

**1 km and 142 years**

# CLIMATE CRUNCH TIME



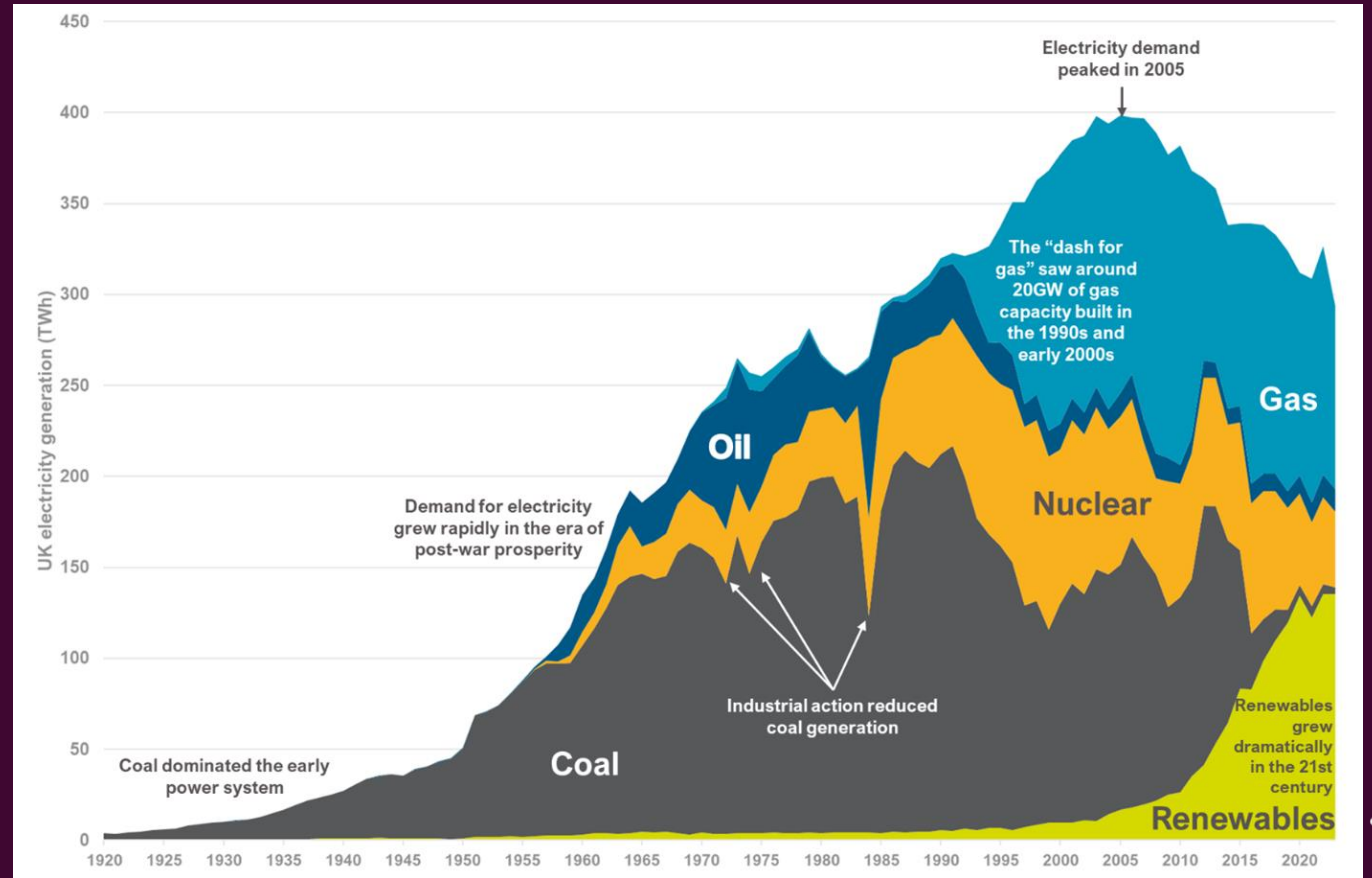
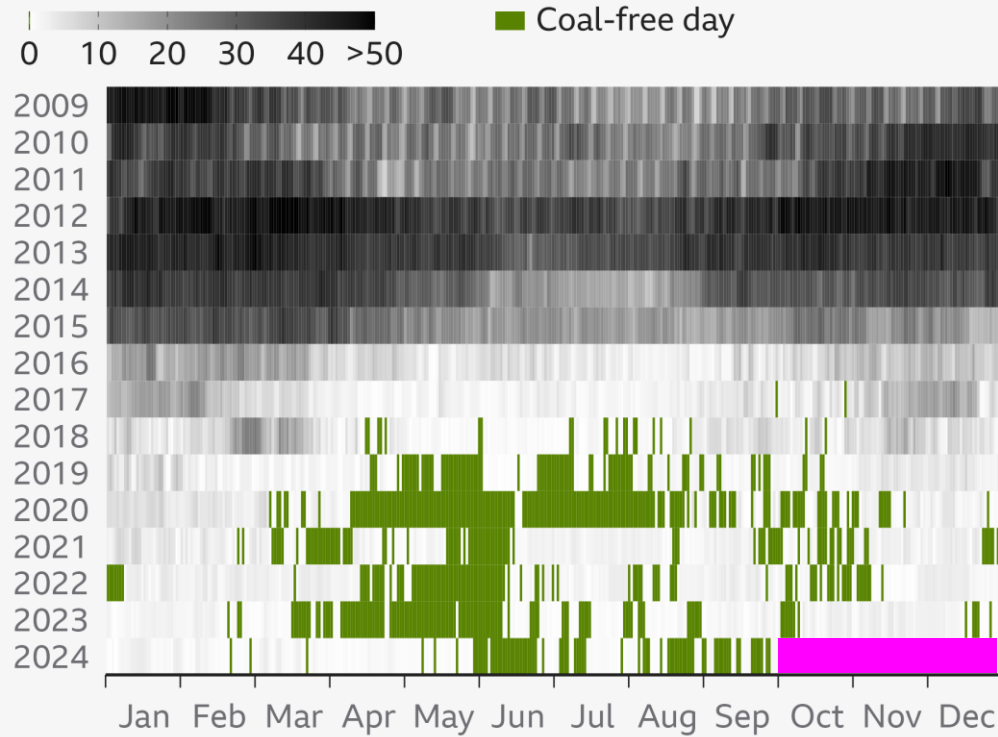
# NESO

National Energy  
System Operator



### Decline of coal in Great Britain's electricity

Daily percentage of electricity generation from coal



# The National Energy System Operator

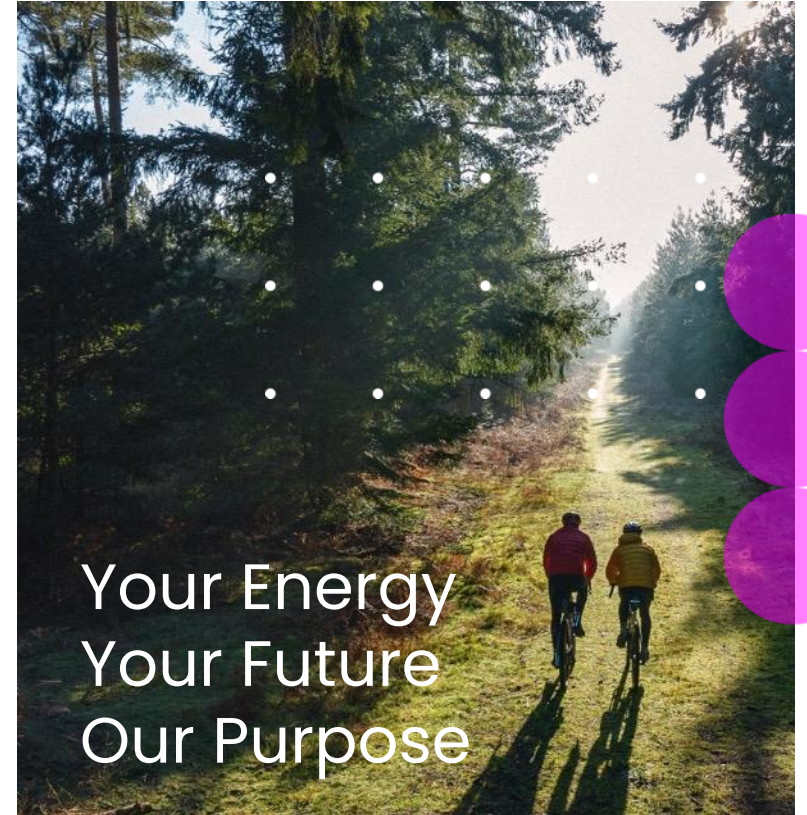
The National Energy System Operator, NESO, is an independent, public corporation at the centre of the energy system taking a whole system view to create a world where everyone has access to **reliable, clean and affordable energy**.

Our work will be the **catalyst for change** across the global community, forging the path to a **sustainable future for everyone**.

## The challenge

Tackling climate change is truly the challenge of our generation; addressing energy security, sustainability and affordability for everyone is at the forefront of the global agenda and drive to meet net zero.

It is our job to transform the whole energy system to meet these challenges and transition to a low-carbon future, embracing new technologies and cleaner generation sources, always with the cost to the consumer in mind.



# NESO Timeline

## History of the System Operator:



**1989**  
The Electricity Act was approved by parliament, which paved the way for privatisation of the electricity industry.



**National Grid**

**1990**  
National Grid was established, creating one regulated company for England and Wales to provide transmission infrastructure and a marketplace; not to buy or sell energy itself.



**1996**  
Our control room, the Electricity National Control Centre (ENCC) was established, in Wokingham.

## Legal Separation of the Electricity System Operator:

**nationalgridESO**

**April 2019**  
National Grid Electricity System Operator (ESO), became a legally separate business within the National Grid PLC Group.



**October 2024**  
NESO is established.



**January 2024**  
The ESO announced the new name for this entity as the National Energy System Operator, or NESO.



**October 2023**  
The Energy Act 2023 was passed with cross-party support, legislating for a Future System Operator to be created.

