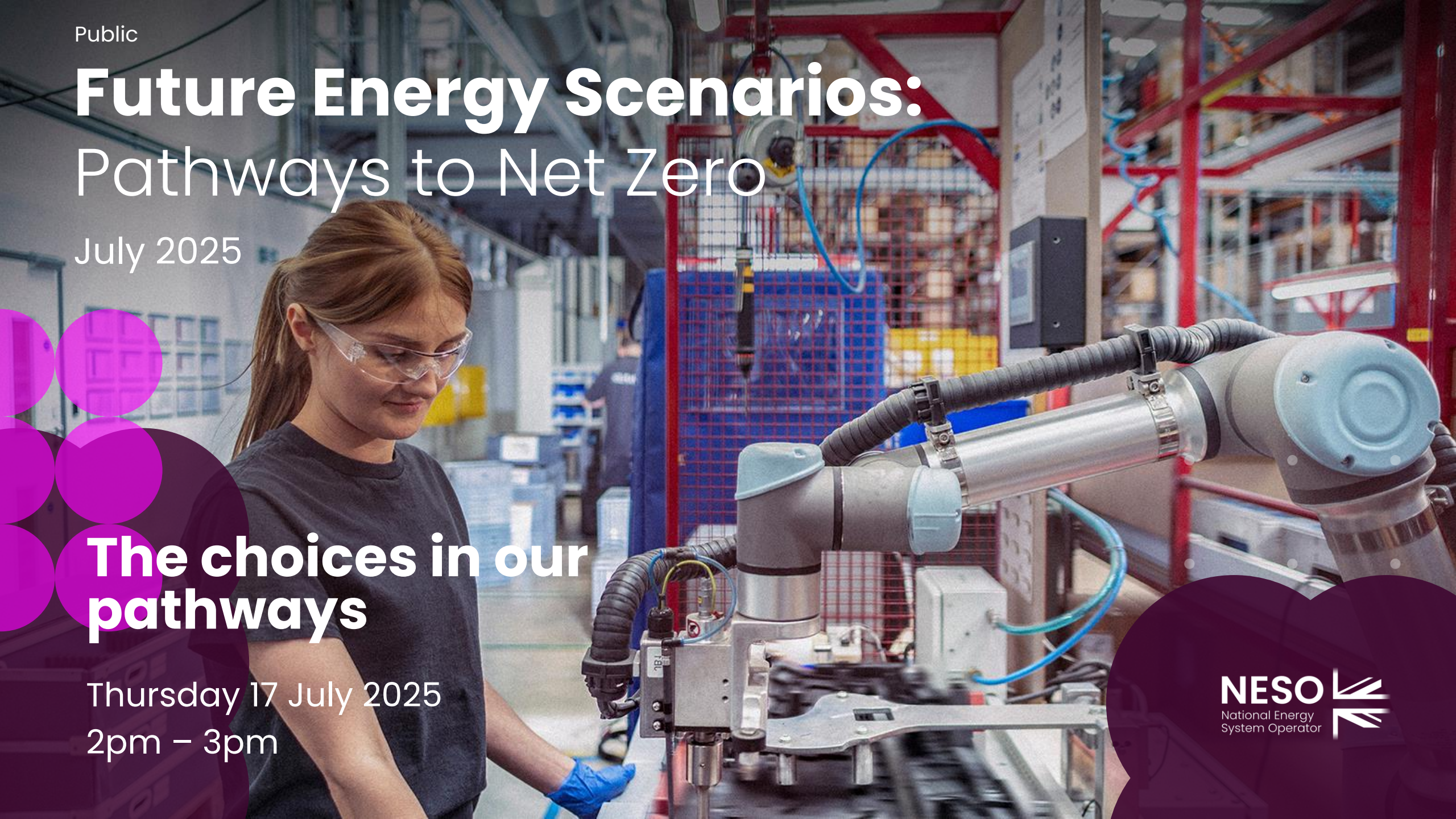
Public

Future Energy Scenarios:
Pathways to Net Zero

July 2025



The choices in our pathways

Thursday 17 July 2025
2pm – 3pm

NESO
National Energy System Operator

Agenda

	Time	Presenter
Welcome	2:00pm	Sian Ramirez-Bower
Purpose, pathways and key messages	2:05pm	Sian Ramirez-Bower
FES 2025 insights	2:15pm	Aneesa Parkar
Q&A	2.40pm	Sian Ramirez-Bower
Close	3:00pm	

NESO Pathways to Net Zero

FES feeds into, and works alongside, established and new energy system processes:

Inputs:

- Stakeholder engagement
- Policy and targets
- External technical data
- Economic data

Outputs:

FES analysis and insight

- Pathways, Faling Behind and Ten Year Forecast of:
  - Energy demand
  - Electricity supply
  - Gas supply
  - Hydrogen supply
  - Bioenergy supply
  - Emissions

Uses:

- Strategic Energy Planning
- Markets
- Security of supply
- Operability
- Strategic insights and advisory
- Private sector and energy industry

While based on the SSEP*, the CSNP** will use FES for stress-testing for electricity and hydrogen.

Some of the FES technical data is also used in the SSEP and RESP***.

See Appendix 1 of the FES 2025 report

*SSEP = Strategic Spatial Energy Plan
**CSNP = Centralised Strategic Network Plan
*** RESP = Regional Energy System Planning

What do we model?

