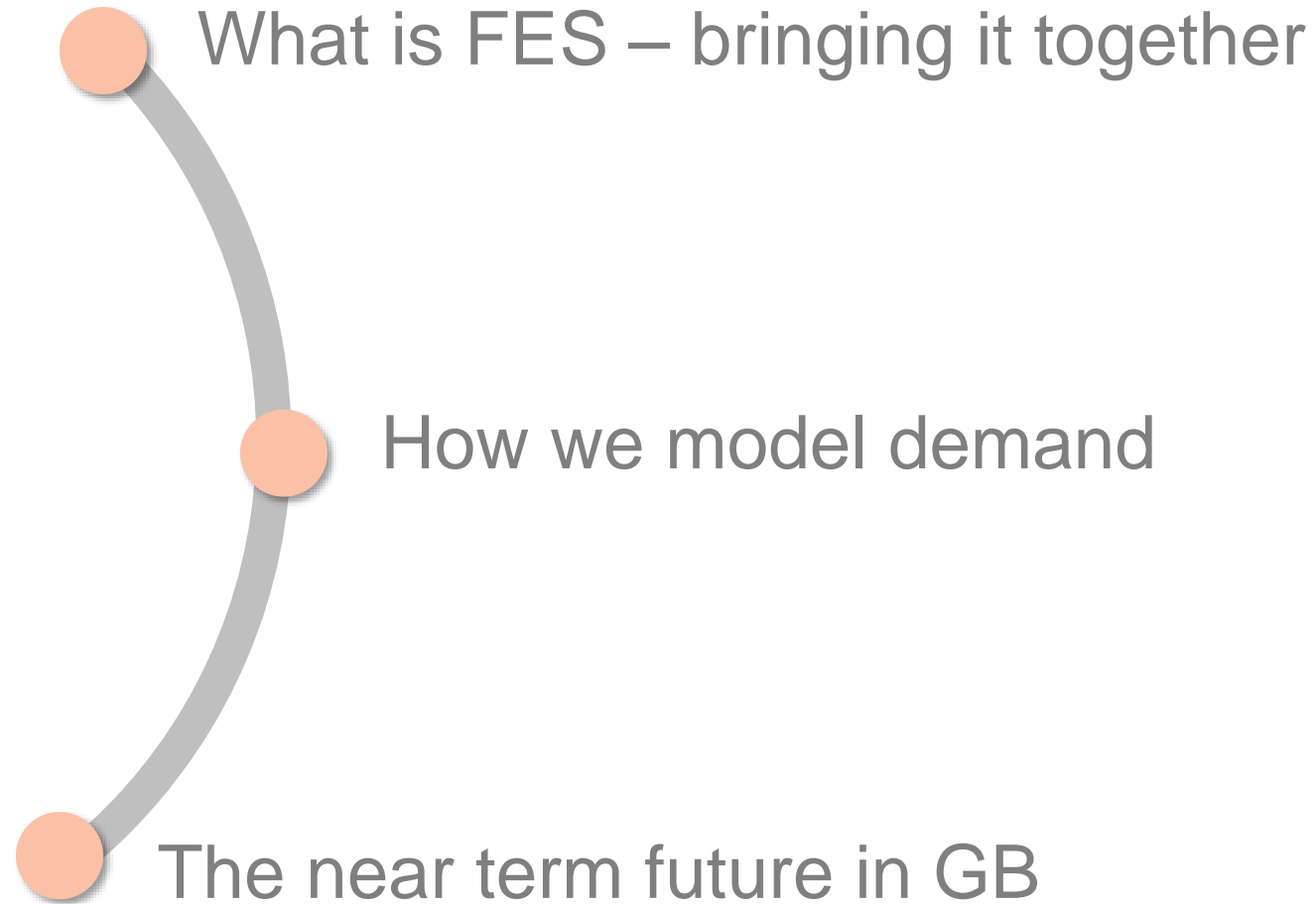
- Lower energy efficiency
- Supply side flexibility

STEADY PROGRESSION

- Slowest credible decarbonisation
- Minimal behaviour change
- Decarbonisation in power and transport but not heat