## The Formation of the National Energy System Operator:



**April 2022**  
Following industry consultation, the UK government decided that the Future System Operator would be a public corporation free from commercial interests and operationally independent.



# Our Purpose, Vision And Values



Our purpose is to forge the path to a sustainable future for everyone.



Our vision is a future where everyone has access to reliable, clean and affordable energy; our work will be a catalyst for change across the global community.

Our values are what define us, setting the foundation for our purpose and guiding us as we move towards achieving our vision.



## Accelerate Progress

We deliver better outcomes at pace when we take accountability, are courageous and progress the bigger picture.



## Be Curious

We achieve more when we demonstrate a growth mindset, being curious, asking questions beyond and within our organisation to develop, learn and innovate.



## Build Trust

We build trust when we listen to and understand the needs of our colleagues and customers, are transparent with our actions and deliver on our commitments.



## Create Belonging

We perform at our best when we can be our true selves, embrace diversity and are truly inclusive.

# The National Energy System Operator

The UK's 2023 Energy Act set the legislative framework for an independent system planner and operator to be set up to help accelerate Great Britain's energy transition, leading to the establishment of the National Energy System Operator (NESO).

## Our Primary Duties

NESO will promote the following three objectives:



**Net Zero**  
Enabling the Government to deliver on its legally binding emissions targets.



**Efficiency & Economy**  
Promoting efficient, co-ordinated and economical systems for electricity and gas.



**Security of Supply**  
Ensuring security of supply for current and future customers of electricity and gases.

## Our Secondary Duties

NESO will also have regard to:



**Facilitating Competition**  
Creating and maintaining competitive energy markets and networks.



**Consumer Impacts**  
Understanding what changes mean for consumers.



**Whole System Impacts**  
Understanding linkages across systems.



**Facilitating Innovation**  
Creating an environment that enables others to help solve energy challenges.



# Our Governance

NESO is operationally independent of government. Taking a whole system approach, we plan the electricity and gas systems and operate the electricity system to deliver the government's policy outcomes.

Being independent enables us to make fair and unbiased decisions based on evidence and data. This means we can give impartial recommendations to the government and the regulator.

## Our shareholder



The Department for Energy Security & Net Zero is responsible for national policy and providing strategic direction and targets in relation to UK energy

## Our regulator



Ofgem is the energy regulator for Great Britain

## Independent NESO Board

The NESO Board oversees our strategic direction, ensuring compliance with regulations and the mitigation of corporate risks. The Board ensures that we build strong relationships with customers and it evaluates performance, ultimately working to protect consumer interests and enable a reliable and secure, efficient, clean energy system.

# Our Priorities

We have identified six priorities that will guide our efforts through to 2026, the end of our current regulatory period, ensuring we fulfil our duties and achieve our purpose and vision.



## Clean Power

We will enable a zero-carbon electricity system by adopting a whole system approach, encouraging innovation and collaboration.



## Decarbonised Energy

We will develop integrated plans for a decarbonised, efficient and flexible energy system fit for the future.



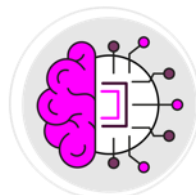
## Consumer Value

We will have unlocked around £3 billion of consumer benefits by 2026 through delivery of our commitments.



## Customer Centricity

We will understand and balance the different needs of our customers to form meaningful partnerships.



## Digital Mindset

We will unlock the potential of technology and teamwork through a digital-first approach, enabling a future of seamless connectivity and innovation at pace.



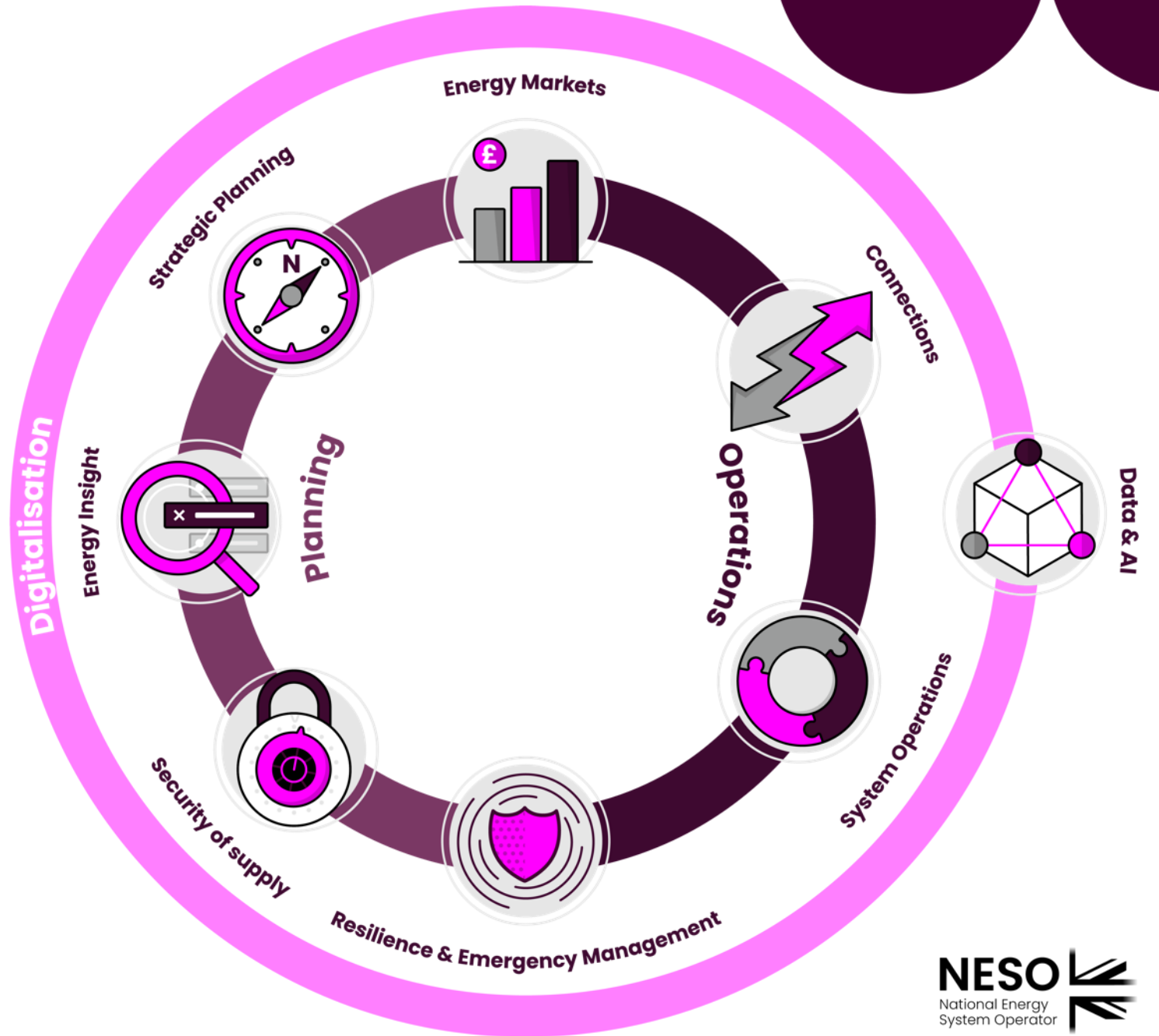
## People Value

We will invest in our people, to ensure we are prepared and empowered to embrace the opportunities of the future

# What We Do

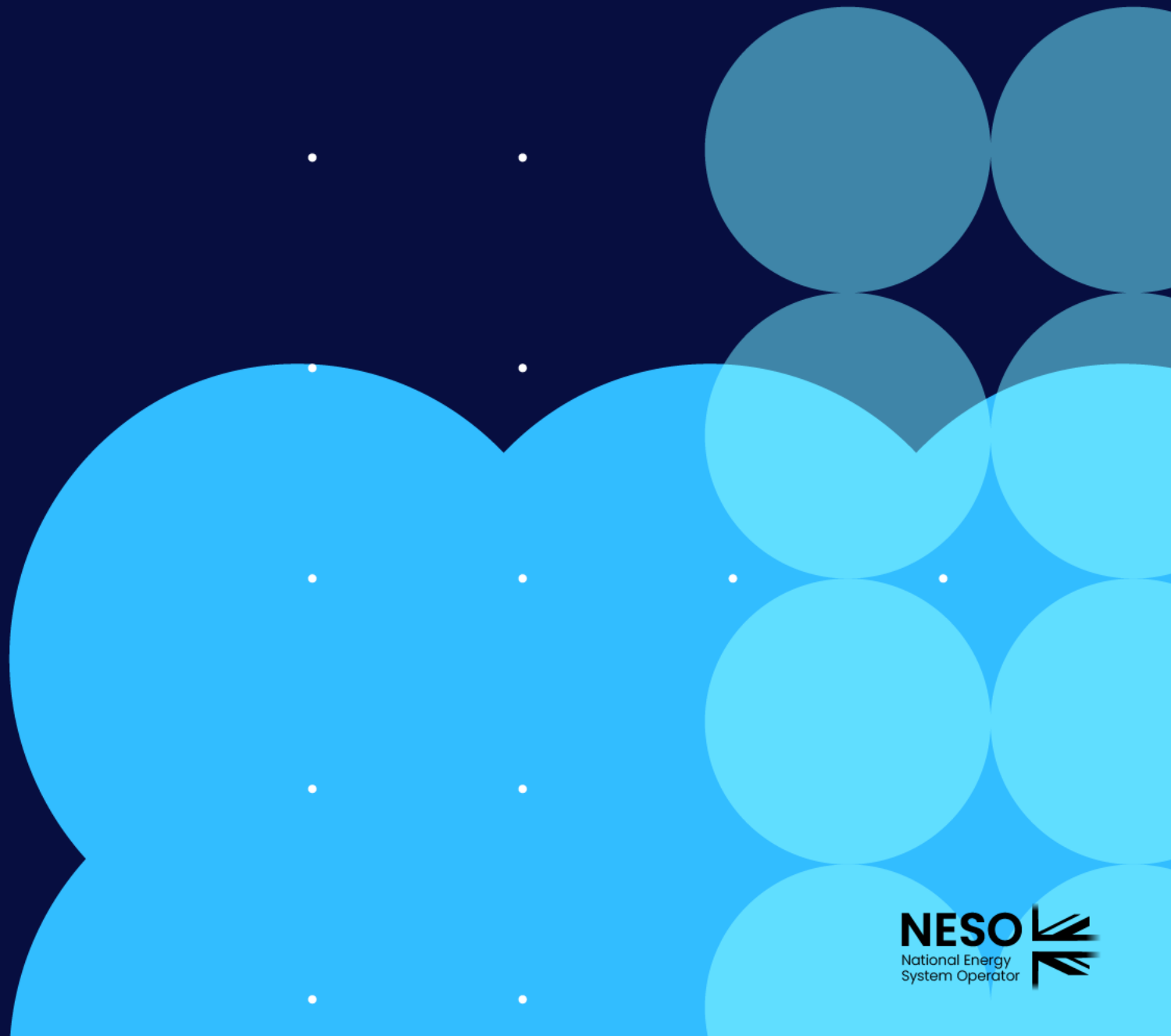
We bring together eight activities required to deliver the plans, markets and operations of the energy system of today and the future.