FES models supply and demand to build whole energy system pathways to net zero.

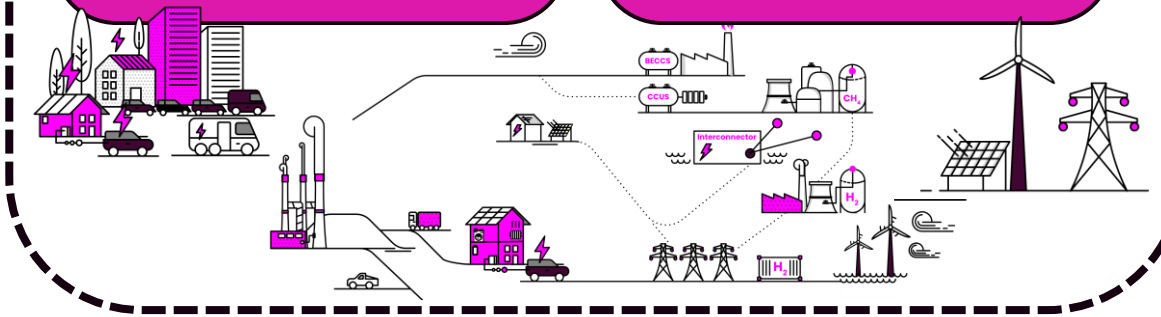
We model these sectors...

- Road transport
- Residential heat
- Appliances
- Commercial
- Industrial
- Demand flexibility

Demand

- Electricity generation and flexibility
- Hydrogen supply
- Gas supply
- Engineered carbon removals