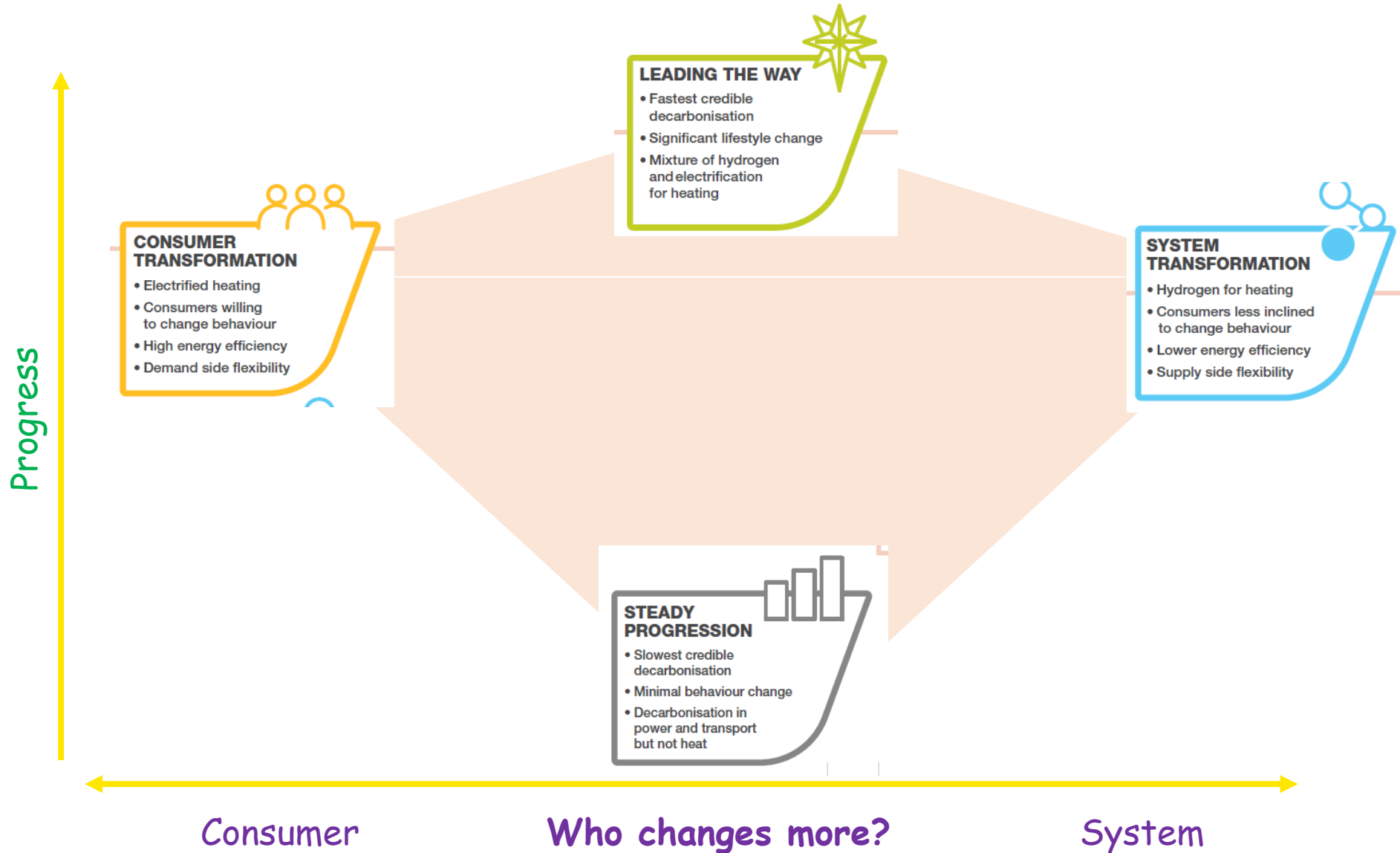


Today

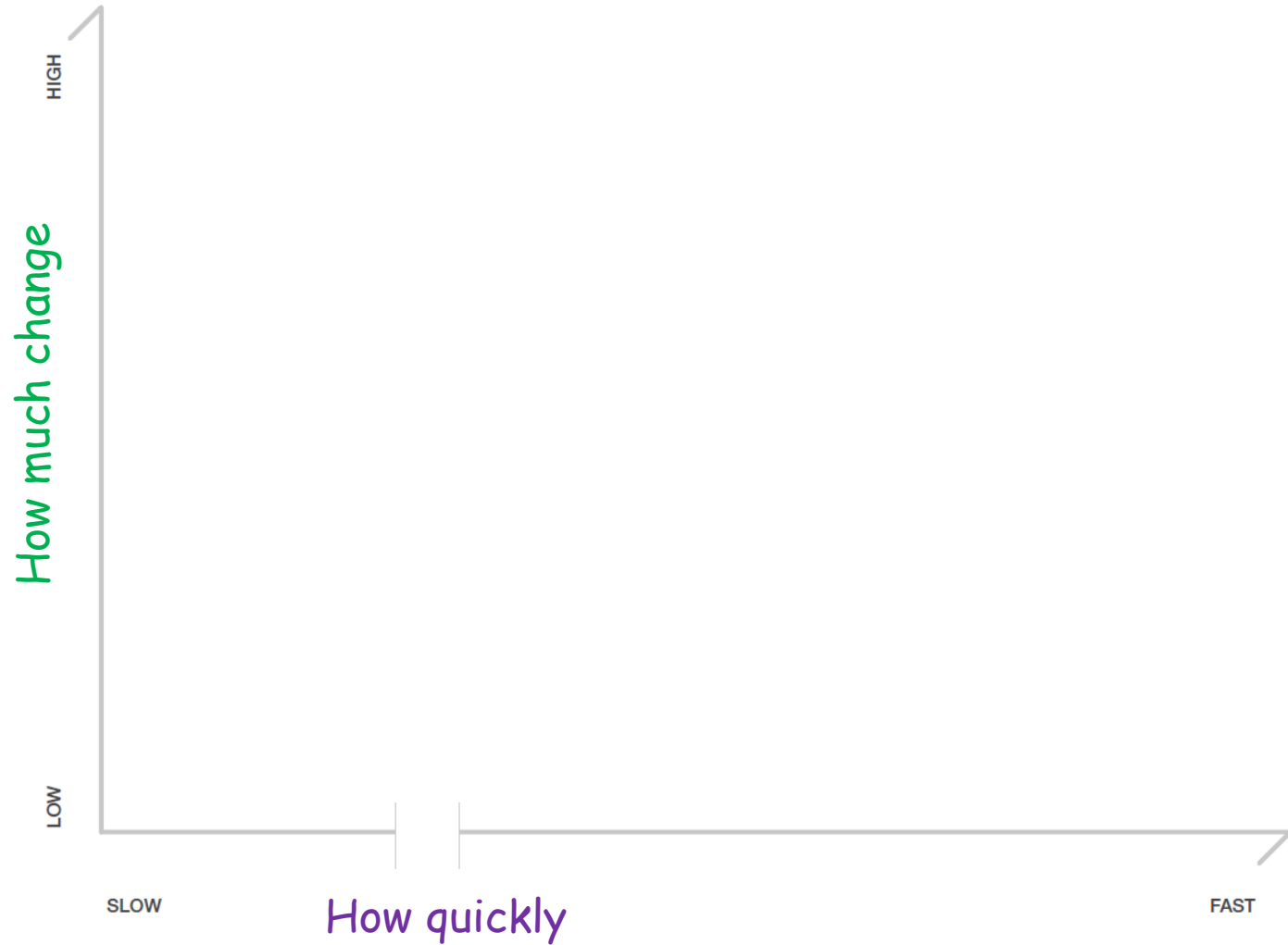


What is FES: Future Energy Scenarios

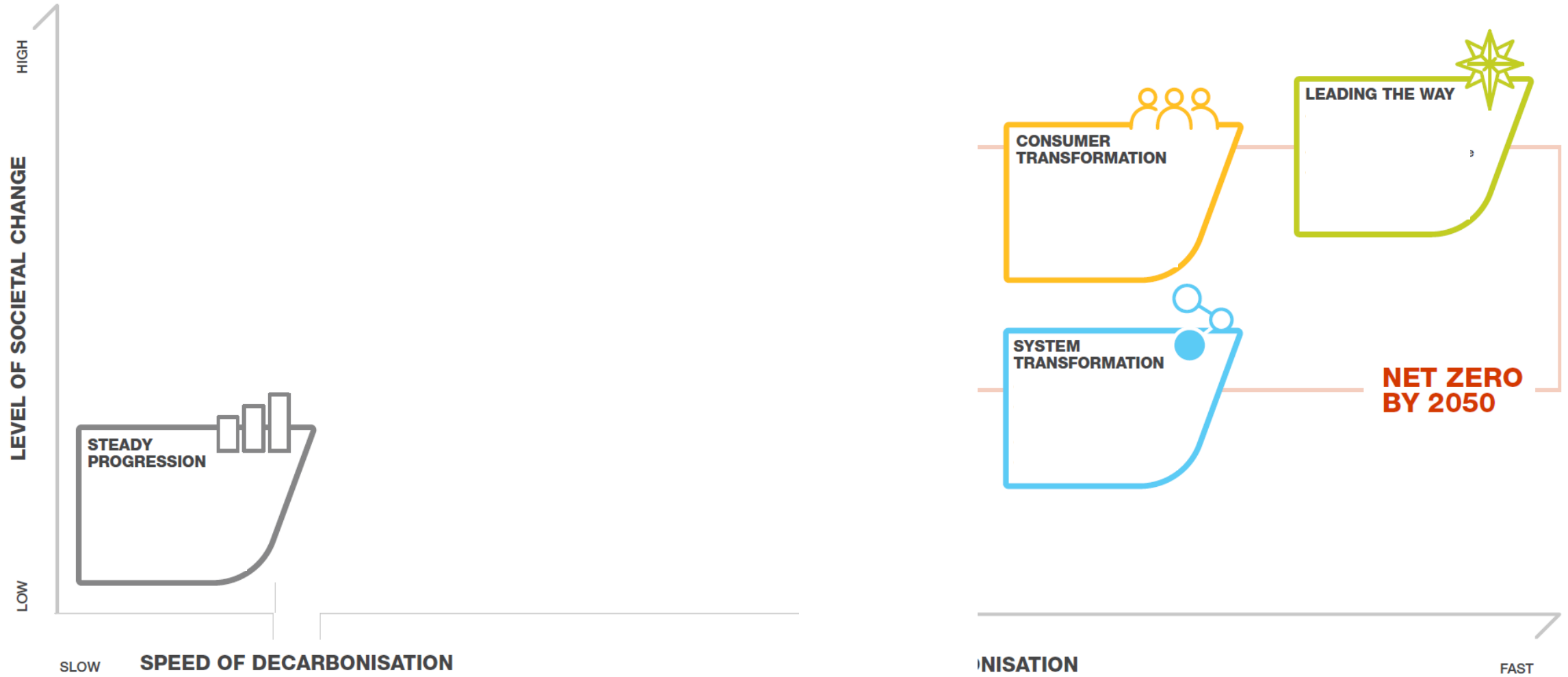
FES represents the edges of uncertainty



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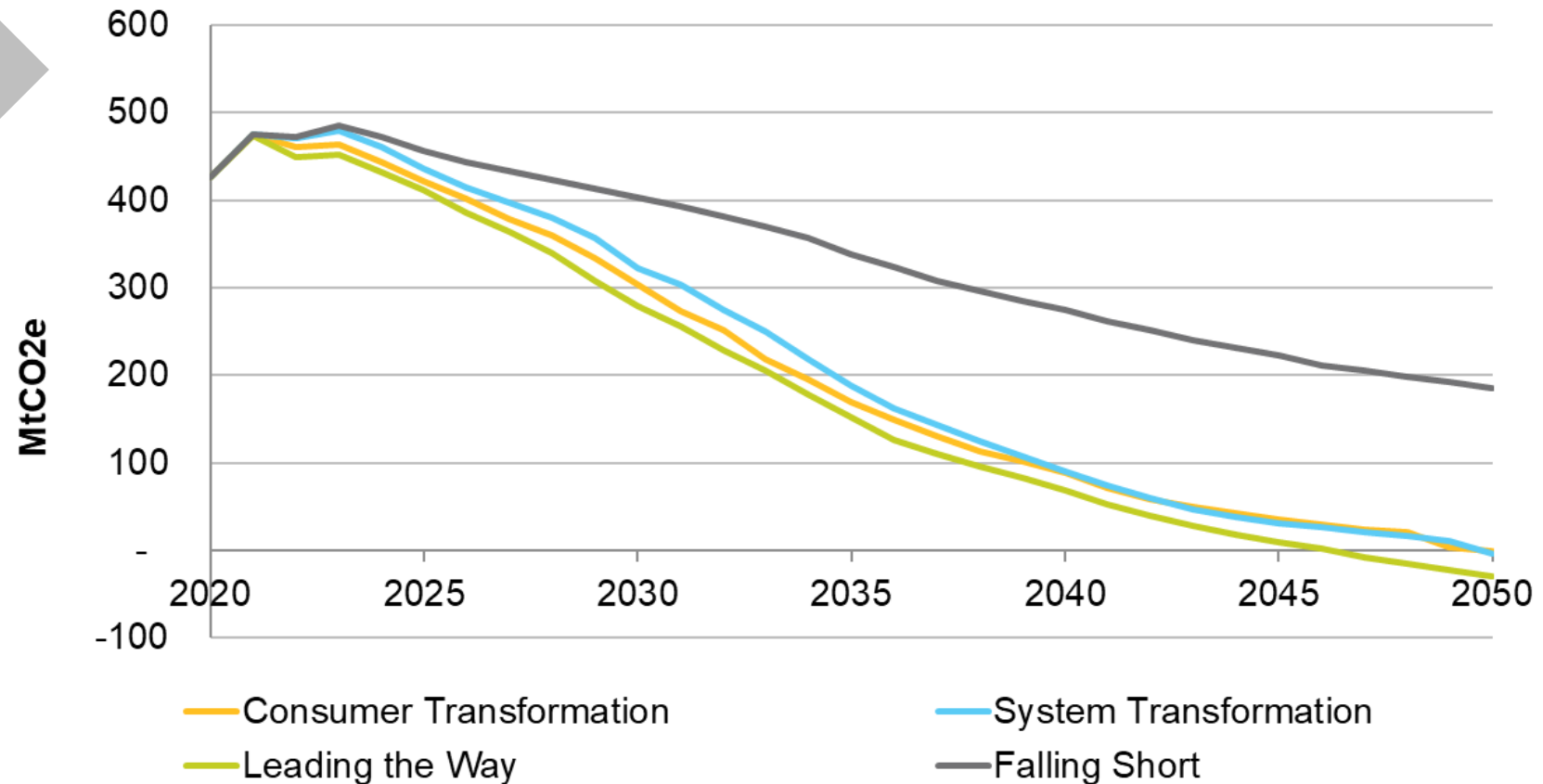
FES represents the edges of uncertainty