Bringing these activities together in one organisation encourages holistic thinking on the most cost-efficient and sustainable solutions to the needs of our customers.



# Energy pathways

And their use in system planning



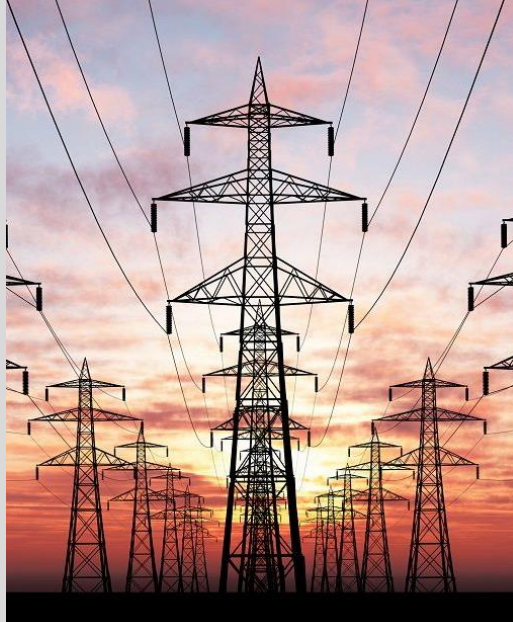


**LEADING THE WAY**

- 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 outlooks...

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

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

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



to change behaviour

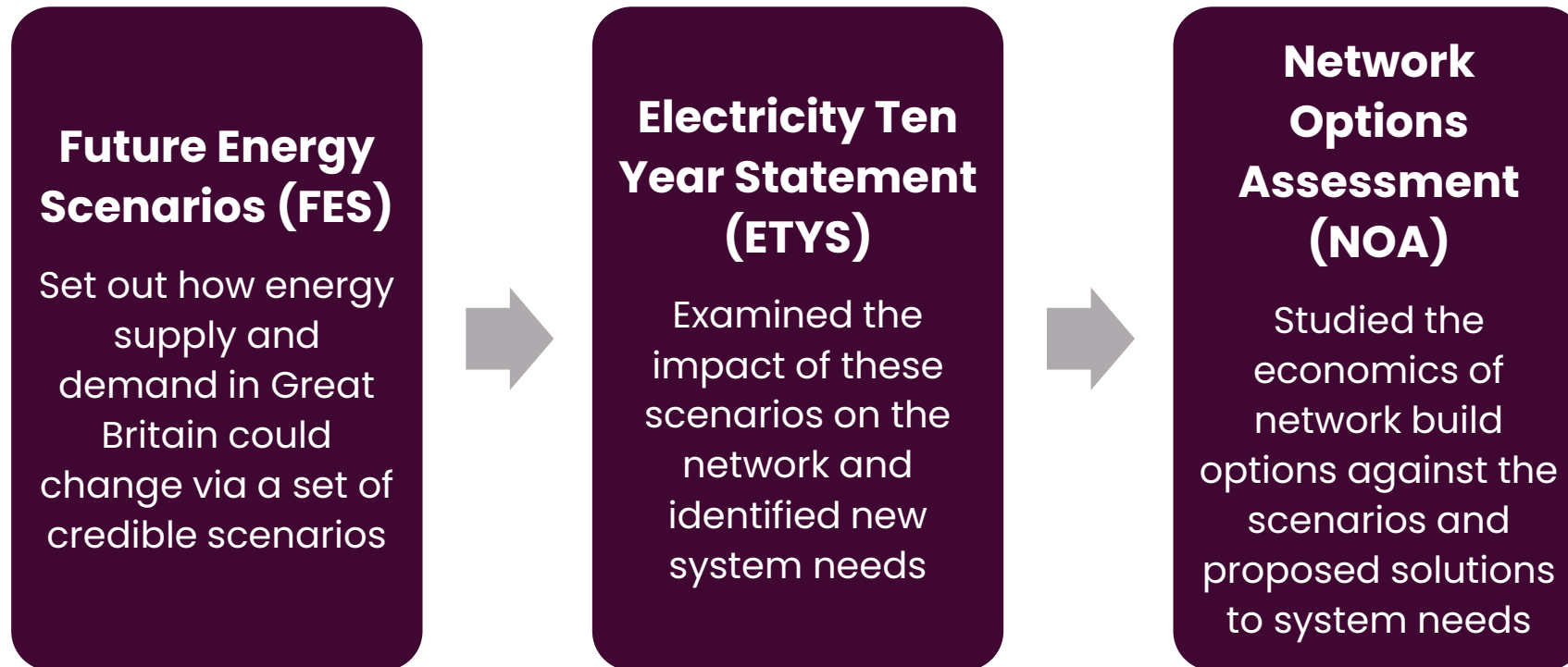
- Lower energy efficiency
- Supply side flexibility

**STEADY PROGRESSION**

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

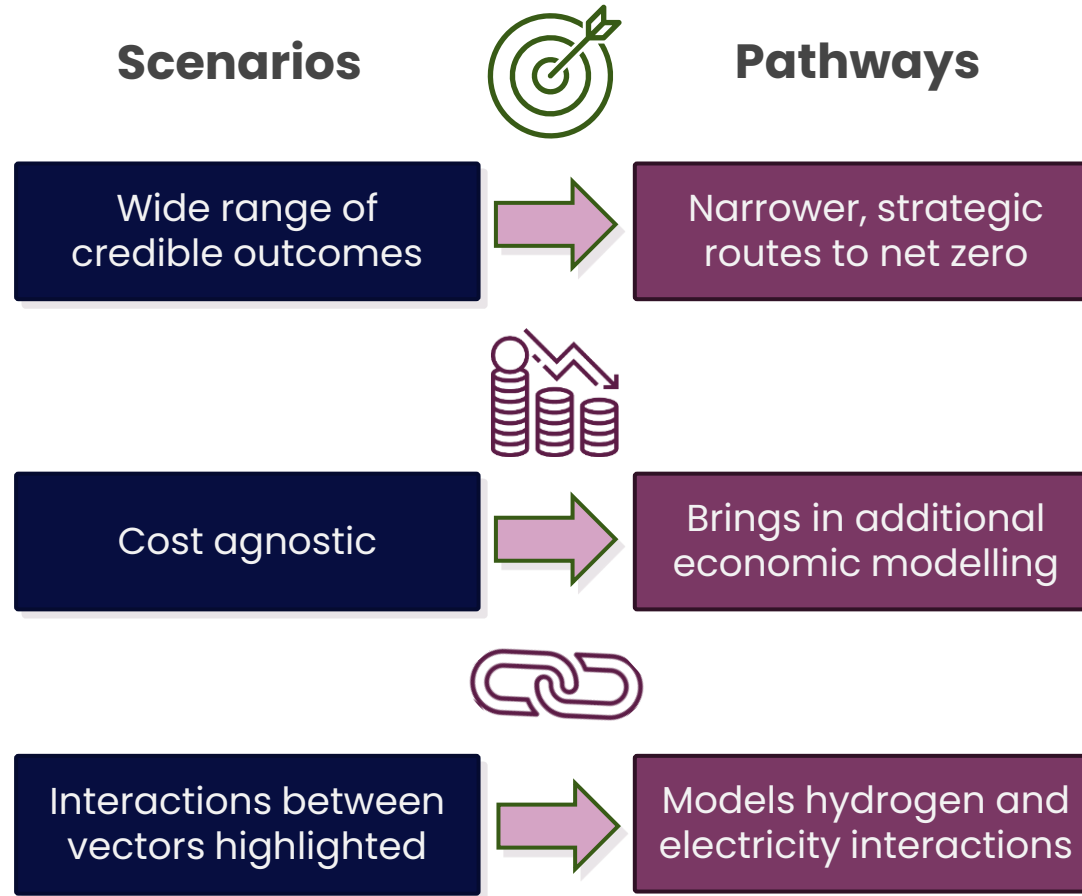


# In the past we looked at what could happen, what system need that created and therefore what network changes were required

