2. Flexibility

12 July 2023, 2pm

ESO

Flexibility

Sli.do #flex

Agenda

2pm	Welcome:	Sian Ramirez Bower
	Key messages:	Paul Hurlock
	Key insights & analysis:	Kelly Loukatou and Tom Laskowski
	Guest speaker:	Zohreh Mohammadi, ESO
	Guest speaker:	Dan Murrant, ESC
	Break	
	Q&A with Sli.do	
	Close	
	Virtual networking follows	

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1 Key Message
Policy and delivery

Measures to reduce uncertainty are needed to ensure the UK delivers a net zero energy system that is affordable and secure.

Net zero policy

Focus on heat

Negative emissions

2 Key Message
Consumer and digitalisation

Consumer behaviour and digitalisation are pivotal to achieving net zero but easy access to information and the right incentives are critical.

Empowering change

Digitalisation and innovation

Energy efficiency

3 Key Message
Markets and flexibility

Improved market signals and new distributed flexibility solutions are key to managing a secure, net zero energy system at lowest costs to consumer.

Distributed flexibility

Transport flexibility

Locational signals

4 Key Message
Infrastructure and whole energy system

Benefits to the whole energy system must be considered to optimise the cost of delivering net zero technology and infrastructure.

Strategic network investment

Connections reform

Location of large electricity demands

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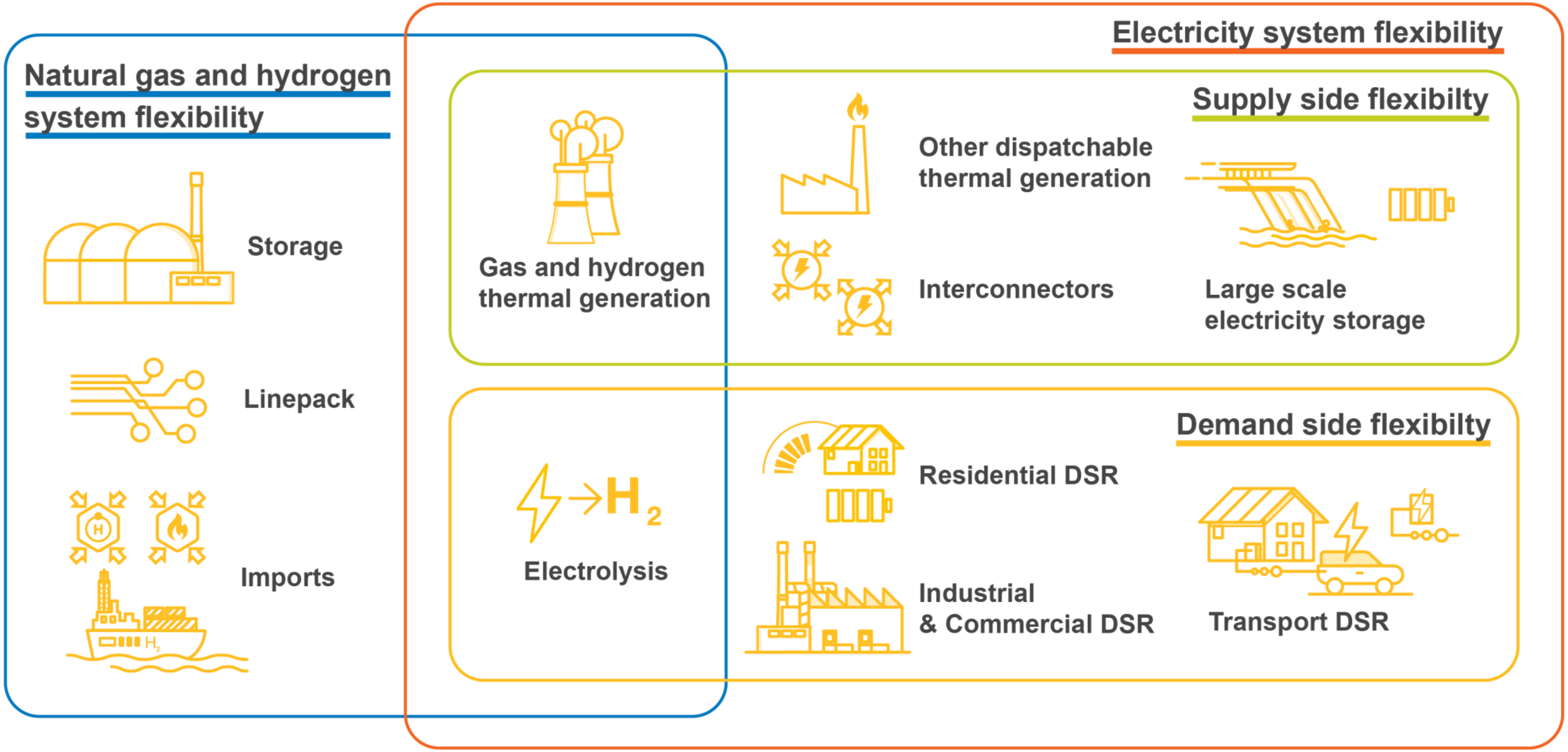
Executive summary