It matters. FES shows three distinct ways to reach Net Zero by 2050... but also that we may fall short

Was over 800
in 1990

Carbon emissions for total GB economy by year (MtCO₂e)



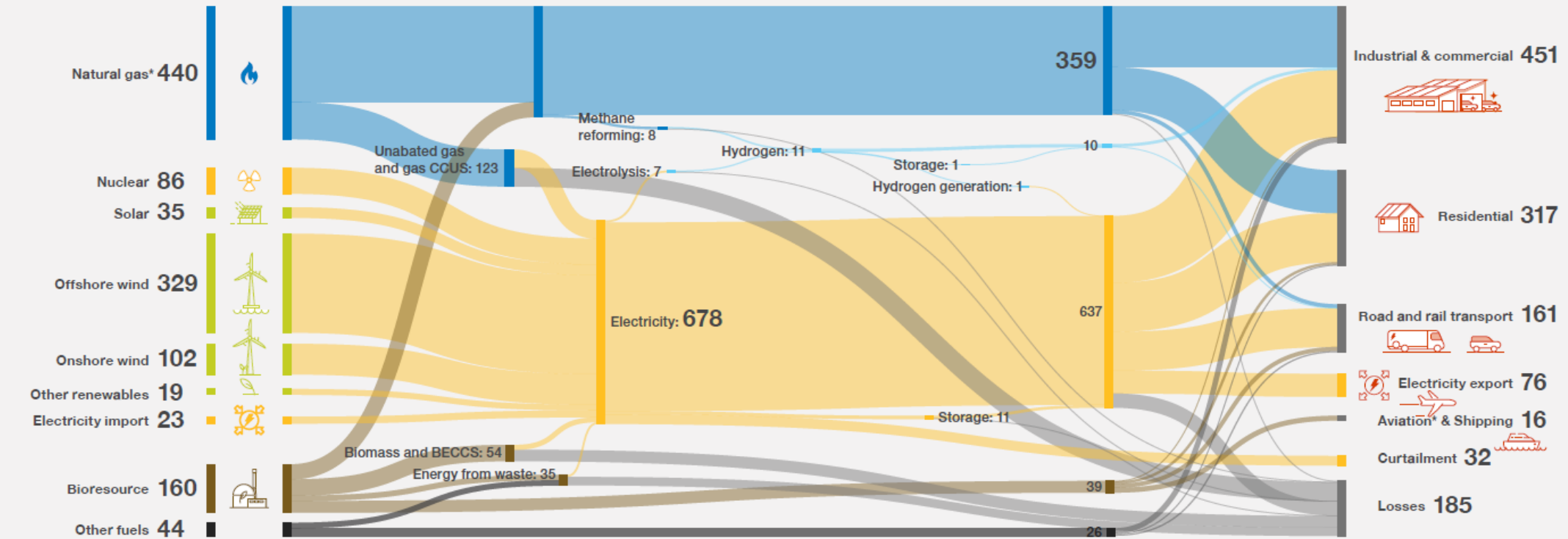
Scenario overviews

Falling Short (1237 TWh)



Hover over the scenario you wish to view.