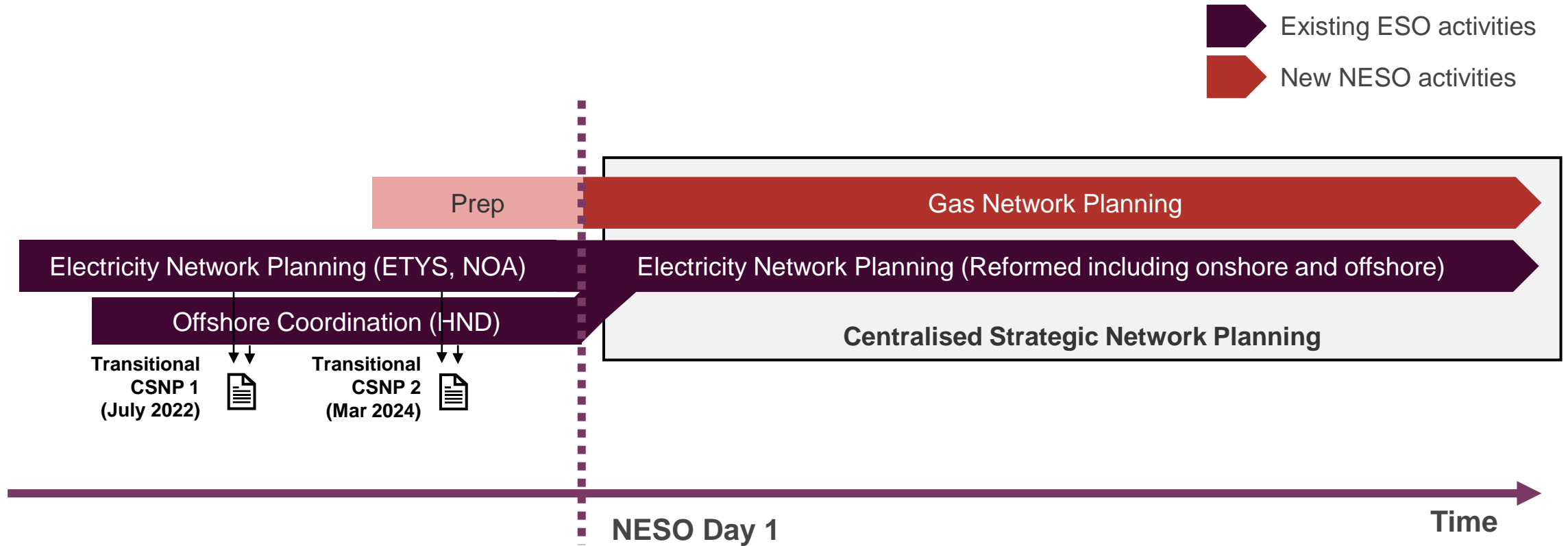


The move NESO brings a new approach to how we think about energy futures and how we plan the network system

# We have moved from scenarios to pathways; these provide narrower, strategic routes to net zero

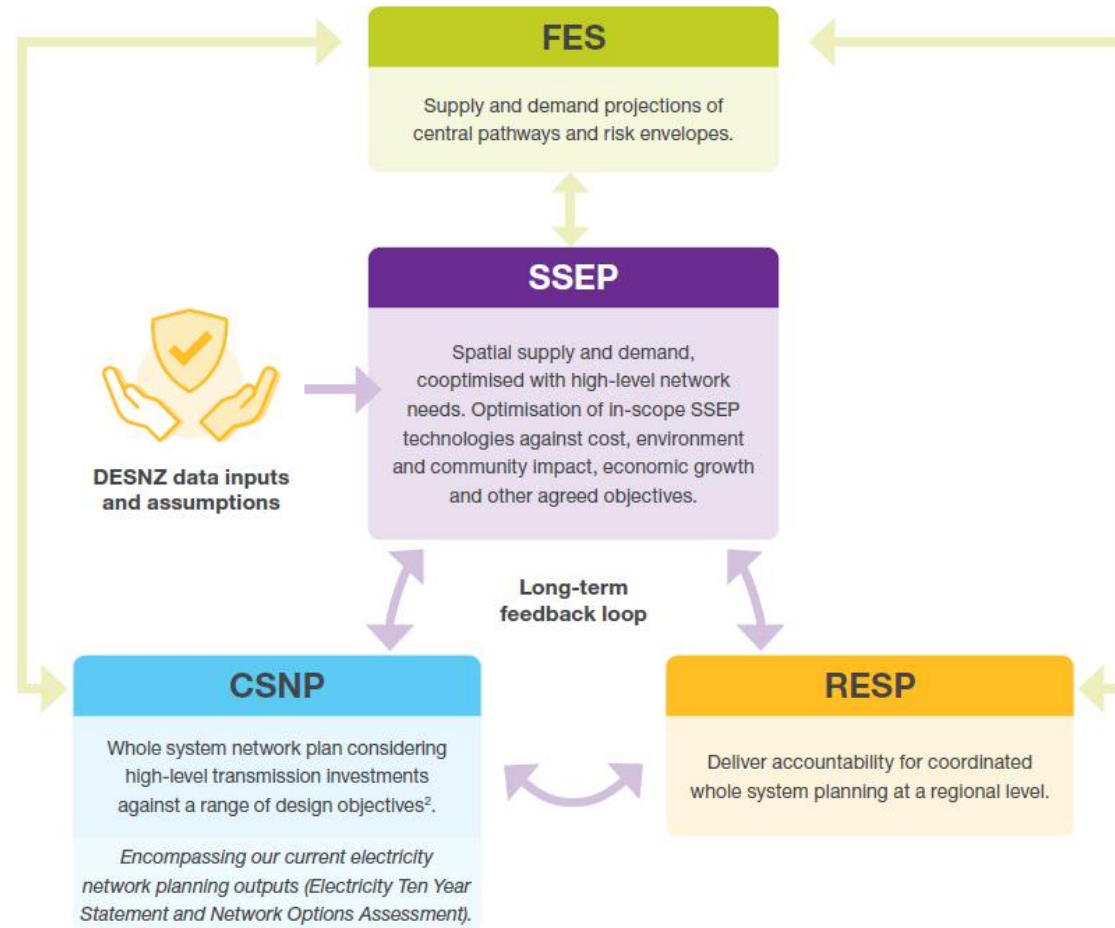


# The Centralised Strategic Network Plan will be a collection of plans for electricity transmission, natural gas transmission and hydrogen





# We also introduce a Spatial Strategic Energy Plan and hold the Regional Energy Strategic Planner role



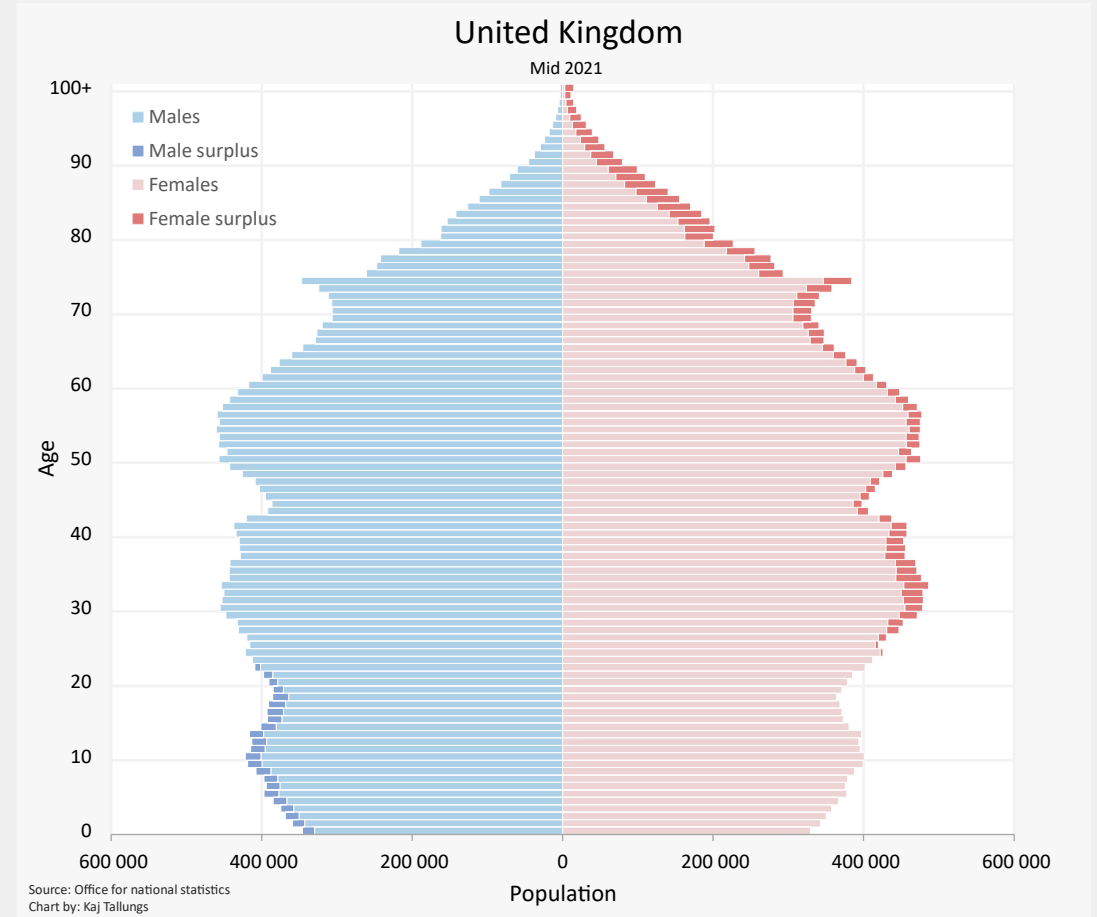
# Your turn

Exploring your view on  
the future of energy

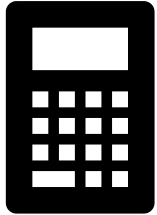
# Population forecasting

Total energy demand, and its profile across the year and regions, is linked to the population size and characteristics that make it up (e.g. age, wealth, work location). Let's have a go at forecasting the UK population in 2050.

- The UK population at mid-year 2023 was estimated to be 68.3 million (68,265,209); an increase of 1.0% since mid-2022.
- Net international migration, at 677,300, was the main contributor to population increase in the year to mid-2023. Pre-Covid it had been relatively stable at an average of around 250,000 per year since the mid-2000s.
- There were 16,300 more deaths than births across the UK in the year to mid-2023 (births: 664,400; deaths: 680,700).



# Minimum UK population in 2050



Calculators, pens and papers allowed – this is not a test of your ability to do mental maths!

# Minimum UK population in 2050

I've been *back to the future* to 2050 and actually the UK population was a little bit lower than that

"Yeah, on second thought, I can believe that" → You have set your minimum too high, revise it down a bit.

OR

"No, no, I simply cannot believe that. There must be some sort of error or mistake" → Your minimum is low enough.



# Maximum UK population in 2050

I don't want to be accused of *doctoring* your figure, but I know that's too low

"Yeah, on second thought, I can believe that" → You have set your maximum too low, revise it up a bit.