Supply

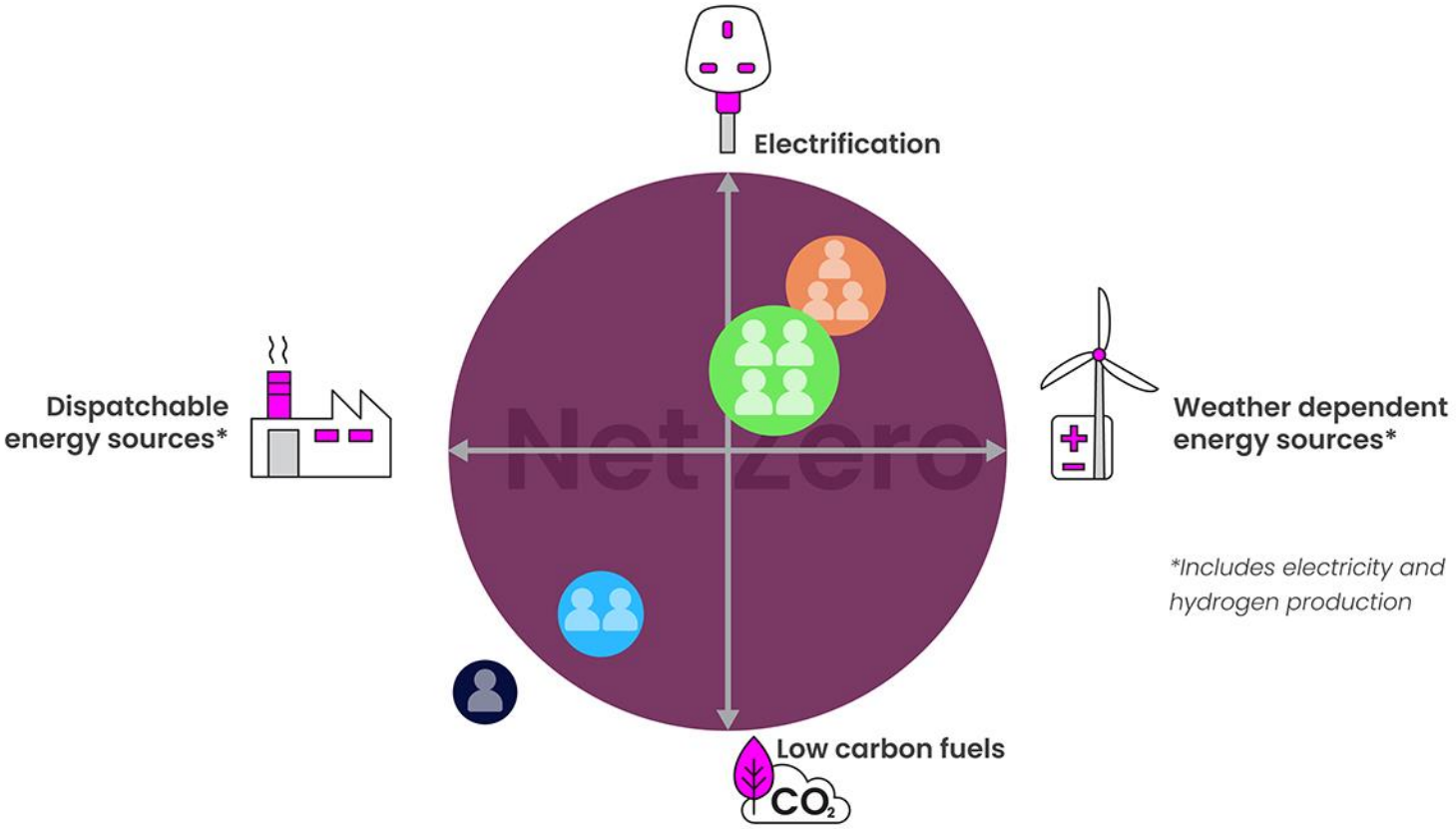


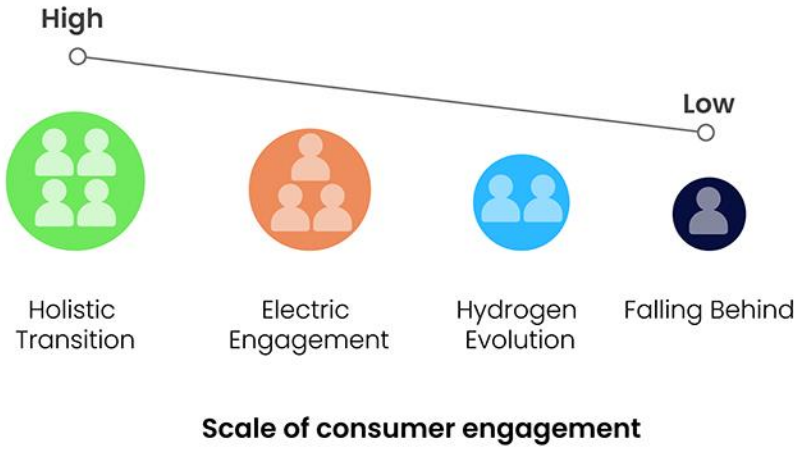
We don't model these sectors – but do use values from the Climate Change Committee

- Aviation and shipping
- Biomass supply
- Land use, land use change and forestry
- Agriculture
- Fluorinated gases
- Fuel supply
- Industrial process emissions

"Non-FES sectors"

The pathway framework

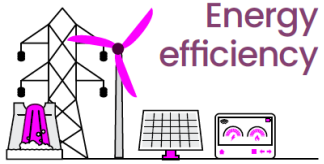




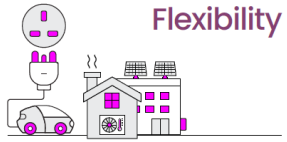
Key messages

> Only bold and sustained action in all sectors will unlock the benefits of an affordable and secure, clean energy system. This means matching the ambition and pace of the clean power goal, accelerating progress across the whole energy system and looking beyond 2030.

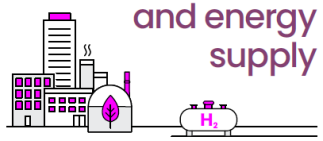
This means action on:



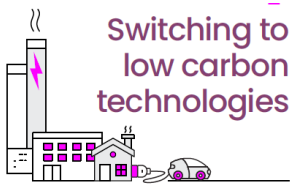
Energy efficiency



Demand Flexibility



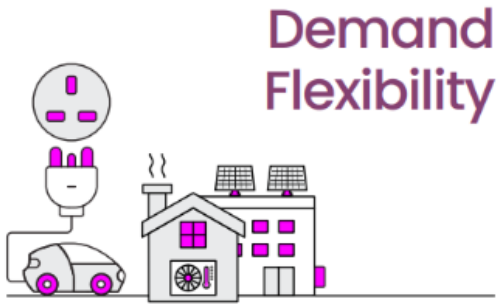
Infrastructure and energy supply



Switching to low carbon technologies

	Today	2030	2040	2050
	Acceleration	Growth	Horizon	
1 Energy efficiency	Implement policy to accelerate widespread adoption of energy efficiency measures	Push forward with efforts to improve efficiency of heat pumps and electric vehicles over time	Maintain momentum on energy efficiency measures and embed optimal operating practices	
2 Demand flexibility	Empower households and businesses willing and able to make informed energy choices	Rapid rollout of smart energy solutions, such as using electric vehicles to support the grid and making heating more flexible	Ensure effortless participation	
3 Infrastructure and energy supply	Deliver coordinated strategic plans across electricity, gas, bioenergy, hydrogen and CO_2 transport and storage	Build the strategic whole system energy infrastructure at pace, considering electricity, gas, bioenergy, hydrogen and CO_2	Drive continuous innovation to fully realise and maximise the value of a net zero energy system	
4 Switching to low carbon technologies	Implement policy to encourage homes and businesses to switch to low carbon energy sources	Deliver mass adoption of low carbon technology and infrastructure to provide certainty for industry	Further reduce reliance on unabated fossil fuels	