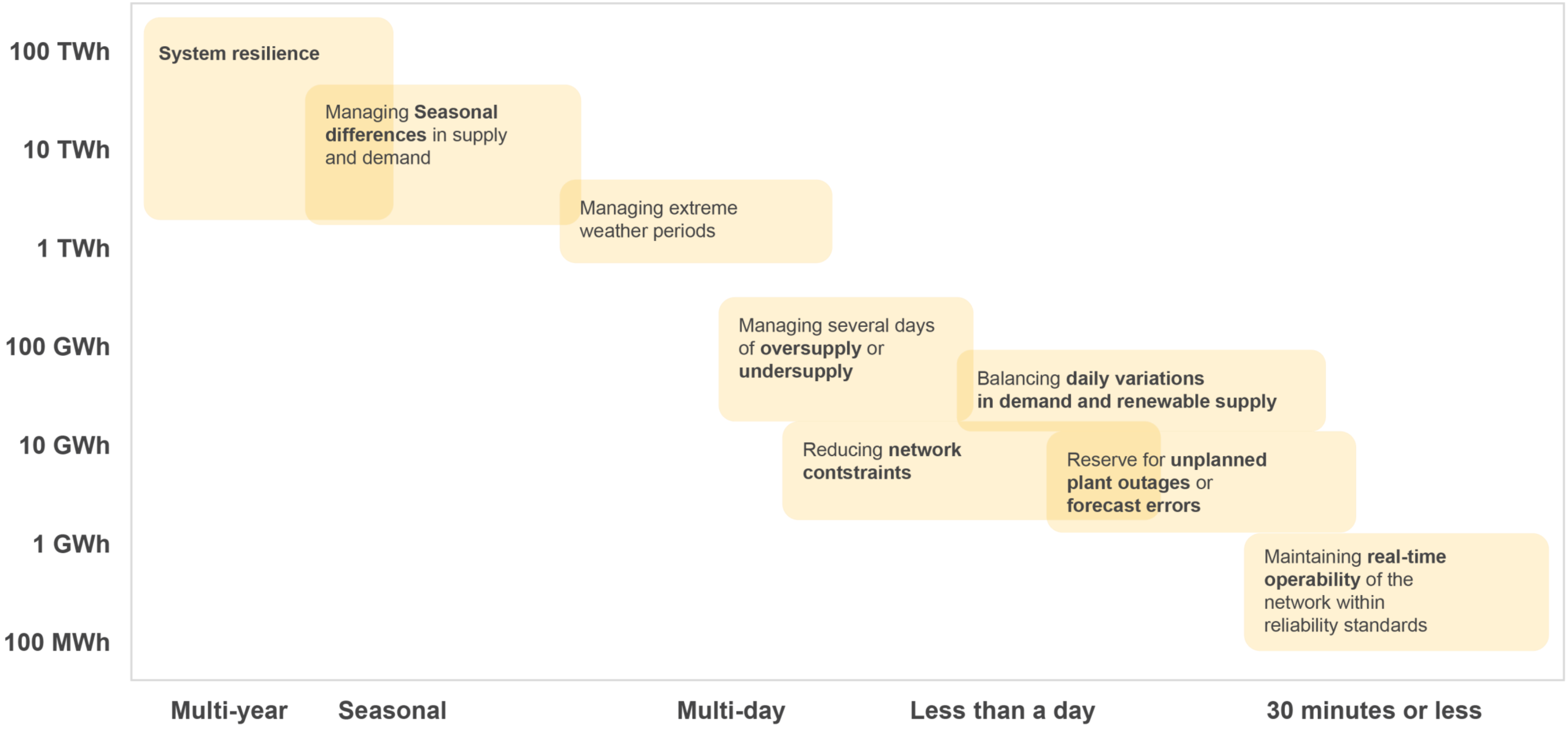
What we've found	Improved market signals and new distributed flexibility solutions are key to managing a secure, net zero energy system at lowest cost to the consumer. Delivery of the required growth in flexibility will depend on key enablers such as market reform, digitalisation and innovation.
Greatest uncertainty	Support/policy on long duration energy storage is currently limited.
No regret actions	Battery storage helping to stabilise the system, smart charging reducing peak demand, demand flexibility service showing consumer willingness to participate in the energy transition
Bottom line	Flexibility is key to managing fluctuations in supply and demand in a future energy system with high levels of renewable energy, and both the consumer and system have vital roles to play. More research is needed on extreme weather periods.

Flexibility options are needed across all vectors towards net zero



Location is important as some flexibility solutions can deliver more value in some areas than others.

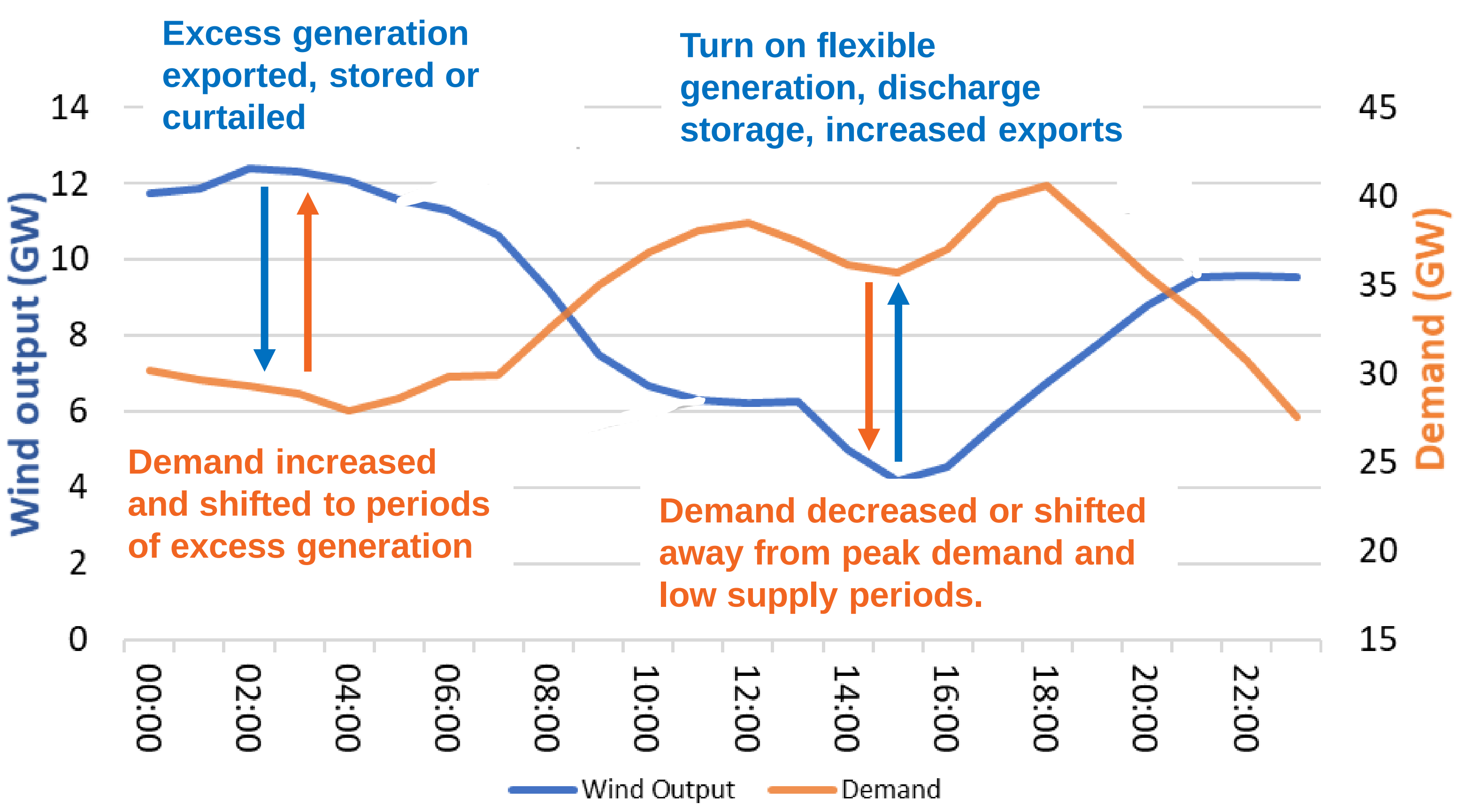
Different levels of flexibility are needed as we move to net zero