OR

"No, no, I simply cannot believe that. There must be an error or mistake" → Your maximum is high enough.



# Best estimate: UK population in 2050

Well, we all know it won't be exactly that. Tell us now whether you think the real answer will be higher or lower, and then in 2050 if you were right, I will give you the house and holiday of your dreams

"The house and holiday of my dreams, you say. Ok, I'm going to say lower" → Revise your best estimate down.

OR

"Oh, that's mean as I really cannot decide. I'm completely indifferent" → You have found your best estimate.

OR

"What a crazy bet to make; this must be my lucky day. I'll bet higher" → Revise your best estimate up.

# Checking your values

- 1. Minimum:** No, no, I simply cannot believe that it will be lower; there must be some sort of error or mistake
- 2. Maximum:** No, no, I simply cannot believe that it will be higher; there must be some sort of error or mistake
- 3. Best estimate:** I'm completely indifferent between accepting your bet that it will be higher/lower



## Electric vehicle forecasting

The route to decarbonisation requires us to move away from petrol and diesel cars. Let's have a go at forecasting the market share of battery electric vehicle (BEV) sales in 2030 (passenger cars).

- The year-to-date market share for BEV was 17.8% in 2024.
- An earlier proposal to ban the sale of petrol and diesel cars by 2030 was pushed back to 2035 by Rishi Sunak; it's unclear how the current government might change this although they did pledge 2030 in their manifesto.
- The zero emission vehicle mandate sets the percentage of zero emission cars required in 2030 at 80%; although car manufacturers may opt to pay the fine instead.

### SEPTEMBER

	2024	2023	% change	Mkt share -24	Mkt share -23
Diesel	17,556	18,892	-7.1%	6.4%	6.9%
Petrol	137,793	151,846	-9.3%	50.1%	55.7%
BEV	56,387	45,323	24.4%	20.5%	16.6%
PHEV	24,486	18,535	32.1%	8.9%	6.8%
HEV	39,017	38,014	2.6%	14.2%	13.9%
<b>TOTAL</b>	<b>275,239</b>	<b>272,610</b>	<b>1.0%</b>		

### YEAR TO DATE

	YTD 2024	YTD 2023	% change	Mkt share -24	Mkt share -23
Diesel	97,649	110,935	-12.0%	6.4%	7.6%
Petrol	814,188	820,880	-0.8%	53.8%	56.5%
BEV	269,931	238,544	13.2%	17.8%	16.4%
PHEV	124,943	98,993	26.2%	8.3%	6.8%
HEV	207,383	182,556	13.6%	13.7%	12.6%
<b>TOTAL</b>	<b>1,514,094</b>	<b>1,451,908</b>	<b>4.3%</b>		

BEV - Battery Electric Vehicle; PHEV - Plug-in Hybrid Electric Vehicle; HEV - Hybrid Electric Vehicle, Diesel and Petrol figures include Mild Hybrid Electric Vehicle (MHEV)

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## Heat pump forecasting

Heating can be decarbonised via electrification, biomethane or hydrogen with a key decision on the role of hydrogen expected in 2026. Let's have a go at forecasting the number of heat pumps installed in UK homes in the year 2035.

- There are around 27 million homes in the UK. With current and previous governments aiming to build 300,000 extra per year.
- 8% of homes are heated with electricity with the remainder on gas (85%), oil or LPG.
- Boris Johnson's government in 2021 set a target of reaching 600,000 installations a year by 2028. In January 2024 fewer than 1 in 4 MPs believed this would be met.
- In 2023 heat-pump installations were up 20%, reaching a record 36,799. While in October 2023 the grant that government will pay towards a heat pump increased by 50% to £7,500.



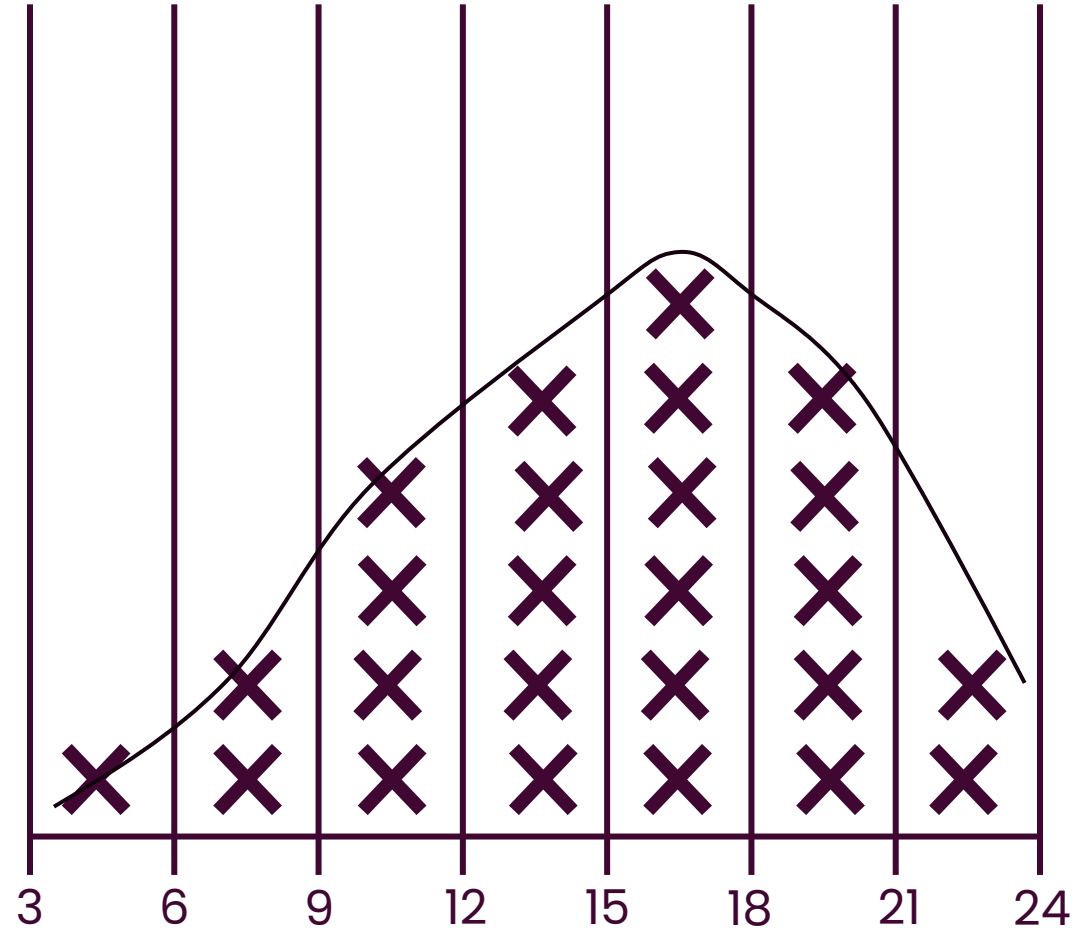
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# Creating a probability distribution

Draw a blank histogram with 5 to 7 equal sized buckets. Place your minimum and maximum at each end.

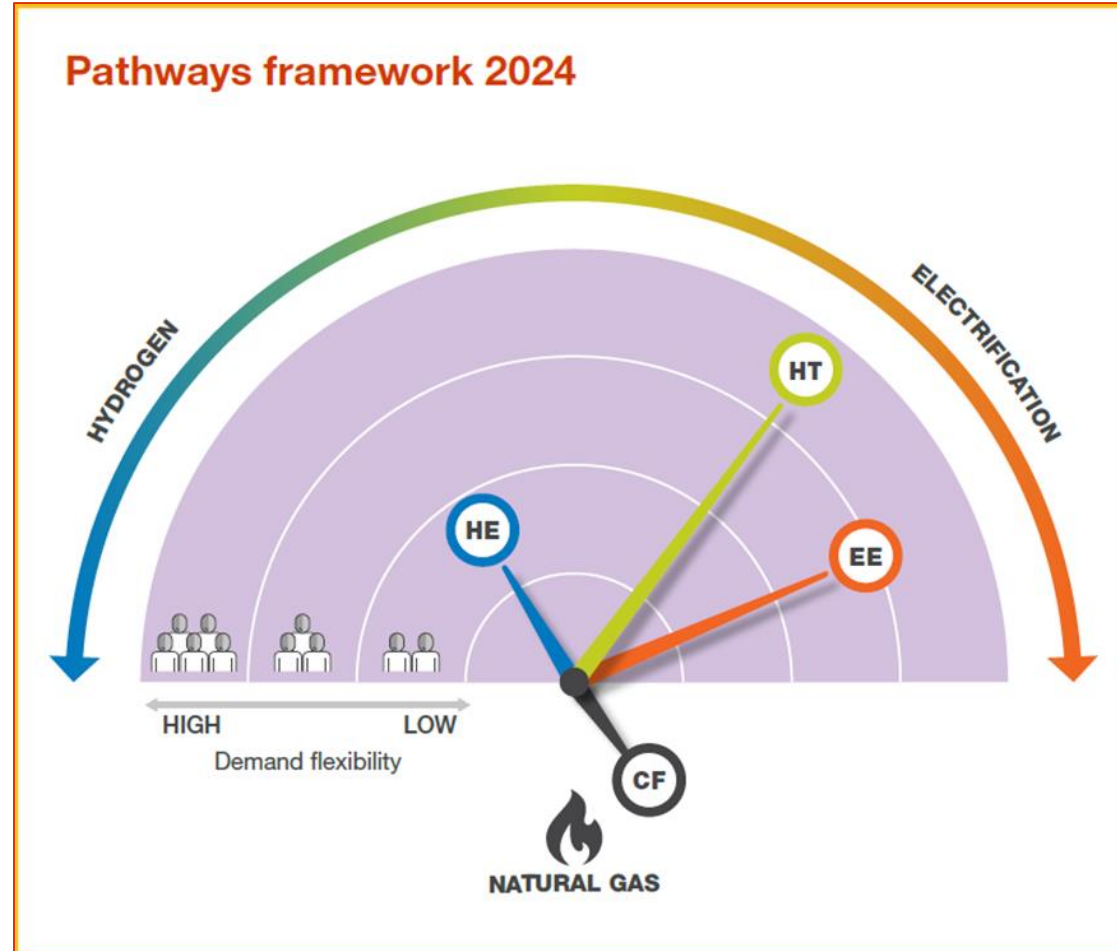
Place 20 (or 25) crosses, which each cross represents 5% (or 4%) likelihood of the answer falling in that bucket.