We consider choices and uncertainty through different pathways



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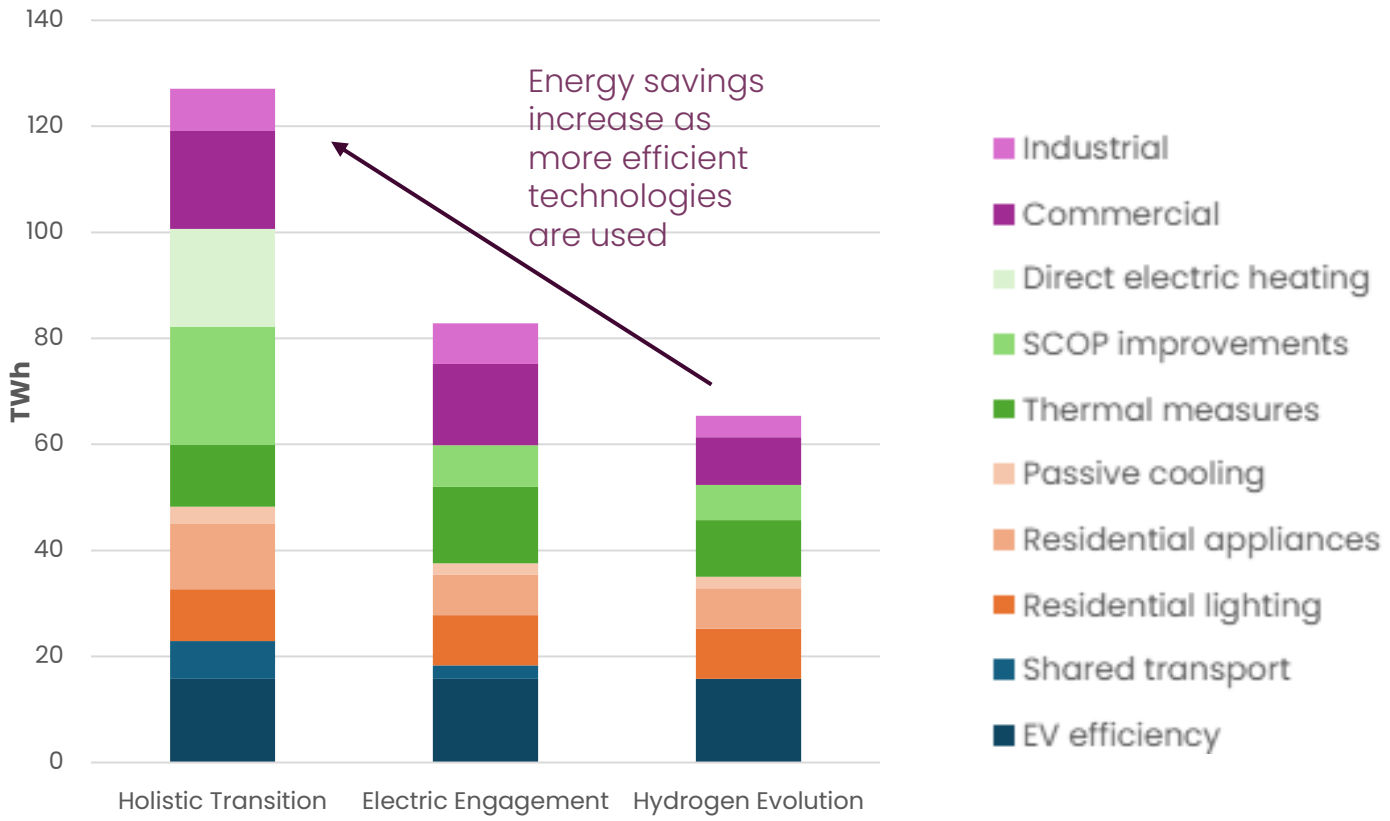
Energy efficiency measures manage growth in demand and reduce operating costs

Our pathways show that it is pivotal in meeting the **2030 Nationally Determined Contribution** emissions target

22TWh of demand for consumers saved in 2050 from heat pump efficiency improving over today's level

If **7% of consumers in EE** switched to heat pumps from direct electric heating, this has the potential to save 18TWh demand in 2050