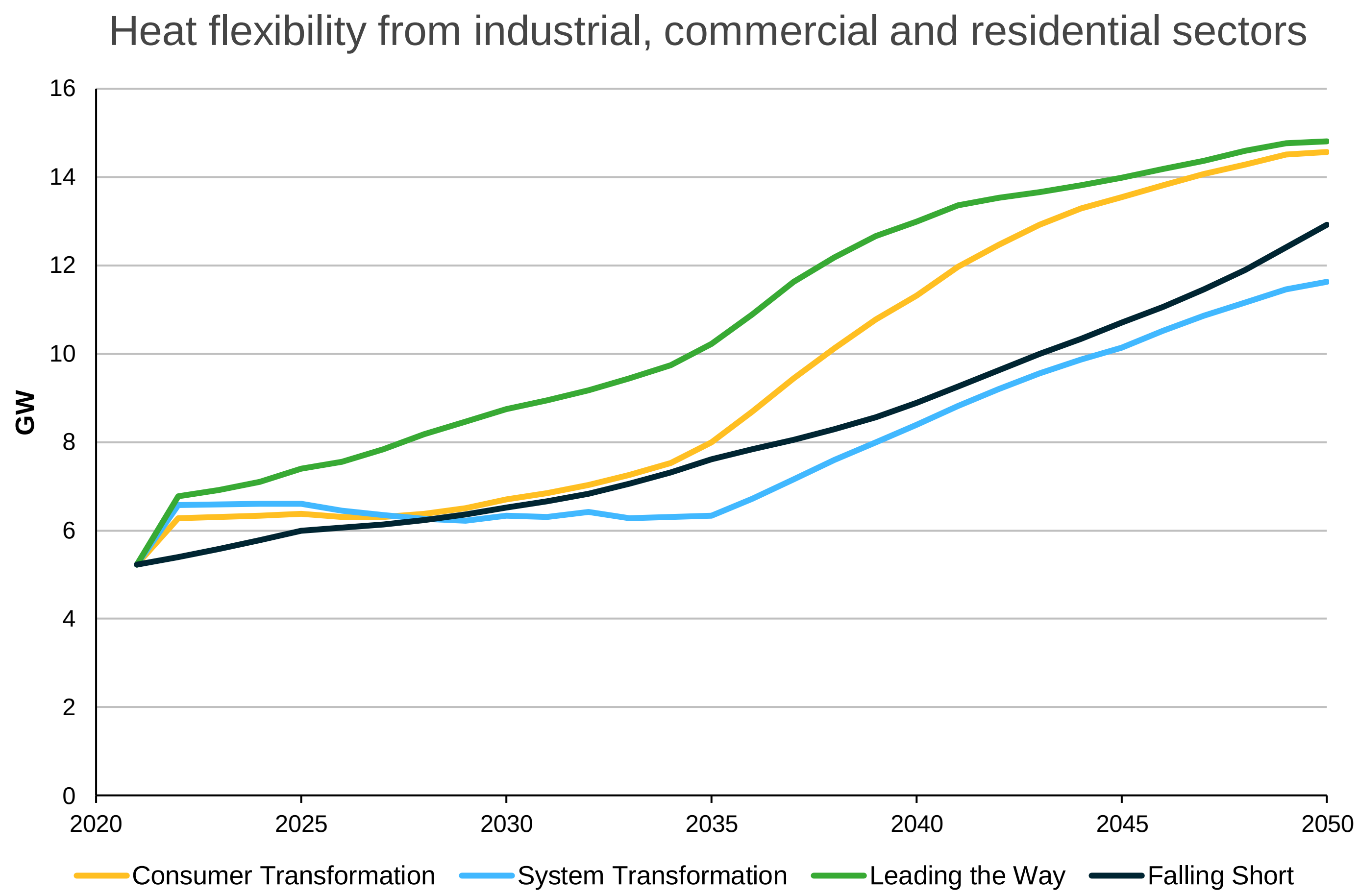
Renewable and demand patterns do not always correlate

Flexibility is needed to shift both supply and demand to ensure a balanced system.

Example day of wind generation and demand

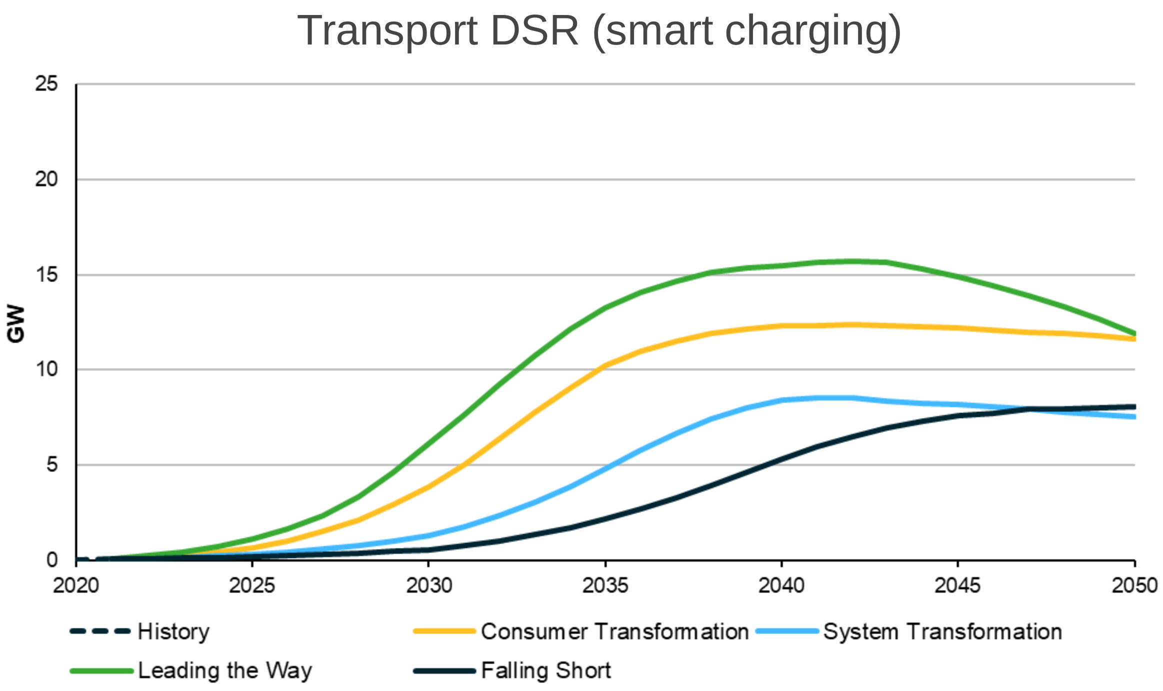


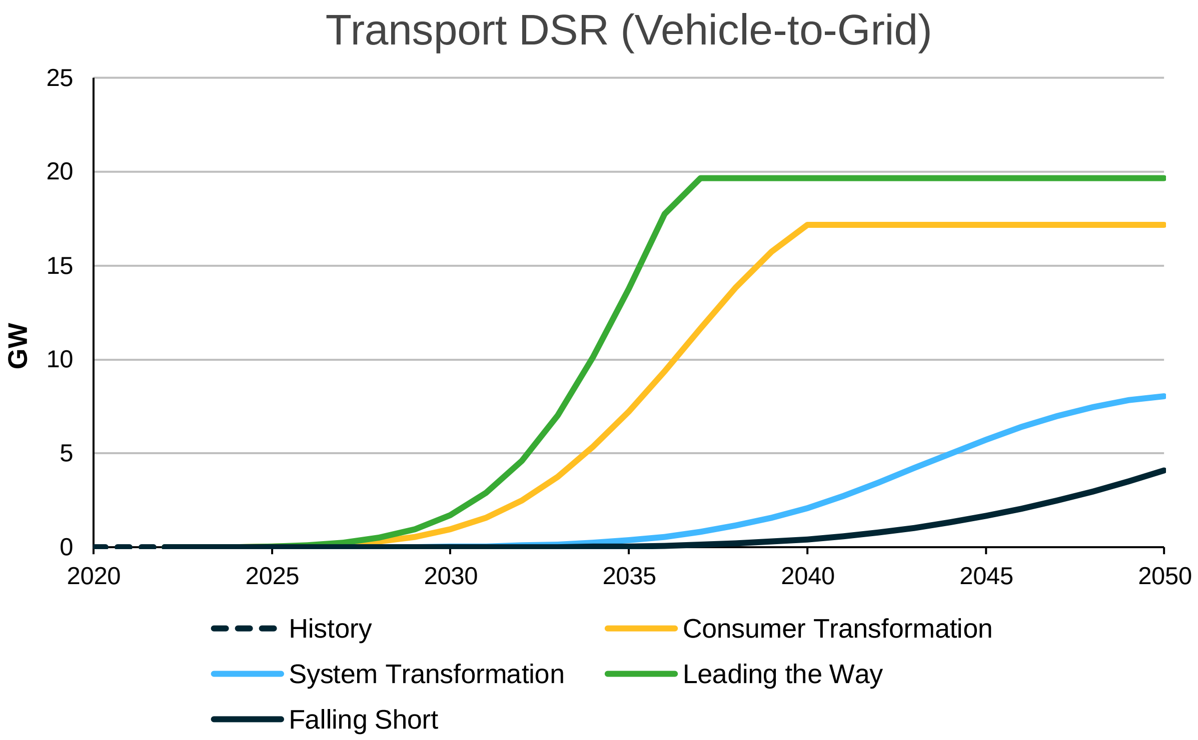
Electrifying heat enables more flexibility