Illustrative example: numbers not related to our exercises

# Latest findings

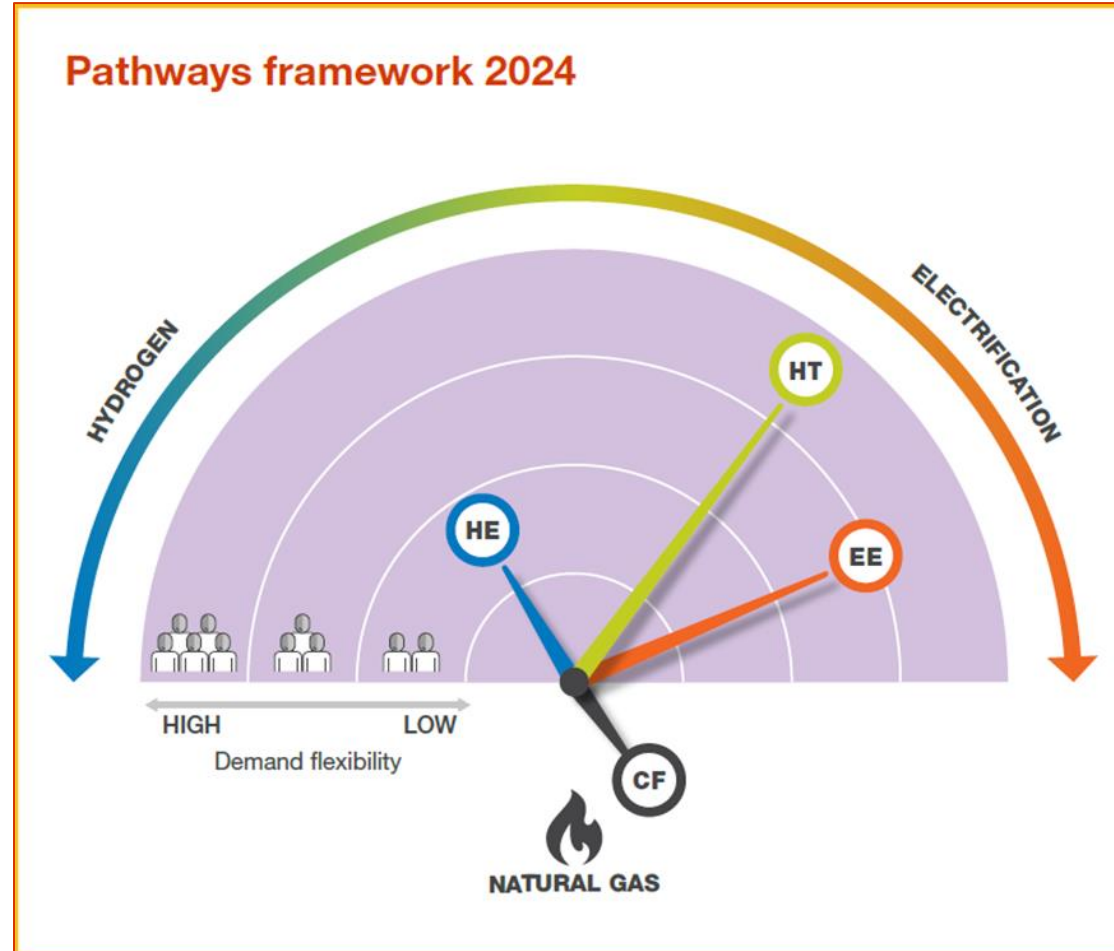
# We created three net zero pathways and a counterfactual based around a new framework



# We created four pathways; three which meet net zero and a counterfactual

## Holistic Transition

- Net zero by 2050
- Mix of electrification and hydrogen
- Very high consumer engagement in the transition

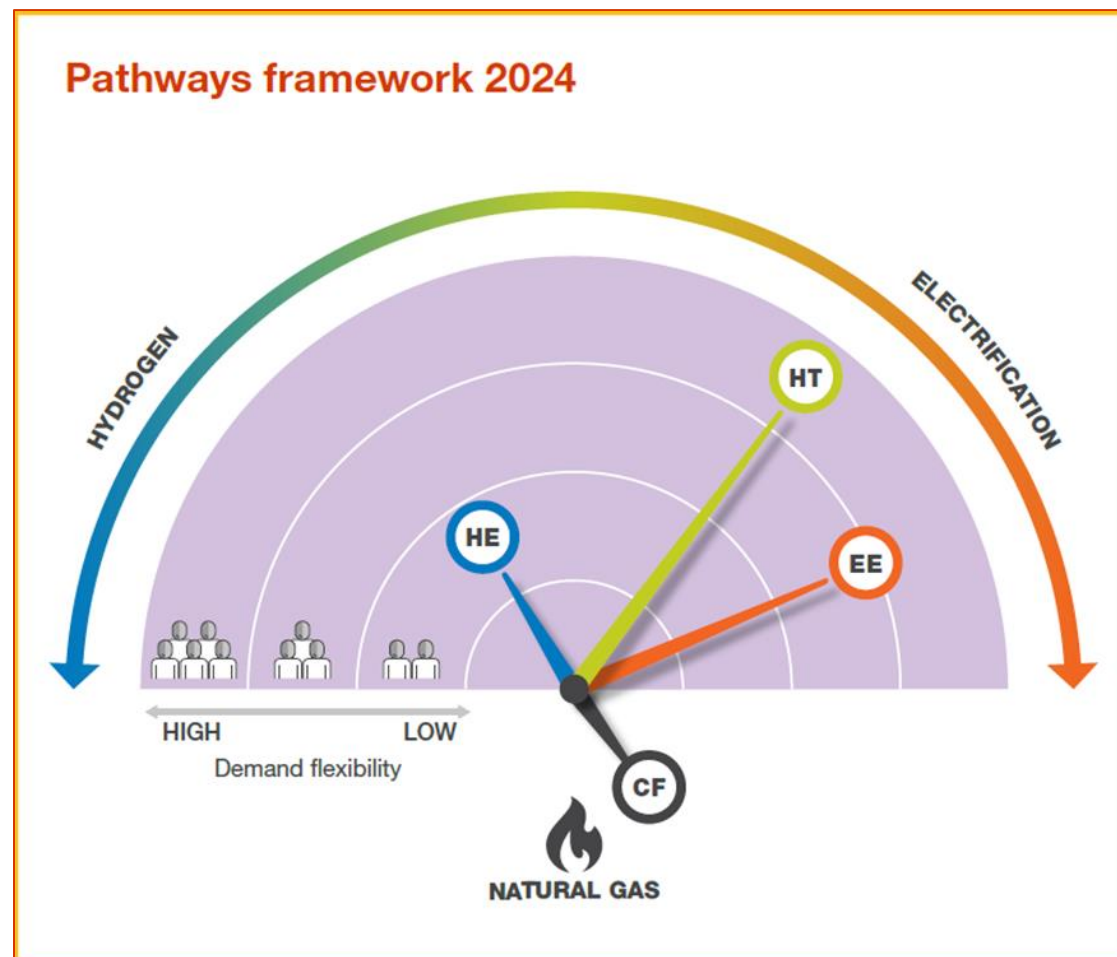




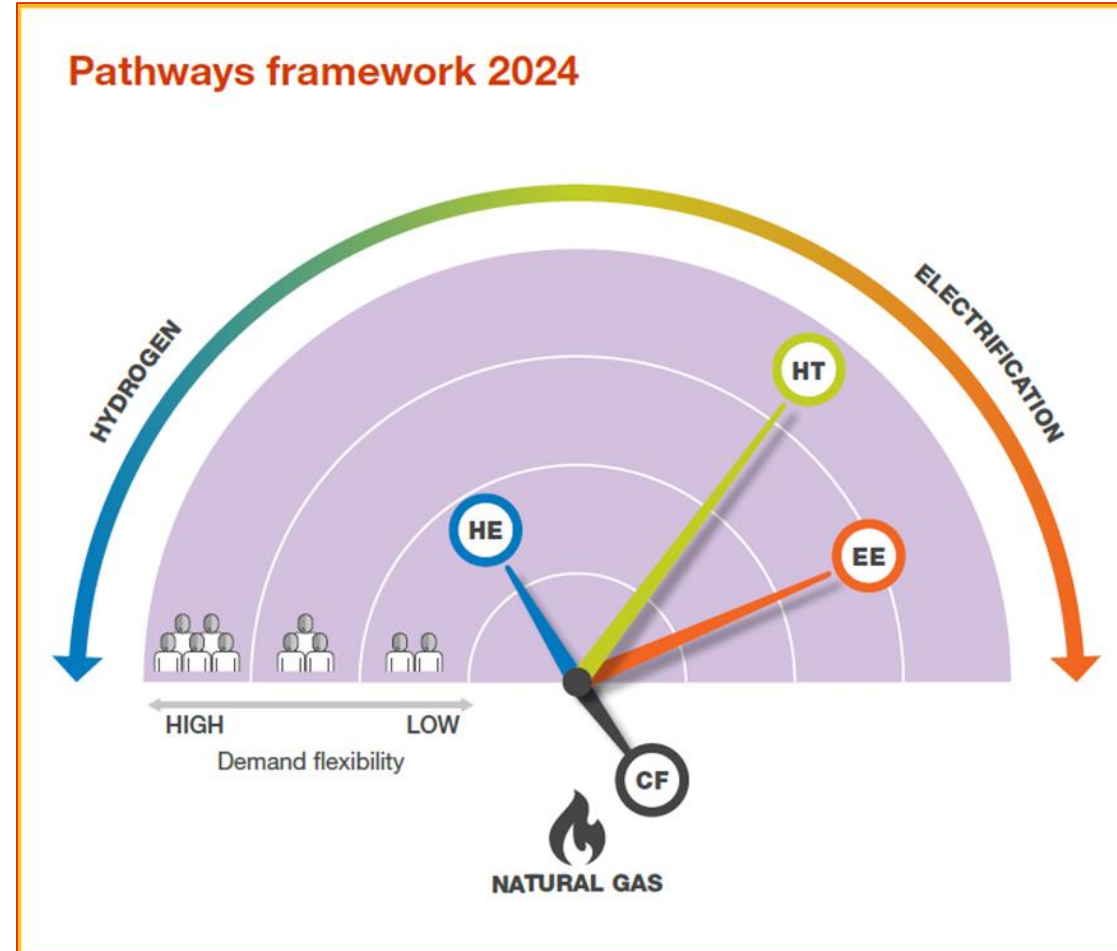
# We created four pathways; three which meet net zero and a counterfactual