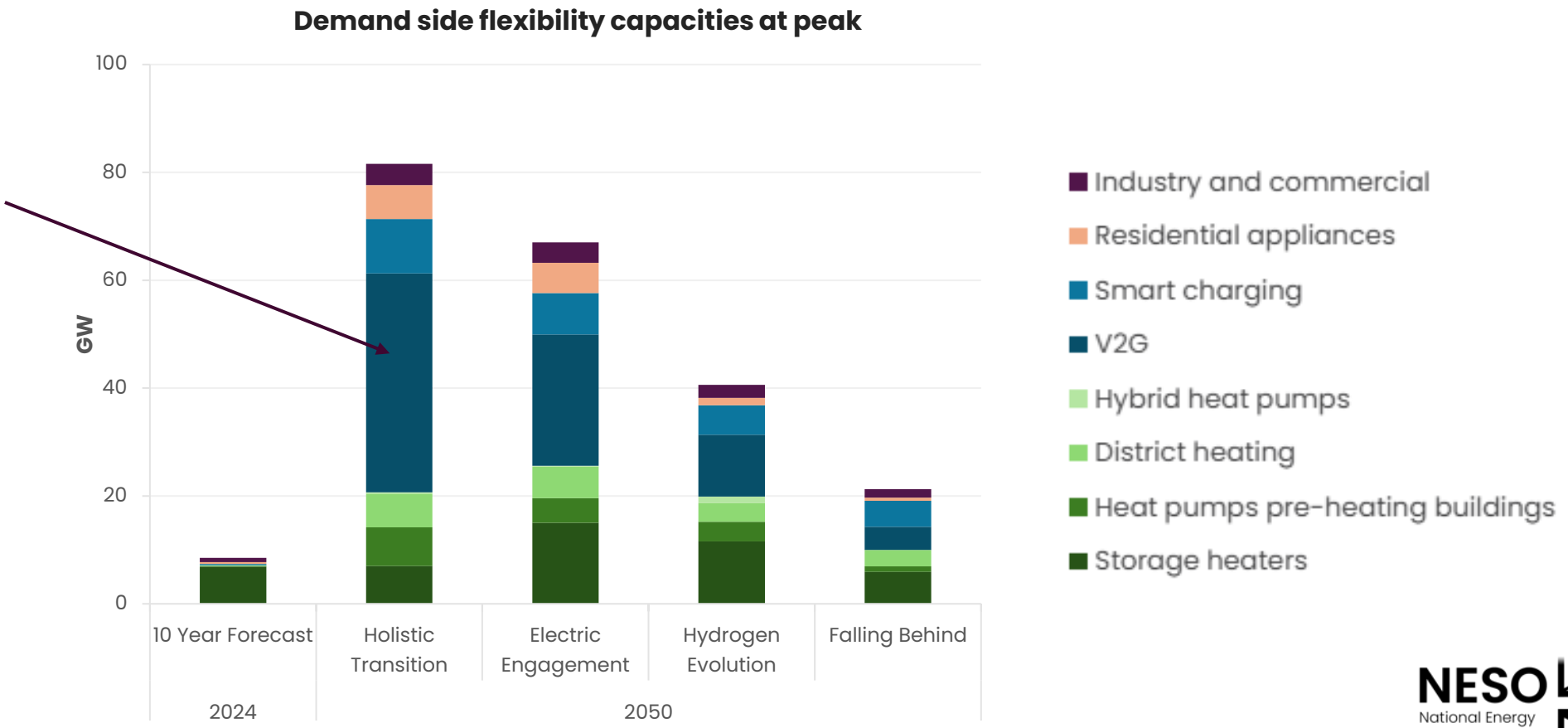
Demand savings and avoidance in 2050 from energy efficiency measures, relative to not enacting these methods



The future of demand flexibility is shaped by consumer engagement and digital solutions

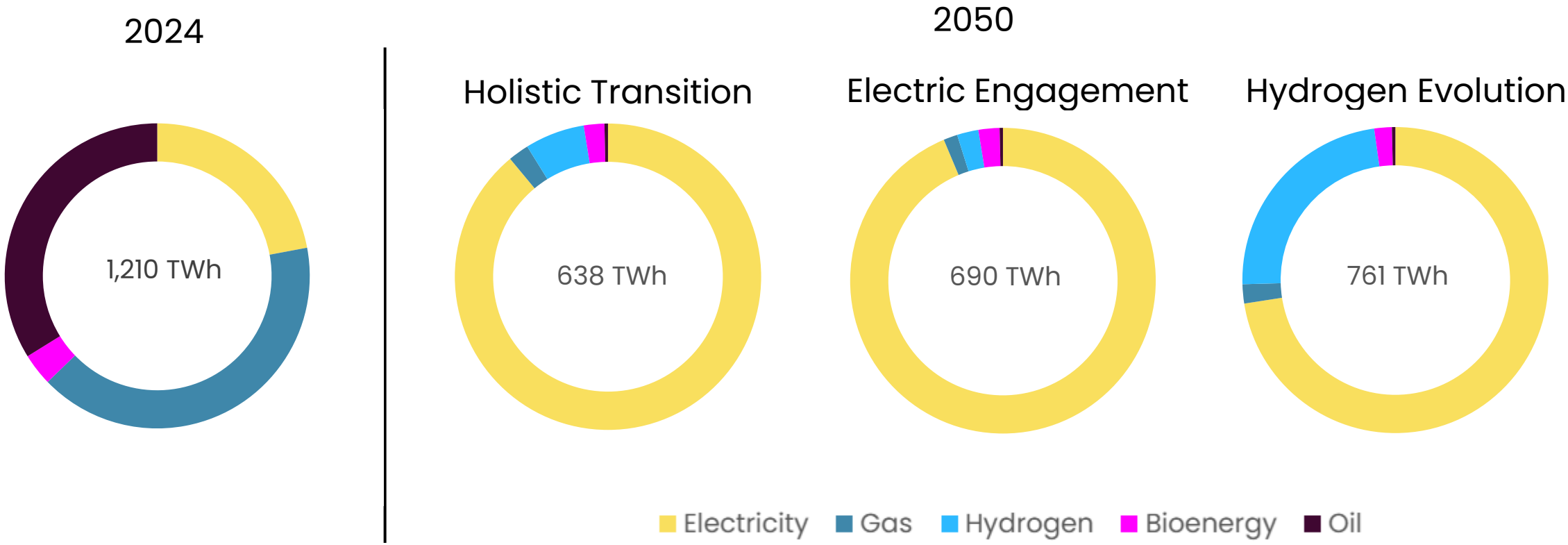
Vehicle to Grid has **41 GW potential** capacity at peak

Consumer trust and **technical readiness** are critical to the success of smart energy technologies