- Continued high usage of natural gas, particularly for domestic heating and industry
- Small private vehicles fully electrified (including some plug-in hybrids) whilst HGVs rely on fossil fuels
- Low use of hydrogen as production isn't decarbonised
- Highest total end-user energy demand due to minimal increase in energy efficiency measures and reliance on inefficient fossil fuels



*excluding exports

*Aviation excludes some demand met by petroleum products

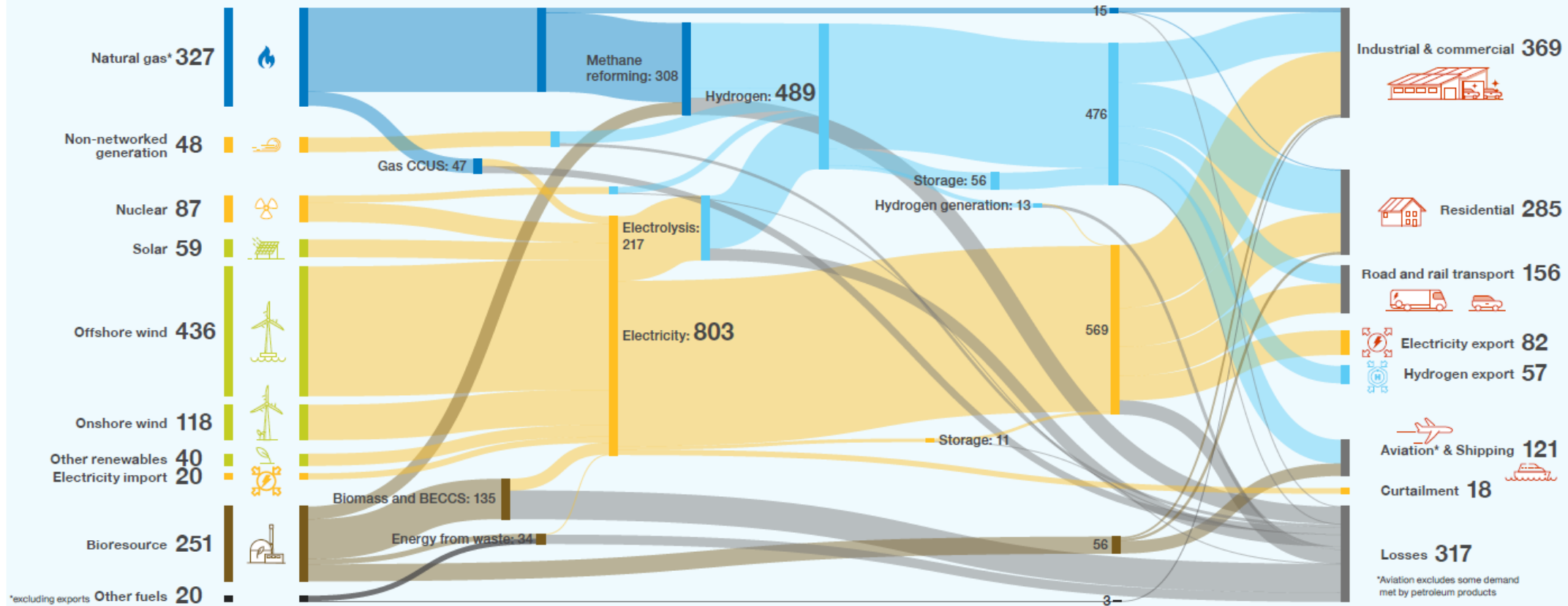
Scenario overviews

System Transformation (1406 TWh)



Hover over the scenario you wish to view.

- Highest proportion of hydrogen across the scenarios with widespread use for home heating, industry and HGVs
- All hydrogen is produced in the UK from a combination of methane reformation and electrolysis
- High levels of hydrogen production enable an export market to form
- Joint highest level of bioresource use with **Consumer Transformation** - biomass used to produce both hydrogen and electricity



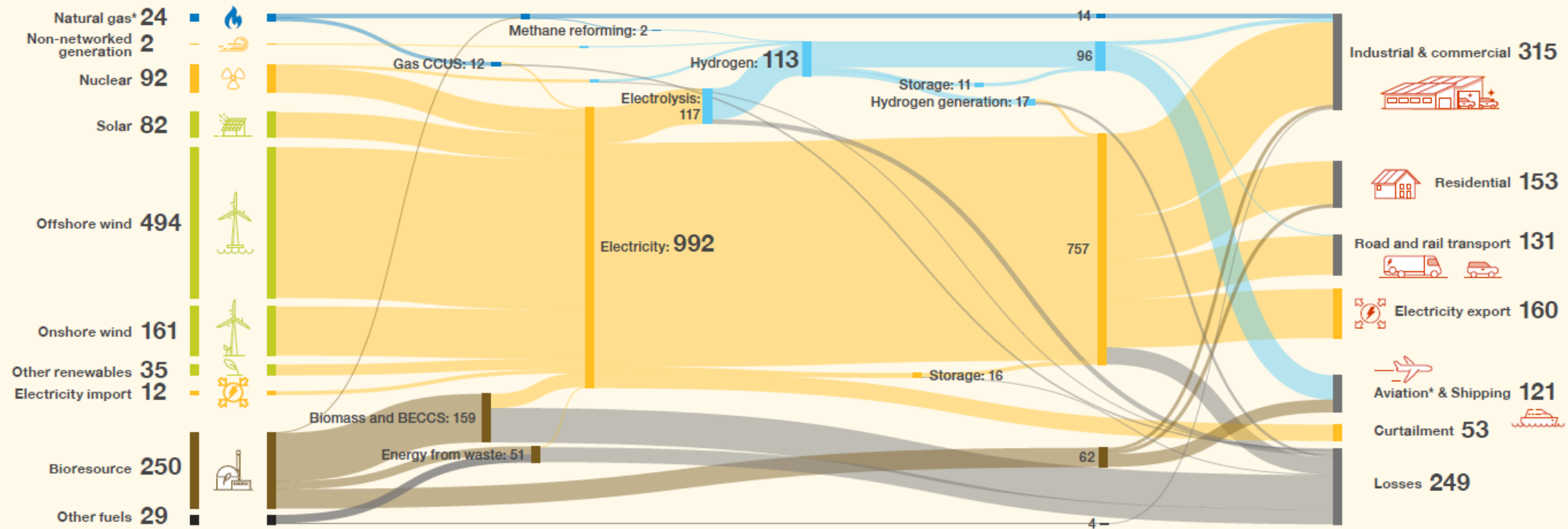
Scenario overviews

Consumer Transformation (1182 TWh)



Hover over the scenario you wish to view.