## Electric Engagement

- Net zero by 2050
- High levels of electrification
- Strong consumer engagement in the transition



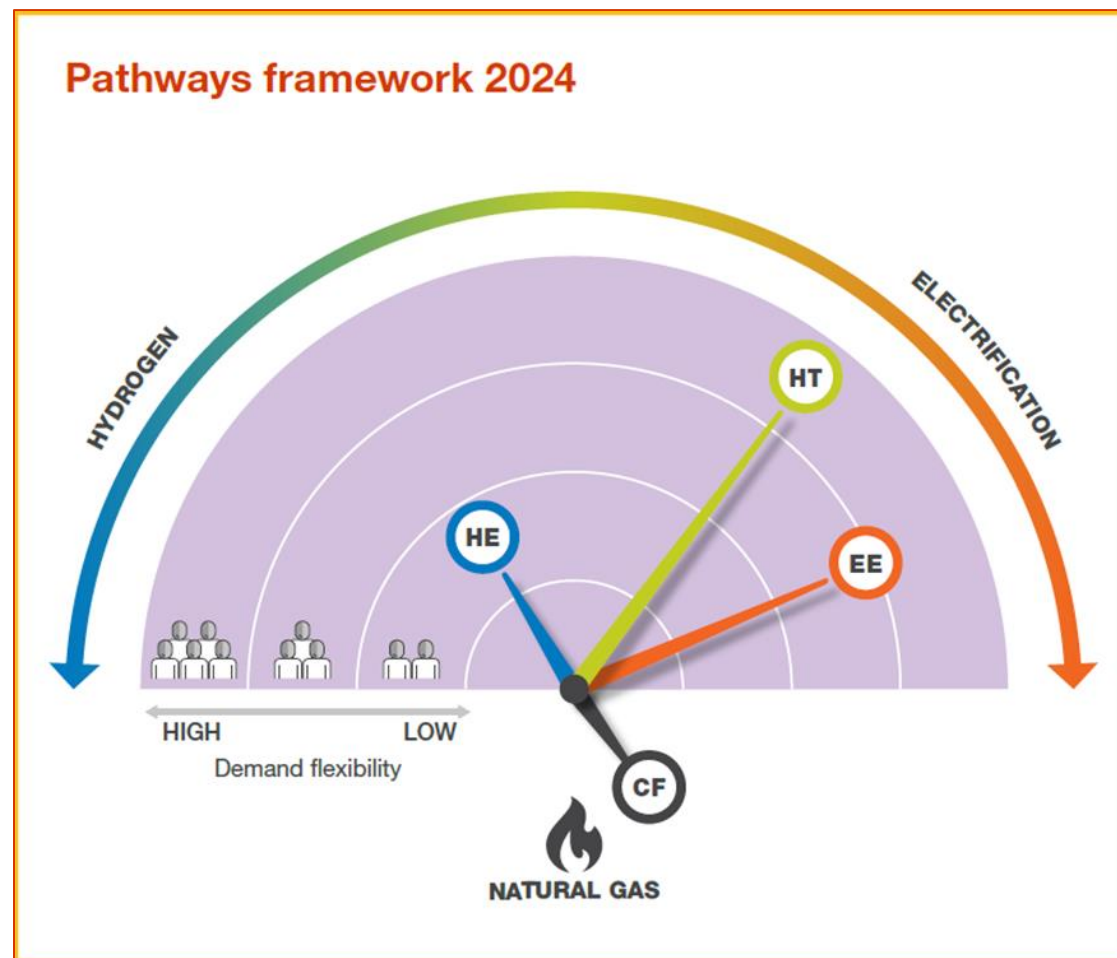
# We created four pathways; three which meet net zero and a counterfactual



## Hydrogen Evolution

- Net zero by 2050
- Fast progress for hydrogen in industry and heat
- Lower levels of consumer engagement

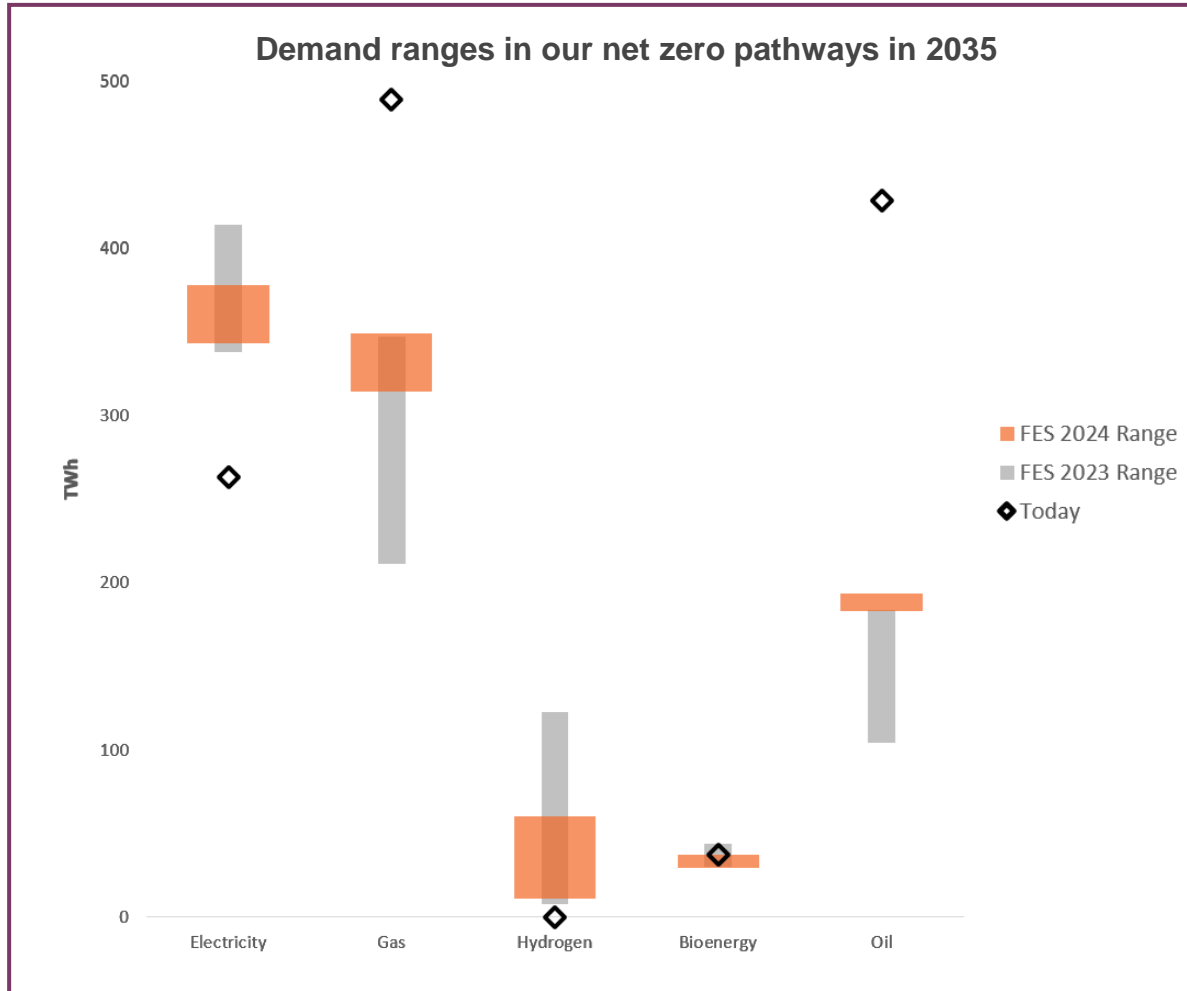
# We created four pathways; three which meet net zero and a counterfactual



 Counterfactual

- Net zero not achieved by 2050
- Some progress is made compared to today
- Heavy reliance on gas across all sectors, particularly power and space heating
- Electric vehicle uptake is slower than the net zero pathways, but still displaces petrol and diesel