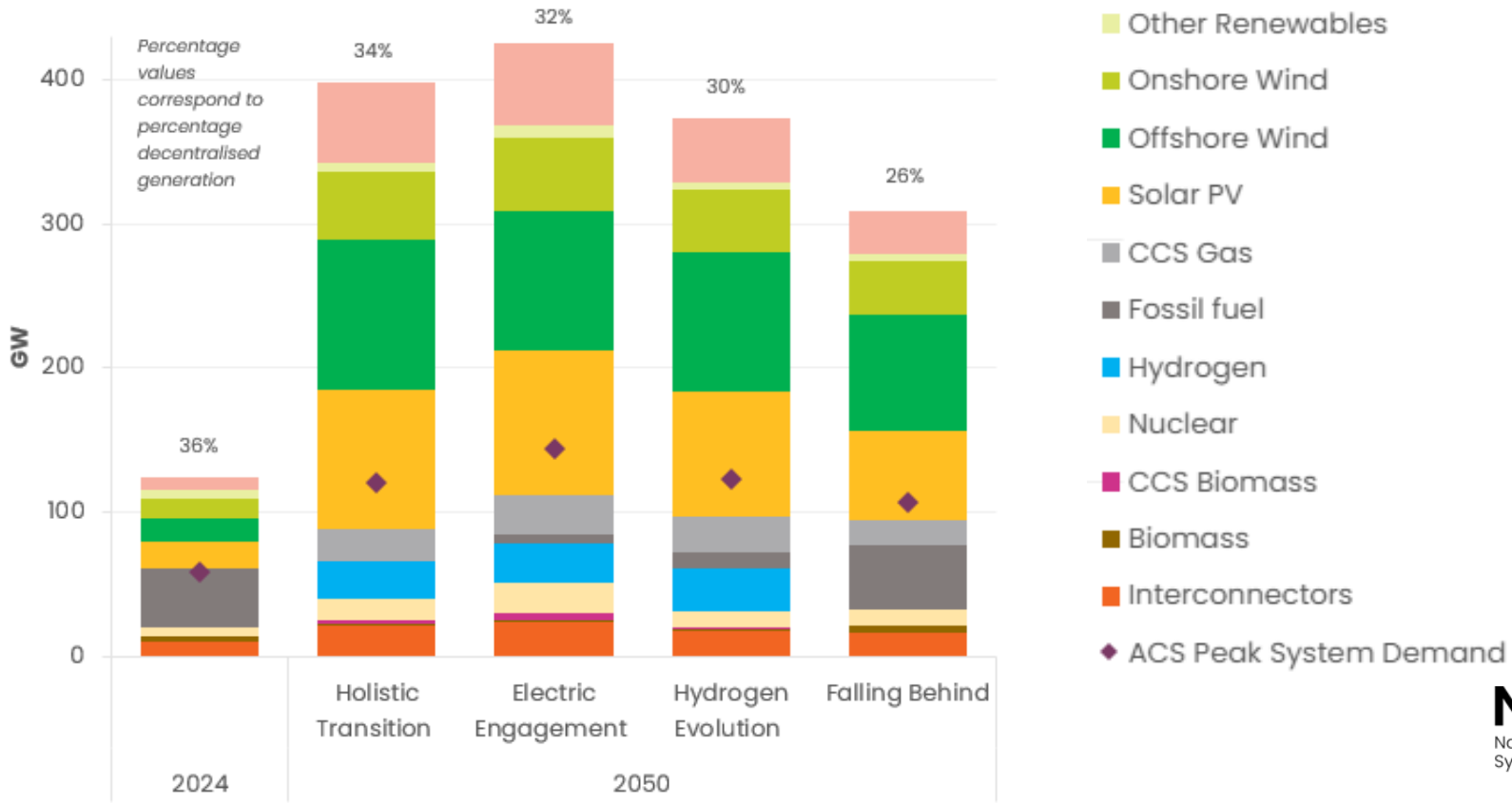
Fuel switching plays a critical role in decarbonising 53% of today's emissions