- Limited heat flexibility in the short-term due to the decreasing number of storage heaters / hot water tanks
- Heat flexibility will increase alongside the number of heat pumps in the 2030s
- 10-14% peak electricity demand can be managed by heat flexibility in 2050 across our net zero scenarios
- Thermal storage essential for diurnal cycling (charge/heat up in the night, and then release heat/discharge in the afternoon)

The potential of Transport Demand Side Response at peak demand reduction



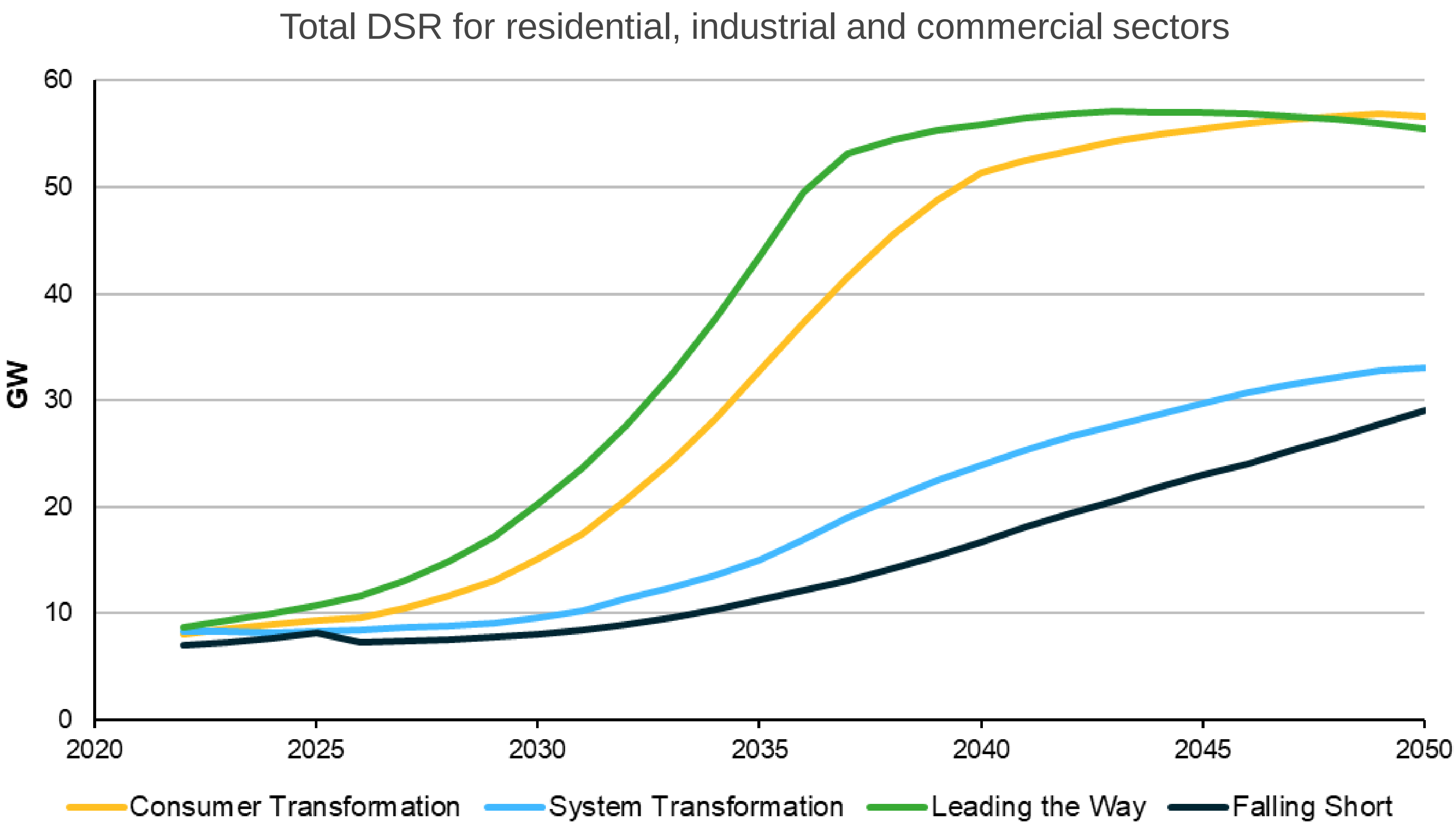


Increasing implementation of **smart EV charging** is a low regret action to help reduce the impact on peak demand and reduce curtailment of renewables.

V2G starts slow and ramps us in 2030s when the relevant barriers have been addressed.

They requires current challenges to be addressed, such as the **slow rollout of charging infrastructure**.