- Home heating, transport and industry largely electrified
- High levels of energy efficiency combined with large-scale electrification lead to lowest end user energy demands across the scenarios
- Electricity generation capacity and output is highest in this scenario to meet high annual electricity demands
- High levels of renewable generation with low hydrogen production leads to highest levels of electricity curtailment across the scenarios



*excluding exports

*Aviation excludes some demand met by petroleum products

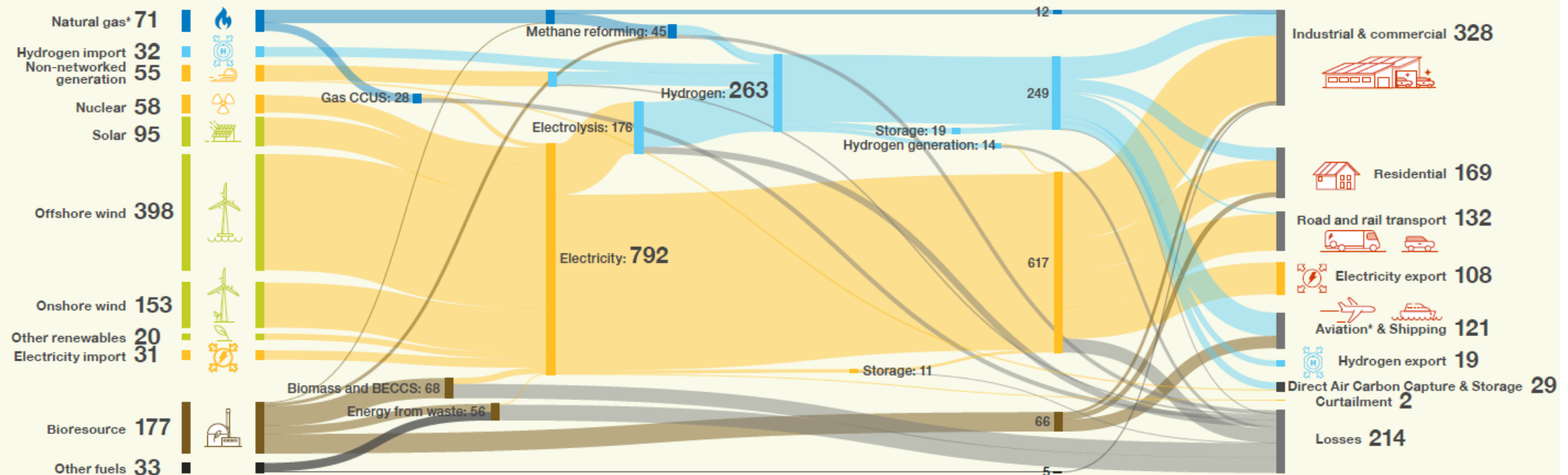
Scenario overviews

Leading the Way (1123 TWh)



Hover over the scenario you wish to view.

- Combination of hydrogen and electricity used in industry and to heat homes
- Imports and exports of hydrogen to provide maximum levels of system flexibility
- Lowest level of electricity curtailment across the scenarios
- Direct air carbon capture and storage (DACCS) used for negative emissions



*excluding exports

*Aviation excludes some demand met by petroleum products

These scenarios are used for....

Network planning

Market planning

Advising government on policy

FES 2023 Launch – 13th & 14th July

Any queries please contact FES@nationalgrideso.com.

1. Net Zero



12 Jul, 10:00 - 11:30

Reaching Net Zero greenhouse gas emissions is now widely recognised as critical to the future of our society. In this webinar we will be focussing on the key analysis, insights and how these link to the FES 2023 Key Messages.

2. Flexibility



12 Jul, 14:00 - 15:30

Energy systems need to match supply and demand; we call this energy balancing. Energy system flexibility is the ability to adjust supply and demand to achieve that balance. In this webinar we will be focussing on the key analysis, insights and how these link to the FES 2023 Key Messages.

3. Energy consumer



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The choices and actions of consumers are going to have a big impact on how we meet Net Zero targets. Empowering consumers to engage with the energy system is crucial to achieving Net Zero in the most cost-effective way. In this webinar we will be focussing on the key analysis, insights and how these link to the FES 2023 Key Messages.

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Modelling demand

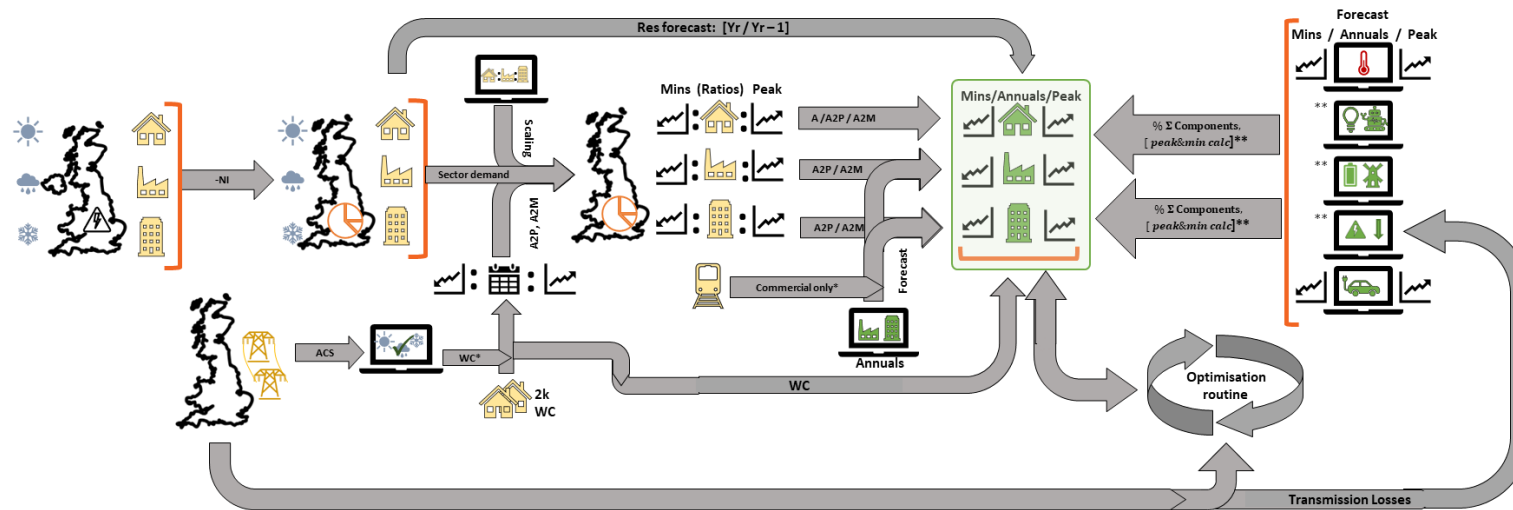
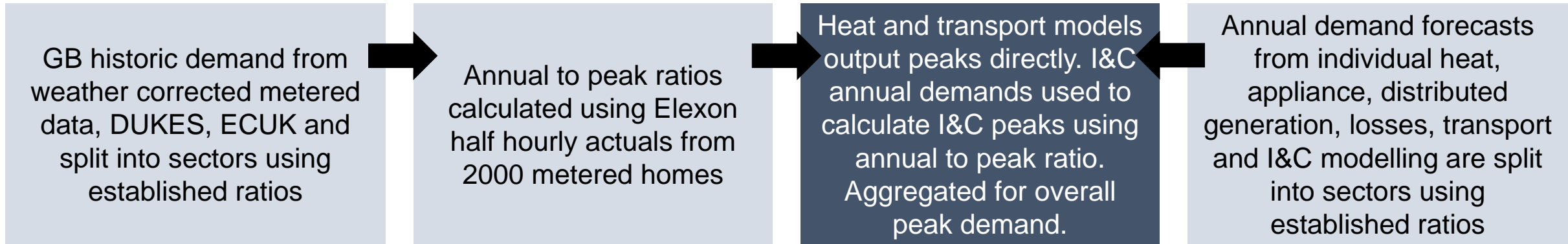
Modelling demand...