Demand energy sources

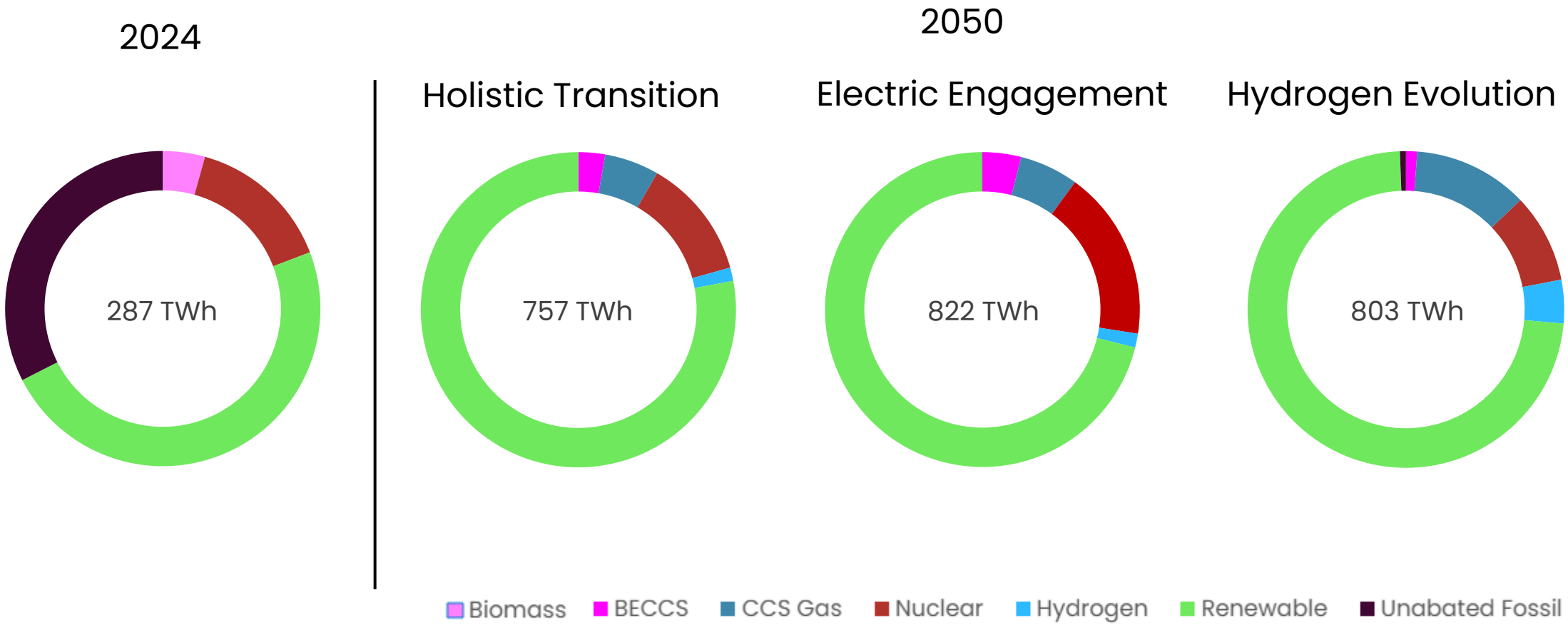


The future energy supply depends on political will, infrastructure, and policy stability

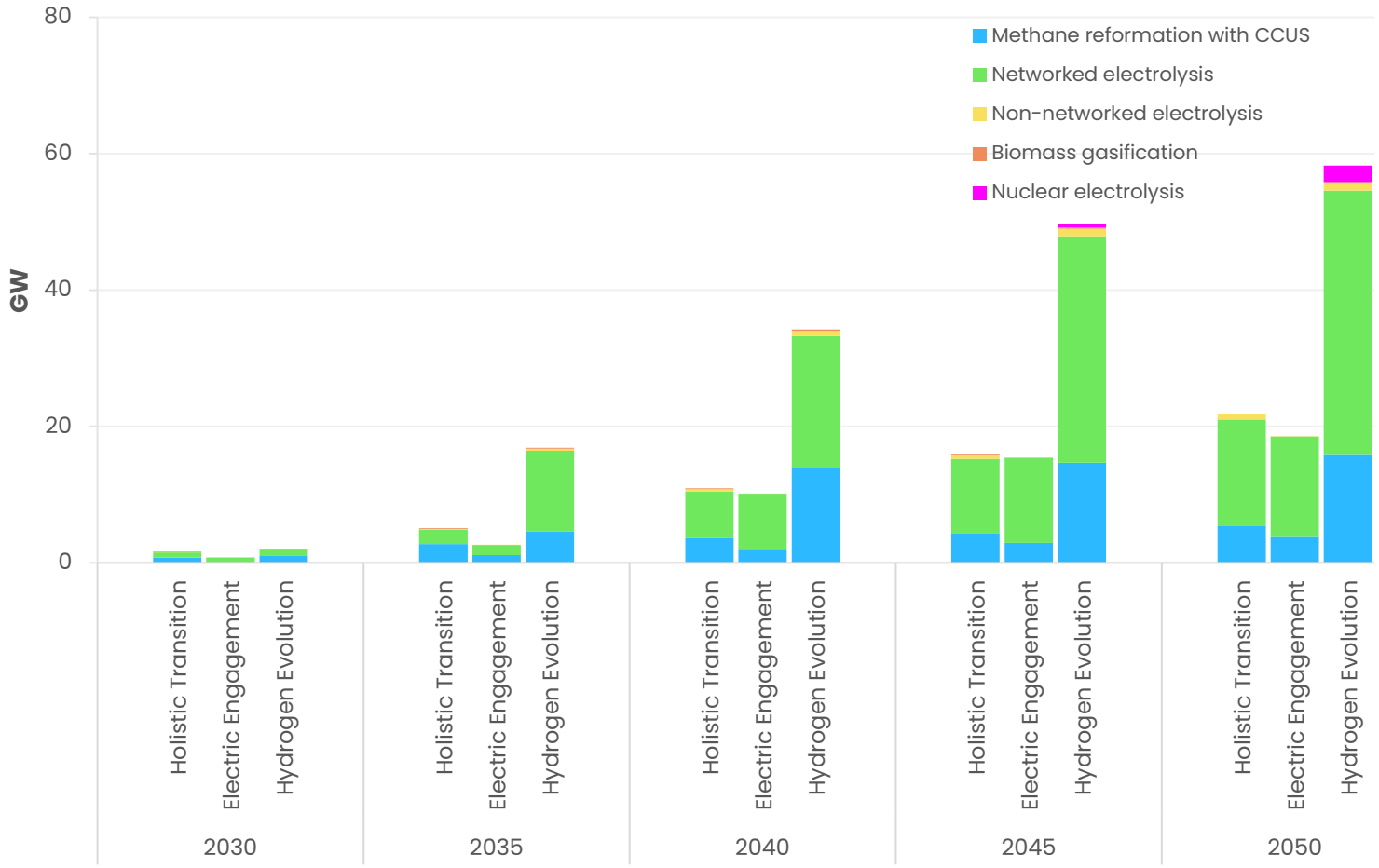
Differences in electricity supply by technology across pathways, from now until 2050