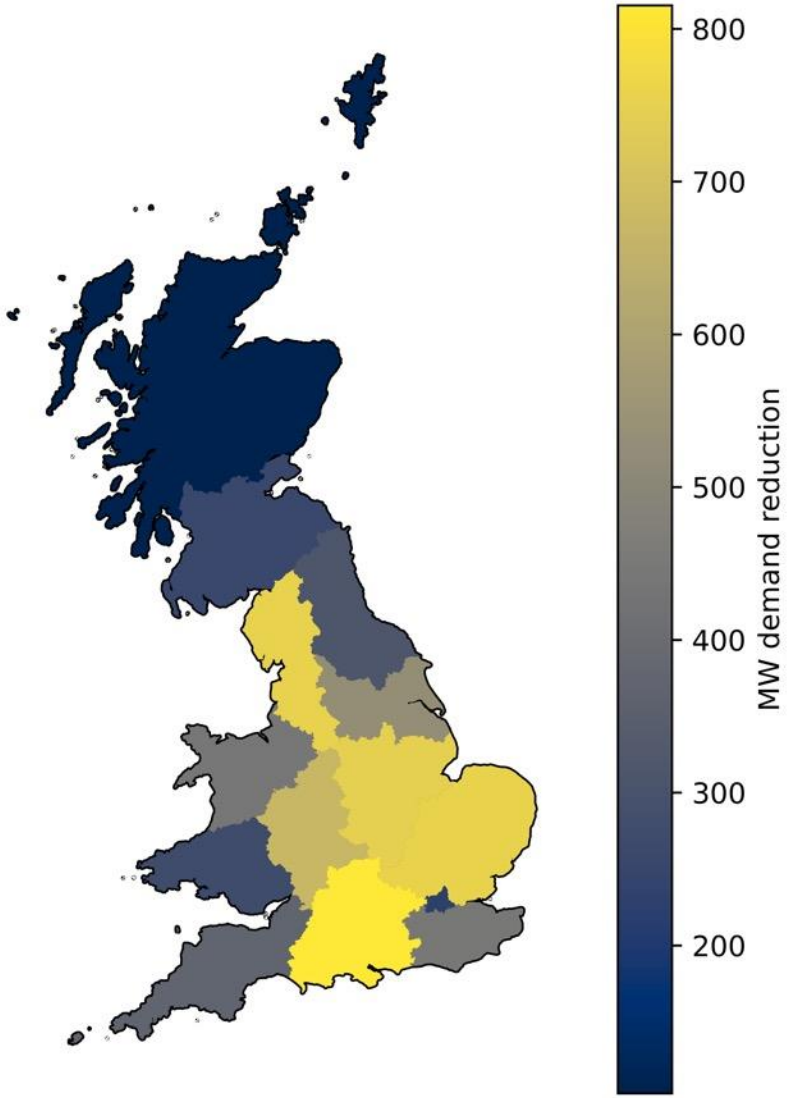
Appropriate market signals and technology advancement needed to ensure effective DSR in the future



Regional demand flexibility service insights

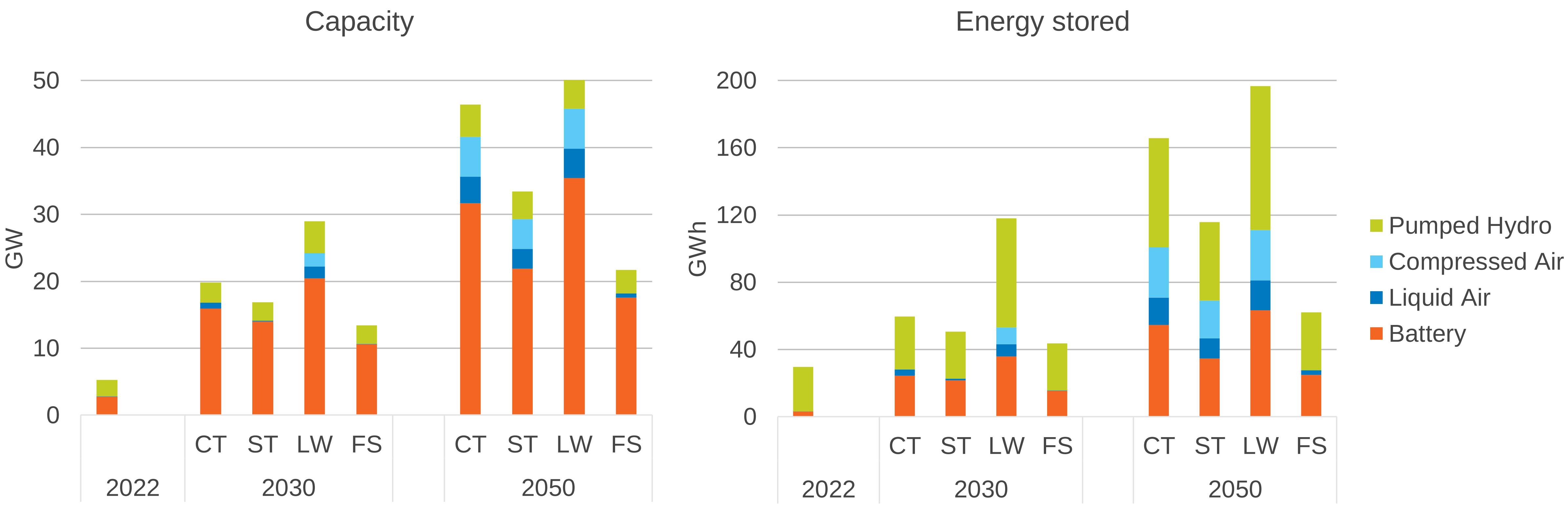
- Consumers and businesses in Wales delivered nearly 350MWh of demand reduction (1.6 million)

- Consumers and businesses in Southern England delivered the highest levels of demand reduction, with over 410MWh reduction across the 22 DFS events held this winter



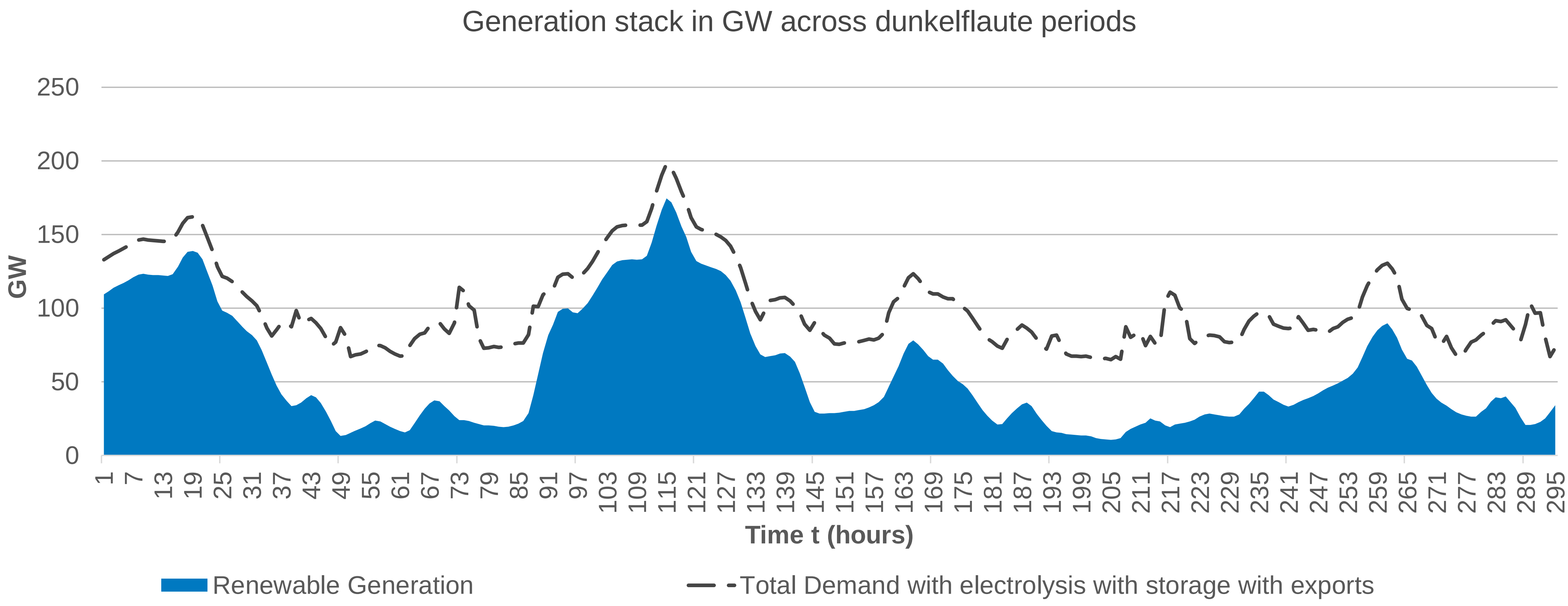
Note: low participation from a region does not imply lower consumer engagement but it also reflects that, whilst DFS was available nationally, not all customers were able to take part through their energy supplier.