Electricity AND gas

Bottom up

Peaks (GW) and Annuals (TWh)

Electricity Demand



Diverse sources and dissenting views matter to us

SOURCES

- Qualitative data and research:
 - Stakeholder engagement (26 industry bilaterals for FES 2023 vs. 22 in FES 2022) plus monthly engagement with DESNZ.
 - Research and conferences
 - Innovation projects
- Economic forecasts: Oxford Economics (OE) and watching brief on current affairs. Economic outlook for GB has been revised several times since modelling started in October 2022.
- Historical demand: GB demand (DUKES), Sector demand (DECC), 2000 homes half hourly metered demand (Elexon), rail demand (ECUK), actual transmission connected demand (ESO)

EVALUATION

- We look for a range of views and test them periodically with our stakeholder base and internally with our peers
- December 2022/January 2023: Early views of demand and the factors influencing it shared with stakeholders at our winter conference for external challenge and review.

- We ensure that our stakeholder base has diverse interests and perspectives

Diversity of Stakeholders



Levers are central to the way we work across supply and demand

Assumption / Lever	NTV	FS	ST	CT	LW	Base Case (Near Term View, NTV)	Falling Short	System Transformation	Consumer Transformation	Leading the Way
Fiscal prioritisation of decarbonisation over other spending - not restricted or strengthened by GDP	Med	Low	Med	Med	High	Decarbonisation is still important but security of supply and cost of living are high on the political agenda. Significant general election expected half way into NTV	Discussions regarding importance of decarbonisation do not translate into financial support and therefore do not materialise.	Government and society prioritise decarbonisation measures due to a combination of subsidies and collective spending.		Decarbonisation is a top priority for Government and individuals and translates into top priority for spending.
Residential consumer engagement: will have an impact on the participation in demand reduction, energy use and time of use tariffs.	High / Low	Low	Med	High	High	High consumer engagement to minimise costs. Low engagement to change heating technology.	Aligned to societal change axis. Low consumer engagement scenario	Aligned to societal change axis. Medium consumer engagement scenario	Aligned to societal change axis. High consumer engagement scenario	
Heat: comfort level Level of internal building temperatures	Low	High	Med	Low	Low	Same outcome as CT and LW but driven by individual necessity rather than voluntary willingness. High energy prices and high awareness of energy spending make consumers reduce consumption.	Low willingness to change lifestyle and accustomed comfort level as energy prices remain low	Some consumer willingness to explore alternative ways of maintaining comfort at lower internal temperatures. High energy prices and awareness of personal environmental impact make consumers reduce consumption	High consumer willingness to explore alternative ways of maintaining comfort at lower internal temperatures. High energy prices and awareness of personal environmental impact make consumers reduce consumption	
Residential thermal efficiency: rate at which this increases.	Low	Low	High	High	High	Low level of energy efficiency improvements as based on solely on enthusiastic consumers and new build homes		High level of support for building efficiency improvements and high willingness of society to accept the levels of disruption associated with implementing deep retrofits		
I&C Demand Side Response: Participation of businesses in DSR services such as STOR, TRIAD, Capacity Market	Med	Low	Med	High	High	Triad incentive for I&C stops but we expect new DSR options to emerge such as the Demand Flex Service	Aligned to societal change axis. Low consumer engagement scenario	Aligned to societal change axis. Medium consumer engagement scenario	Aligned to societal change axis. High consumer engagement scenario	
End consumer energy prices are linked to network and investment costs and have a direct impact on consumption. For gas, this includes nat. gas used for hydrogen production.	High	Low	Med	High	High	Prices are high, especially for the first 1-2 years before reducing, albeit still remaining higher than they are now	Priority is to keep bills low for end consumers		High subsidies are required to fund electrification. For gas, tax used to incentivise consumers to use alternative forms of heating means higher retail price.	

... to derive sector demands (gas, hydrogen and electricity)