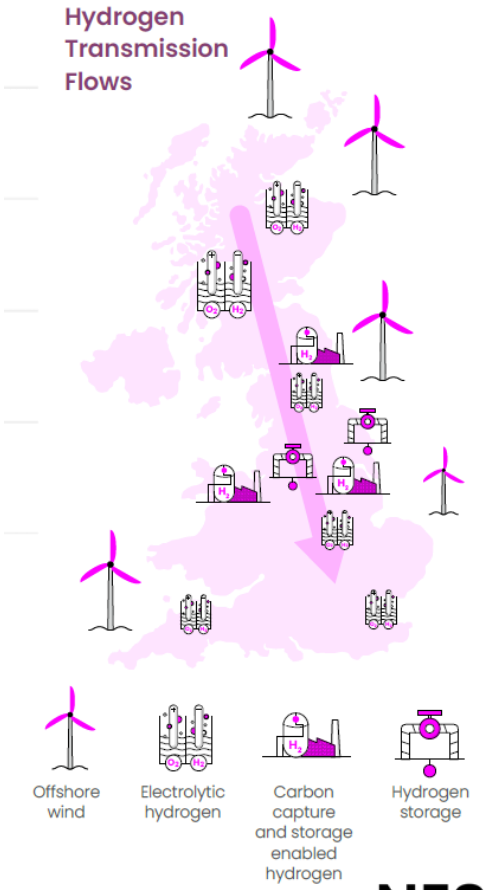


The generation mix balances trade-offs between system flexibility and decarbonisation while meeting security of supply



Electrolysis has high capacity, but as it operates flexibly, production is evenly balanced between electrolysis and methane reformation





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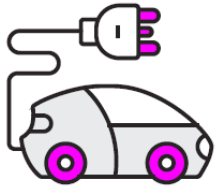
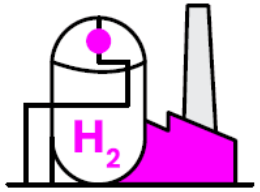
Some things are common across the net zero pathways



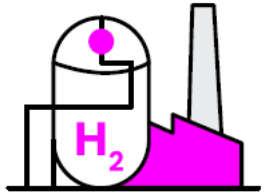
EVs make up 100% of new car sales by 2030

Low-carbon heating systems are the only option for new homes from 2027



Industry reduces unabated gas demand by at least 51% by 2035

At least 25 $MtCO_2e$ of engineered carbon removals by 2050



At least 25 TWh of low-carbon hydrogen supply by 2035

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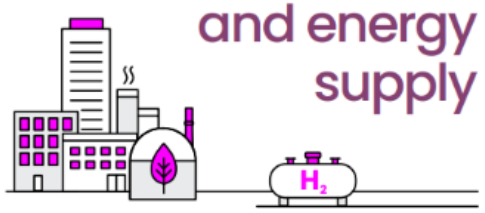
The choices we make today will shape the waves of the new energy era

> Only bold and sustained action in all sectors will unlock the benefits of an affordable and secure, clean energy system. This means matching the ambition and pace of the clean power goal, accelerating progress across the whole energy system and looking beyond 2030.

Energy efficiency

Demand Flexibility



Infrastructure and energy supply

Switching to low-carbon technologies

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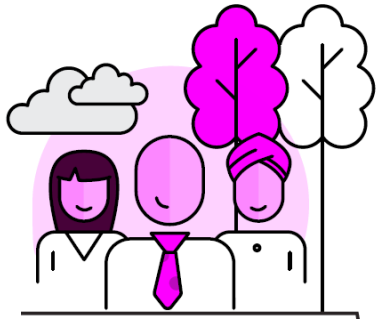
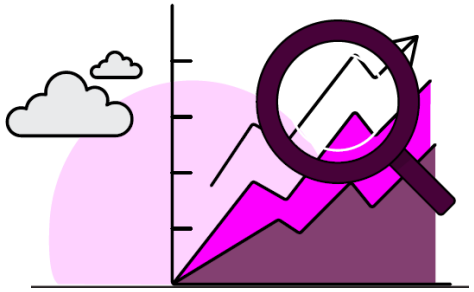
Thank you



Thank you for engaging with our FES analysis throughout the year



Find out more in

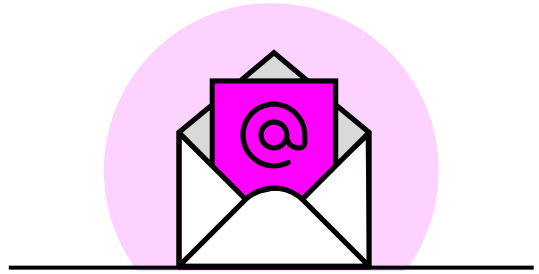
FES 2025

Data Workbook

Changes since FES 2024

Assumptions

Modelling Methods



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