Minimum of 30 GW of storage by 2050 in our net zero scenarios – 35% located in Scotland

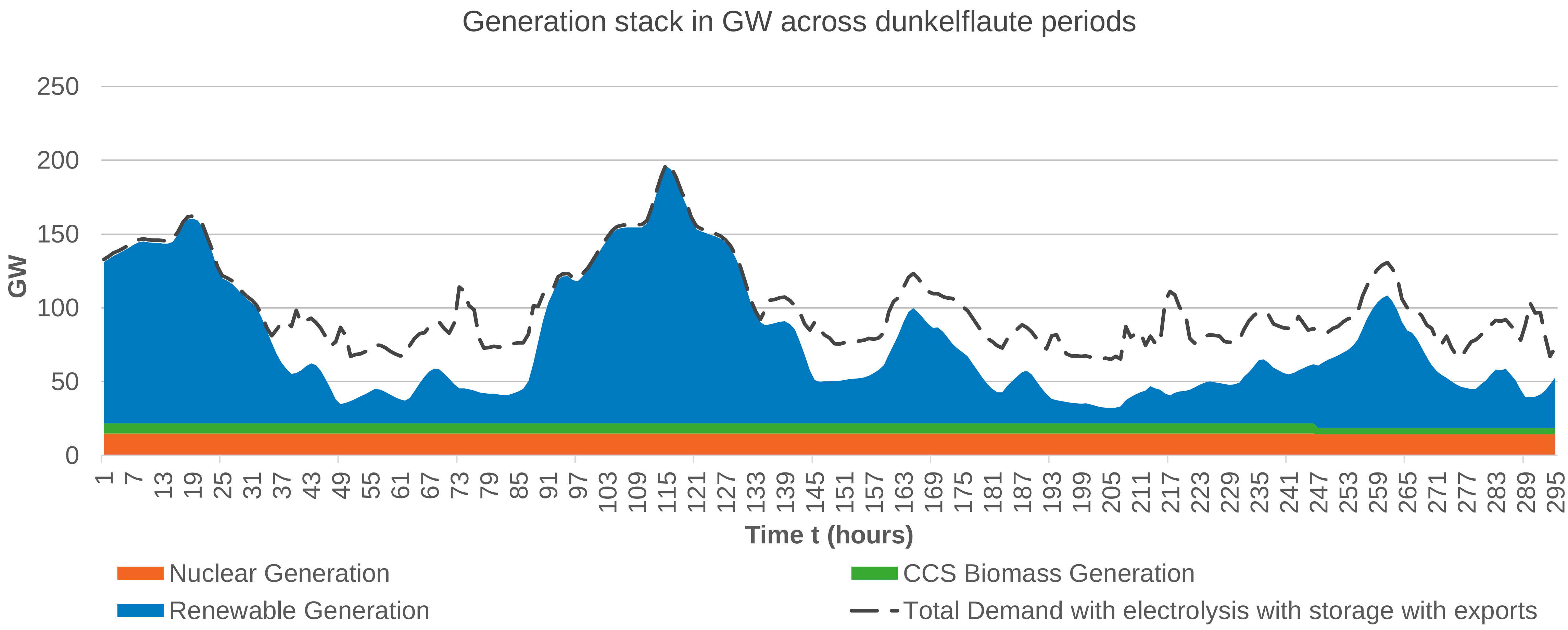


Short-term drivers: new battery storage projects winning contracts in the capacity market
Longer-term drivers: prolonged periods of low renewable output

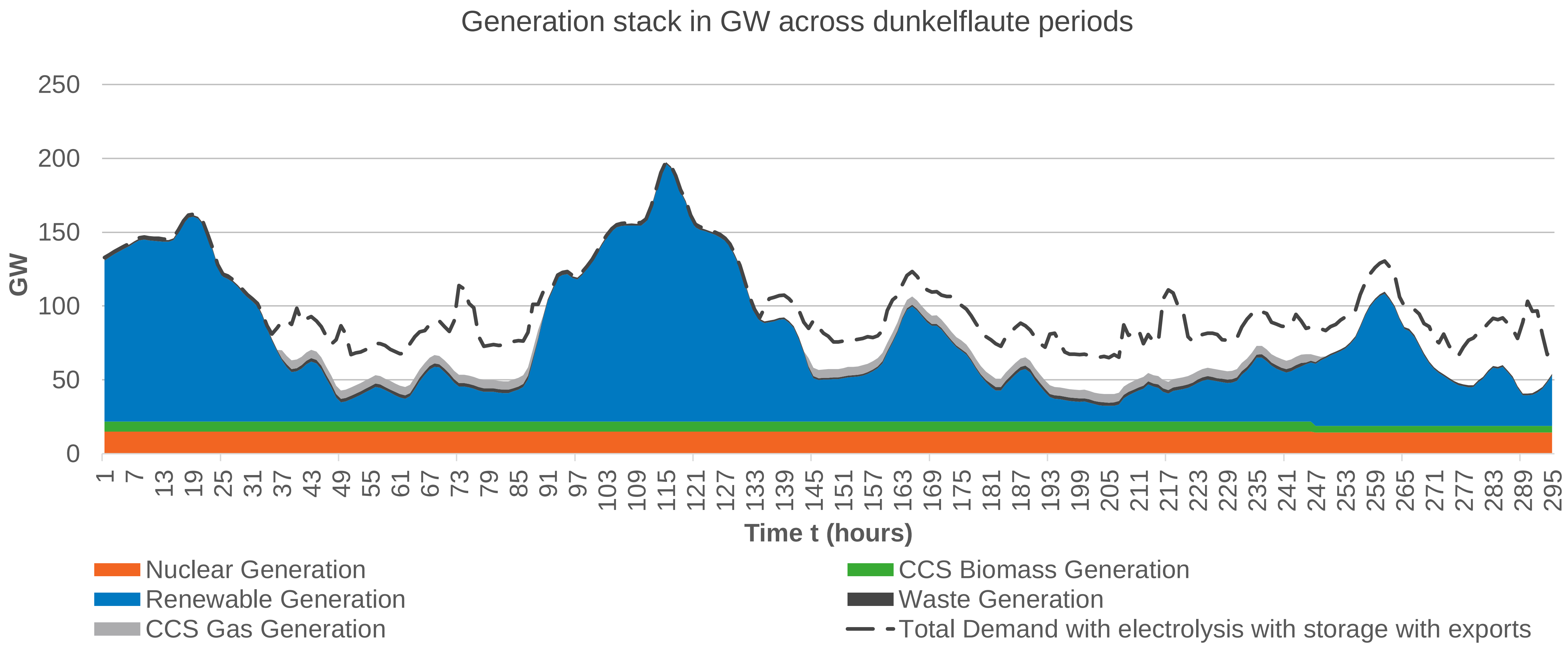
Renewable sources drop to the lowest point of 14 GW