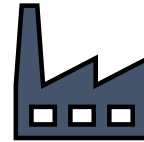
Transport



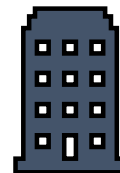
Residential heat



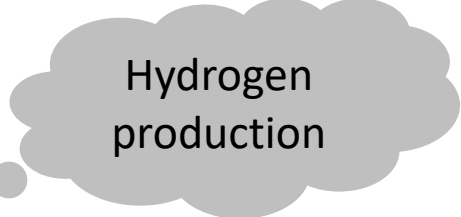
Lighting and appliances



Industrial



Commercial

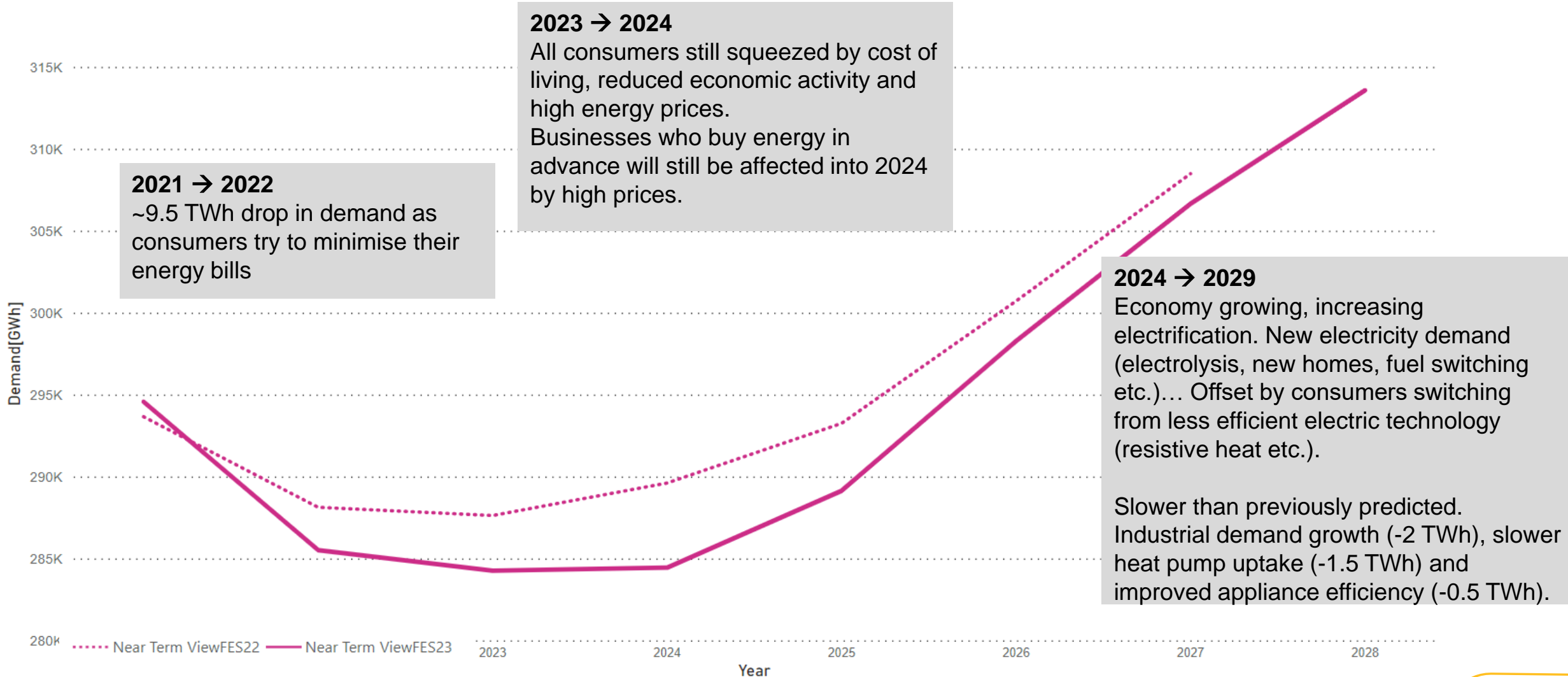


Hydrogen production

Demand forecast for GB

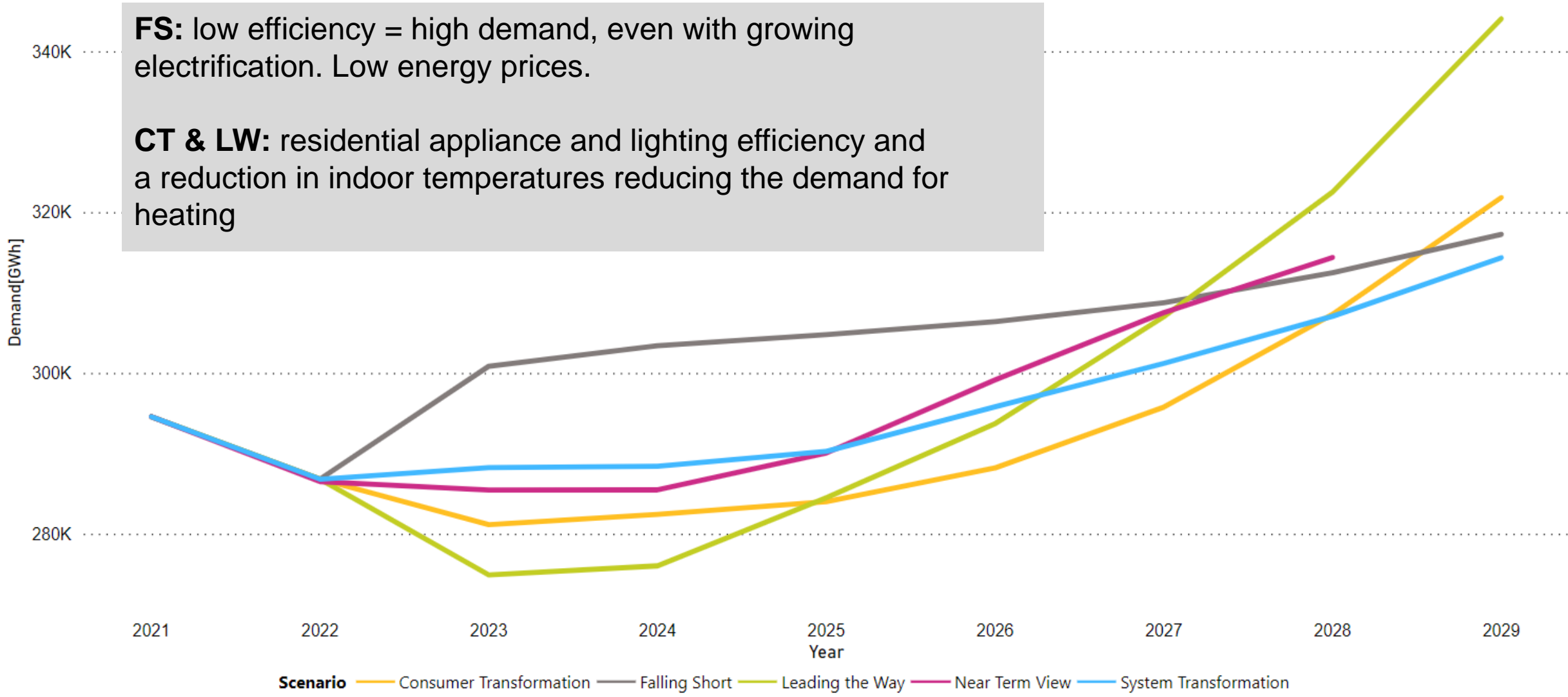
Affordability crisis suppresses demand

Annual demand (TWh) – Near term view



The range of uncertainty is wide

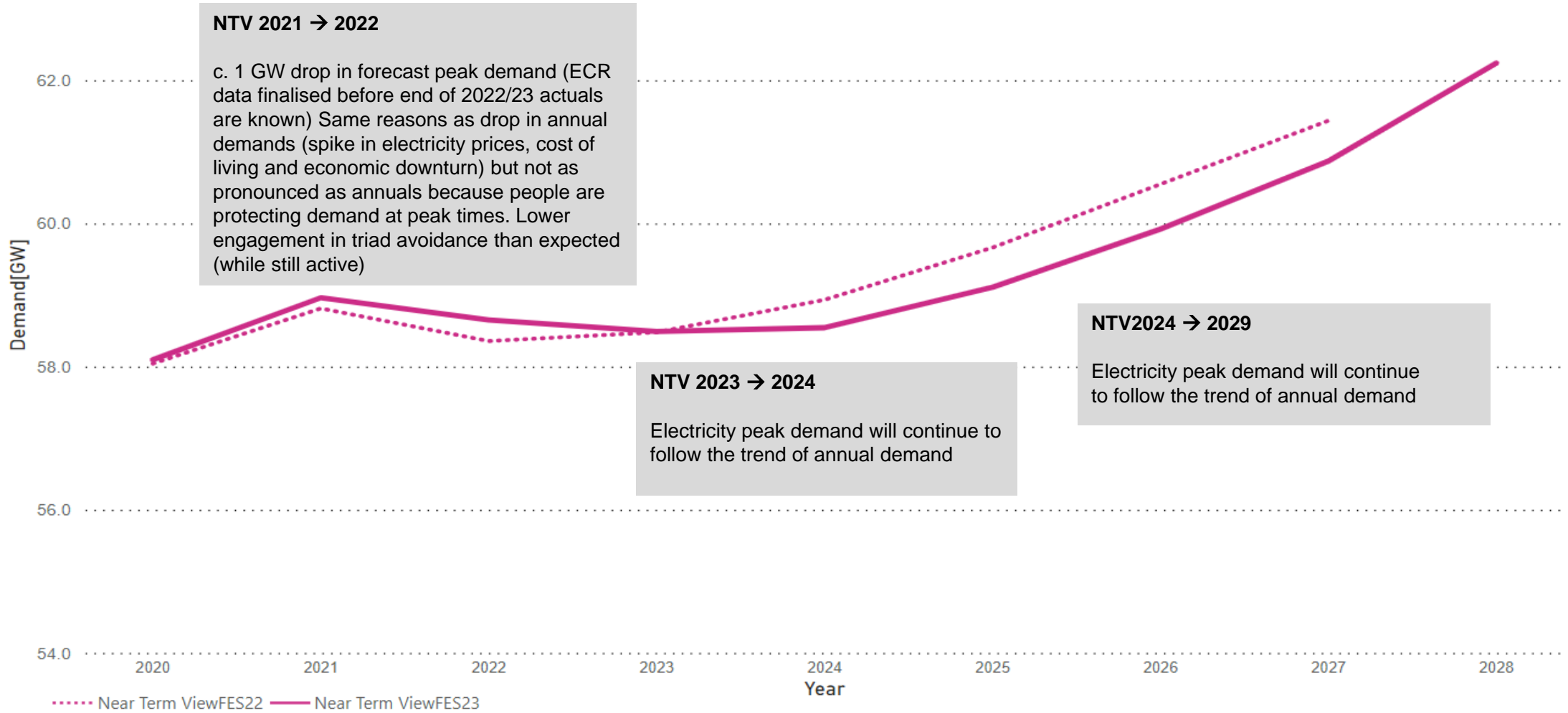
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Peak demand – consumers protect what matters