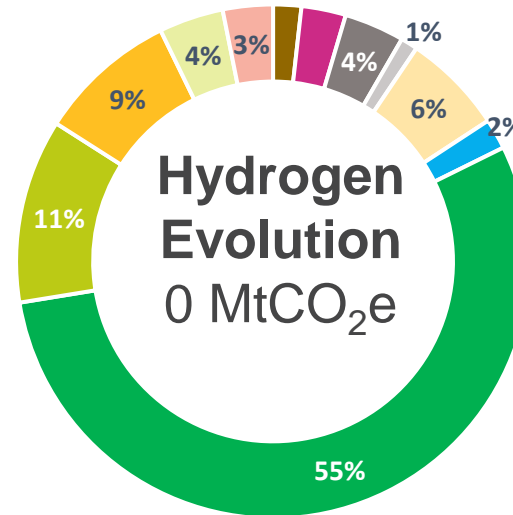
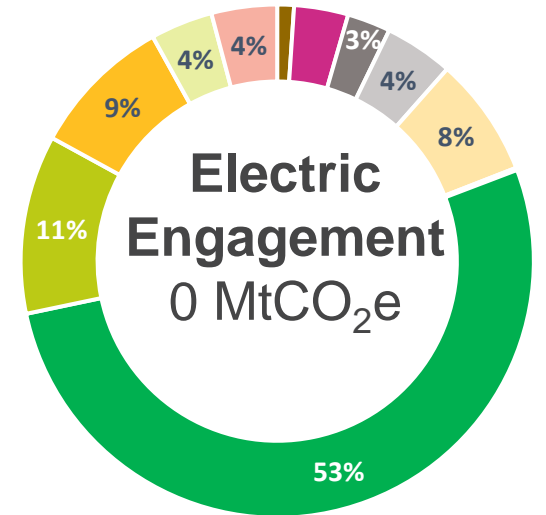
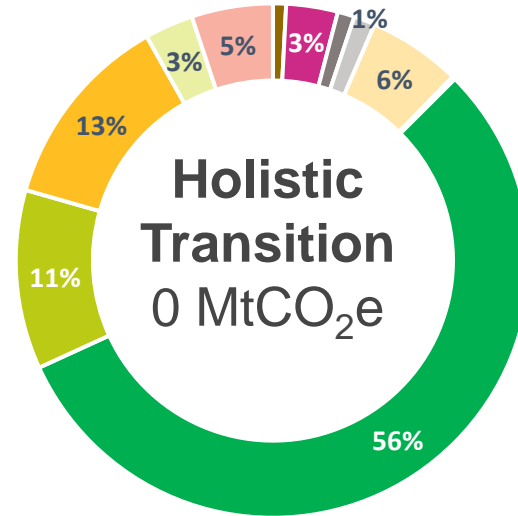
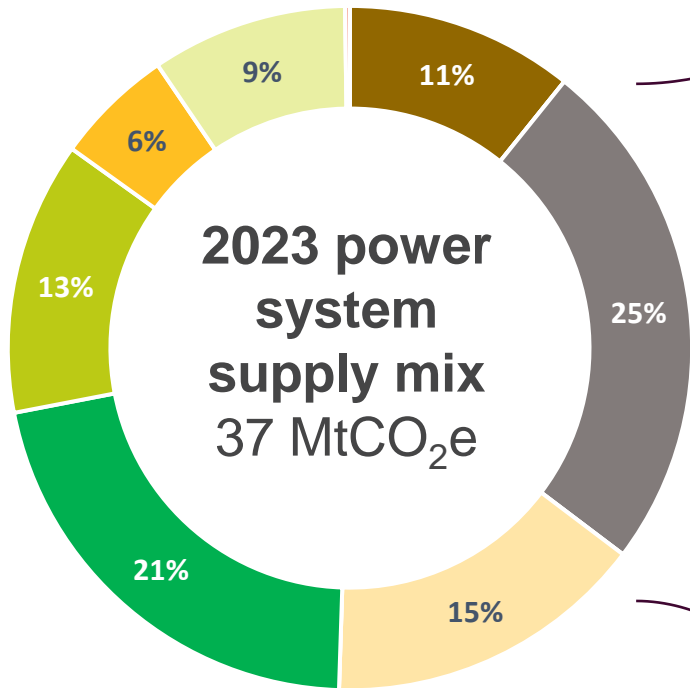
# The move from scenarios to pathways has narrowed the demand range in our outputs



- All pathways follow the Zero Emissions Vehicle Mandate as the policy gives a clear route to decarbonisation
- Due to limited time to accelerate heat pump sales to achieve the Sixth Carbon Budget, we have reduced the uptake range
- Energy efficiency measures are more consistent as the pathways are now saying what should happen
- We have reduced the range of hydrogen in industry as there is more likelihood it will be used

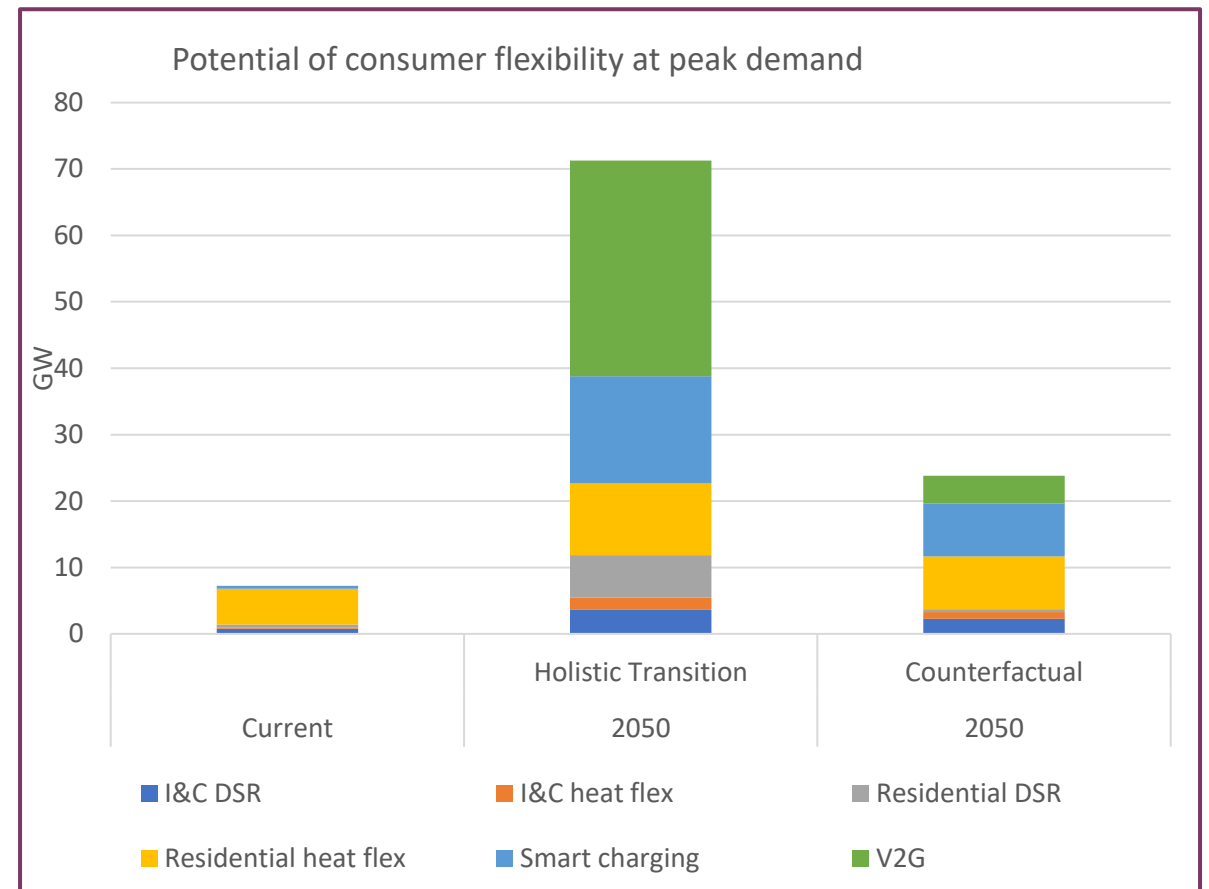
# A decarbonised electricity system is key to achieving net zero

- Biomass
- CCS Biomass
- Fossil Fuel
- CCS Gas
- Nuclear
- Hydrogen
- Offshore Wind
- Onshore Wind
- Solar
- Other Renewables
- Storage



# Peak demand drives system needs so growth of consumer flexibility should be encouraged

- Peak demand drives network and dispatchable capacity requirements
- In an unmanaged decarbonised household, new electrified heat and transport demand coincide with the morning and evening peaks
- What's needed: cost signals and equipment to respond to them
- The aggregation of consumer flexibility has 70 GW potential, which can reduce peak demand and turn up demand at times of oversupply



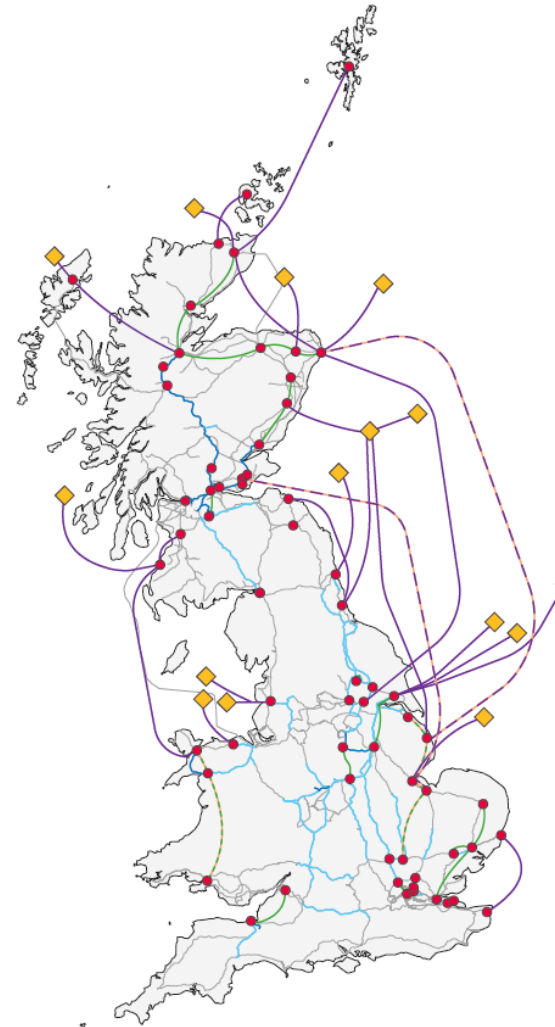
# We are recommending an additional £58 billion of direct investment in electricity networks

Our most recent electricity network plan was published in March 2024.

Our plan includes significant offshore network to facilitate the connection of an additional 21 GW of offshore wind, and support north to south flows across Great Britain.

In addition to the offshore network build, there is a need for reinforcement from Northeast Scotland to Northwest England, to provide greater transfer of power.

Increased coast-to-coast connectivity balances power flows across the country, improving security and ensuring that renewable power can always be accessed regardless of where it is generated.



Category	Key
New offshore network infrastructure	—
New onshore network infrastructure	—
Voltage increase on network	—
Existing network upgrade	—
Substation upgrade or new substation	●
HND wind farm	◆
Existing Network	—

\*Amber dashed lines represent reinforcements required for this blueprint, but current delivery date estimates sit beyond this.

**Note:** all routes and options shown on this map are for illustrative purposes only.

Public

# Thank you