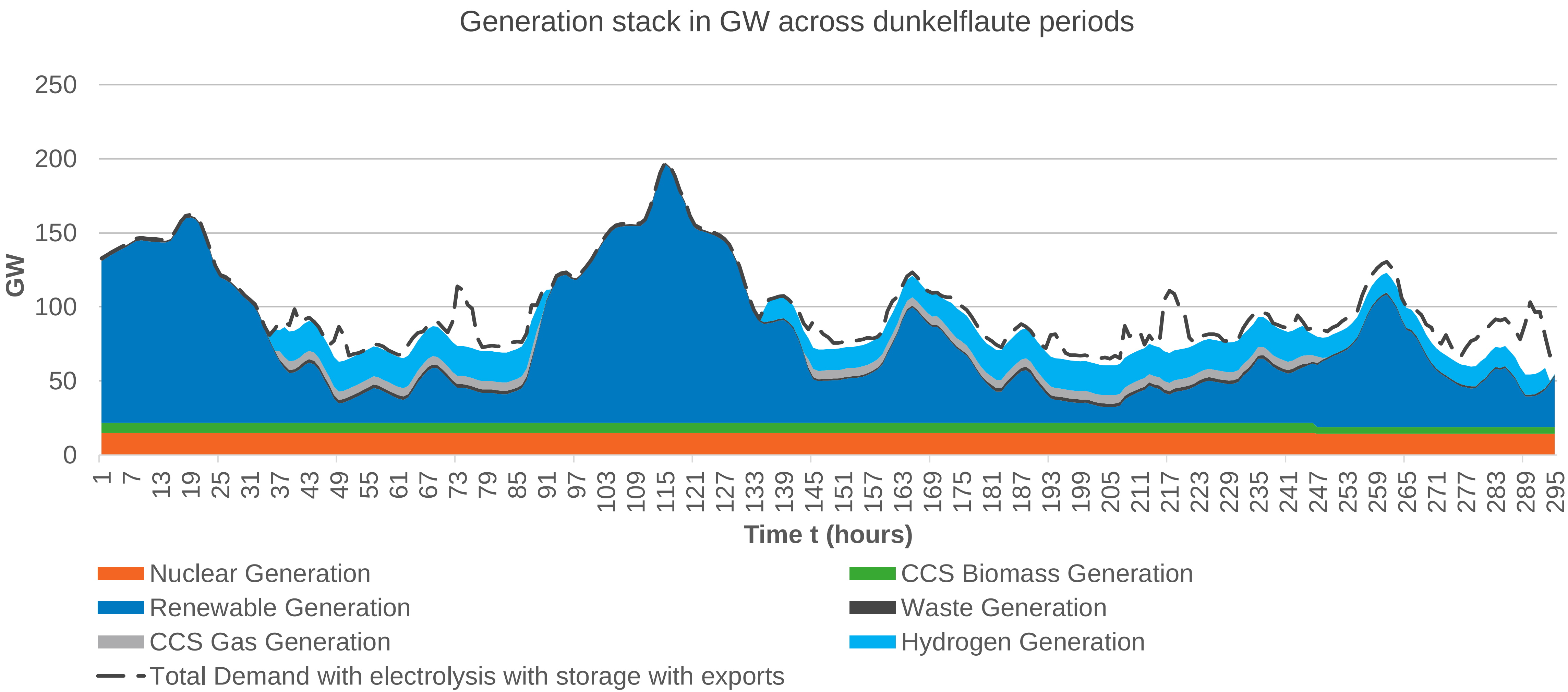
Baseload starts first to cover part of the demand



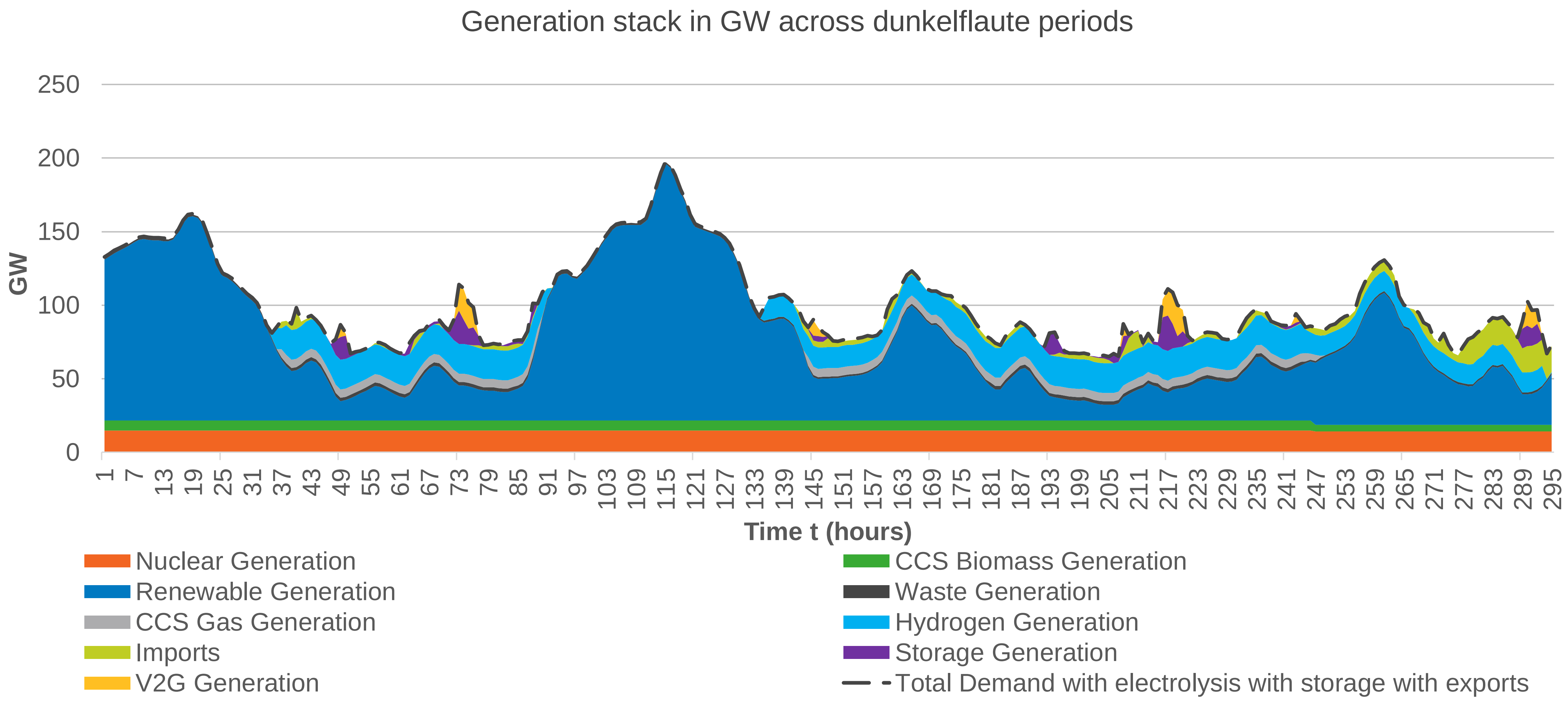
Dispatchable generation is a small percent of the total generation stack