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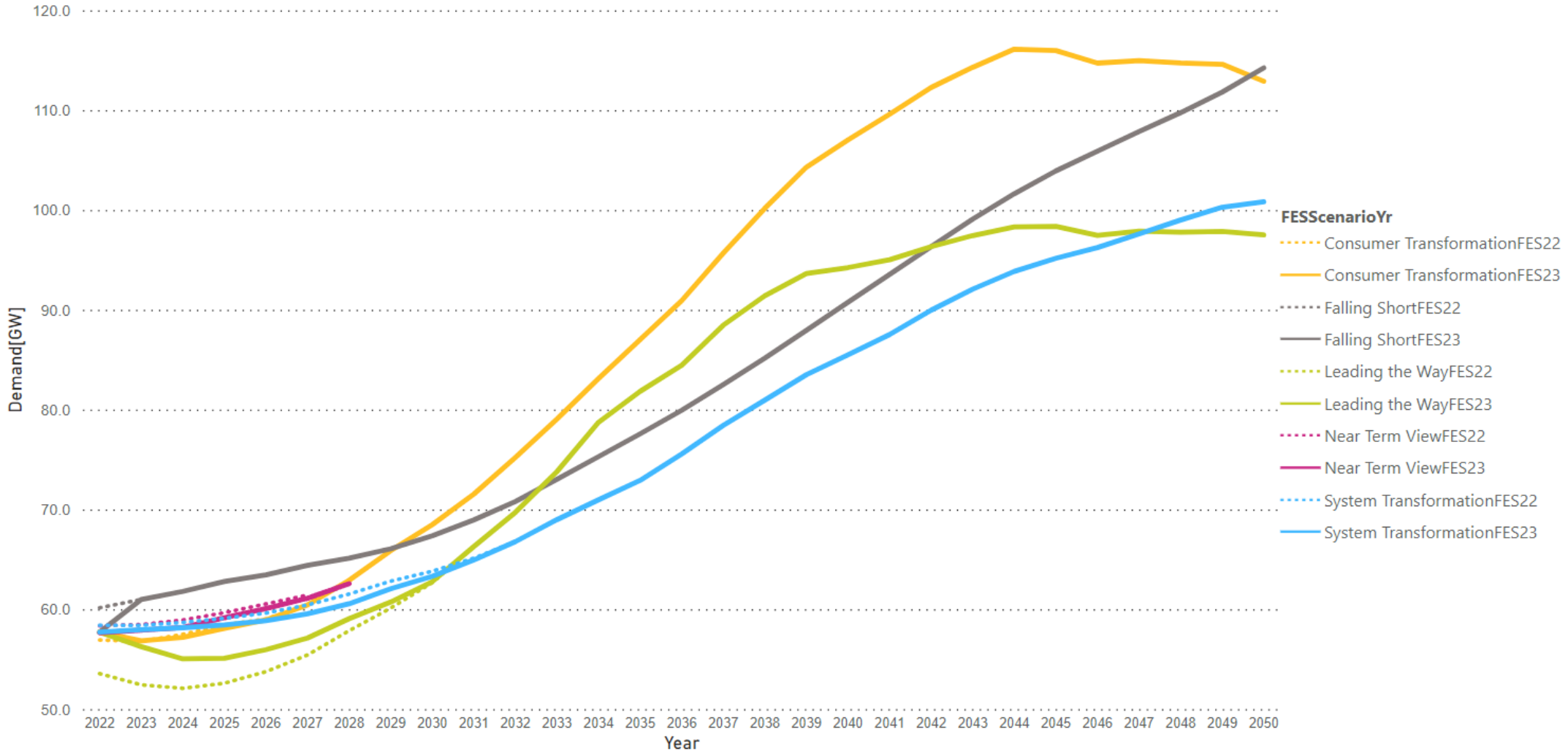
Peak demand follows annual demand trends in general however consumers generally less able or willing to reduce demand at peak times on the same scale as they reduce their annual demand



Peak Electricity Demand rises in all scenarios

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Overall Peak demand – consumer demand before flex, distributed gen and losses are subtracted (GW)



Forecasting accuracy

4 years ahead

Target= 4%

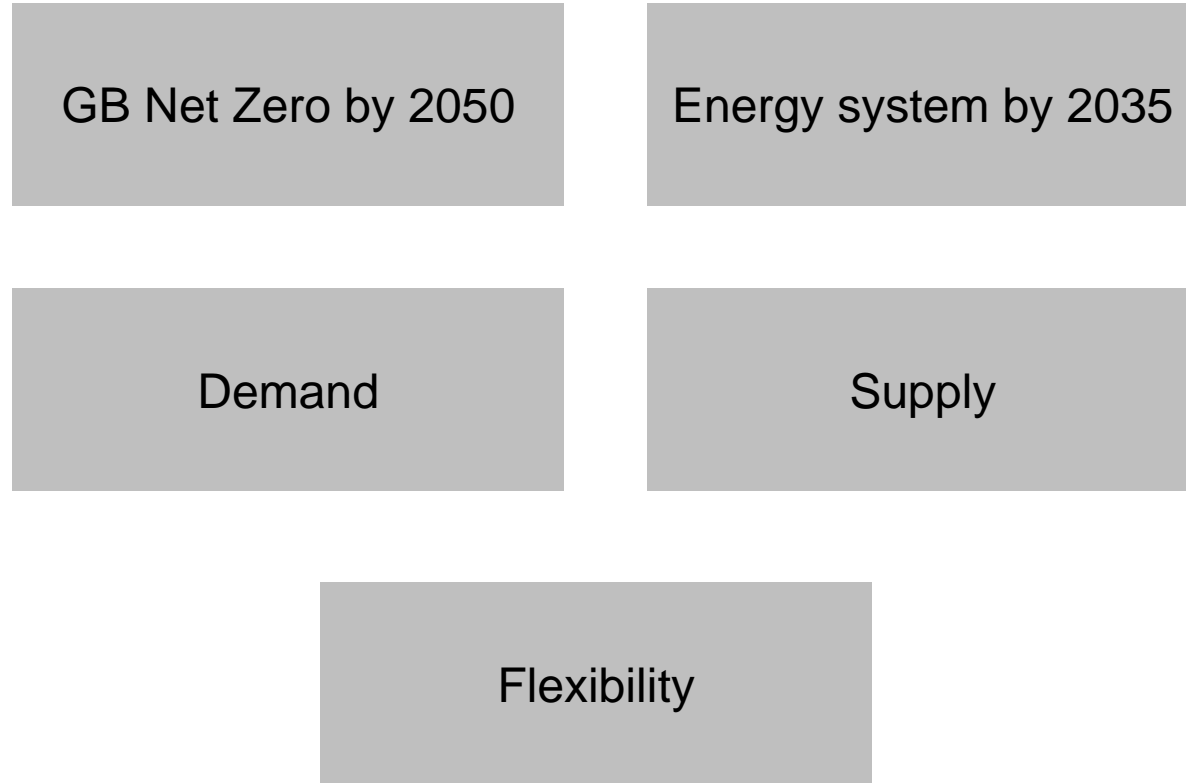
Actual = 2.2%

1 year ahead

Target = 2%

Actual = 0.4%

What else?



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Continuing the conversation

Email us with your views on FES or any of our future of energy documents at: fes@nationalgrideso.com and one of our team members will get in touch.

Access our current and past FES documents, data and multimedia at: nationalgrideso.com/future-energy/future-energy-scenarios

Get involved in the debate on the future of energy and join our LinkedIn group [Future of Energy by National Grid ESO](#)

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