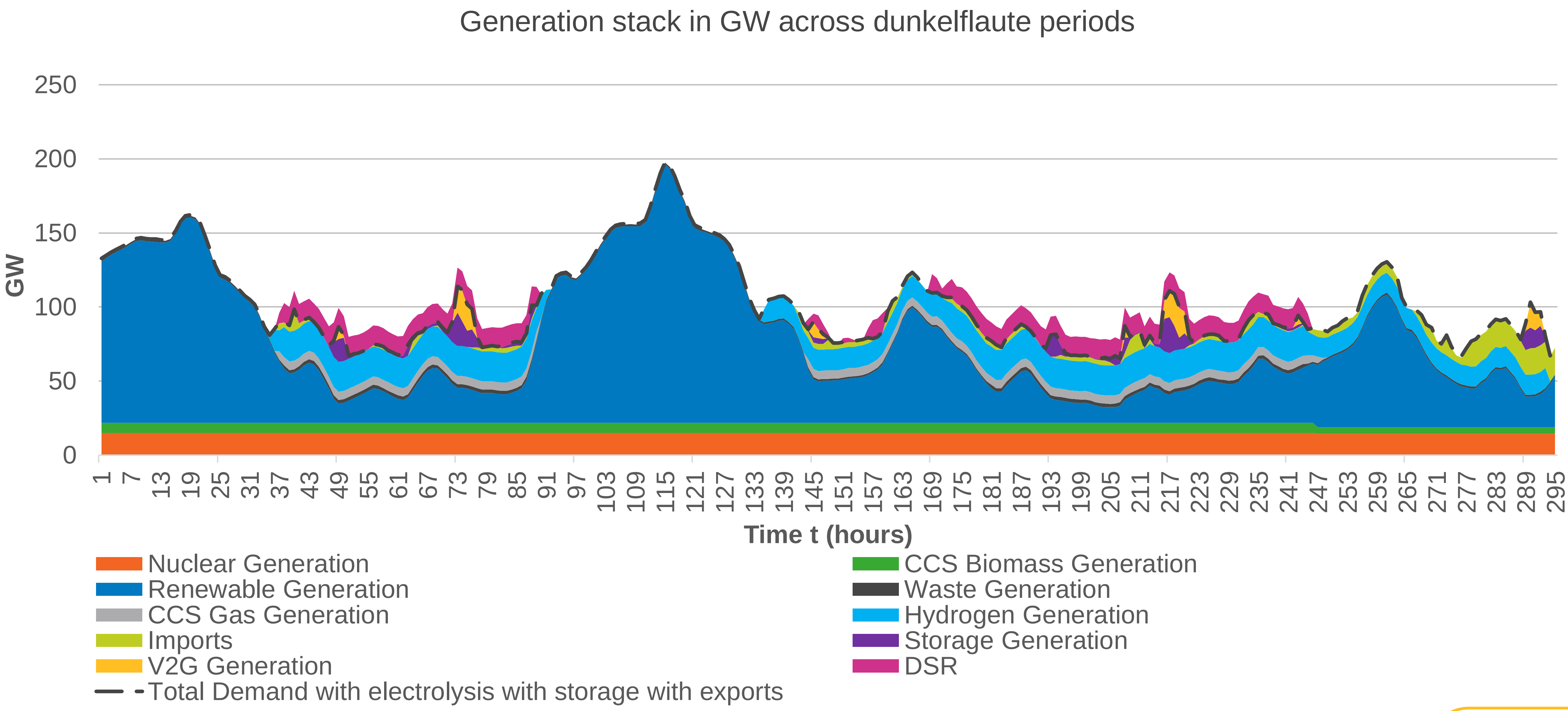
Hydrogen contributes significantly towards the extreme weather period



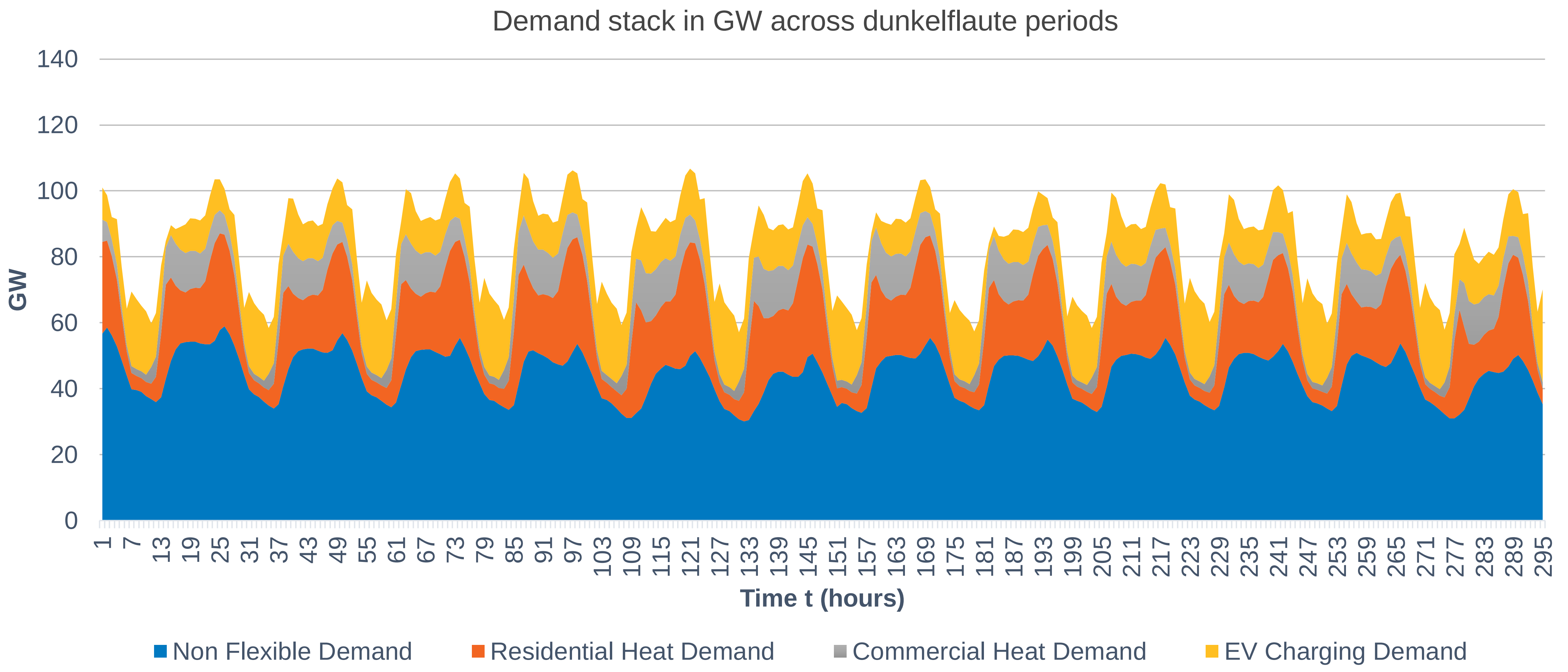
V2G and electricity storage cover the last part of the demand



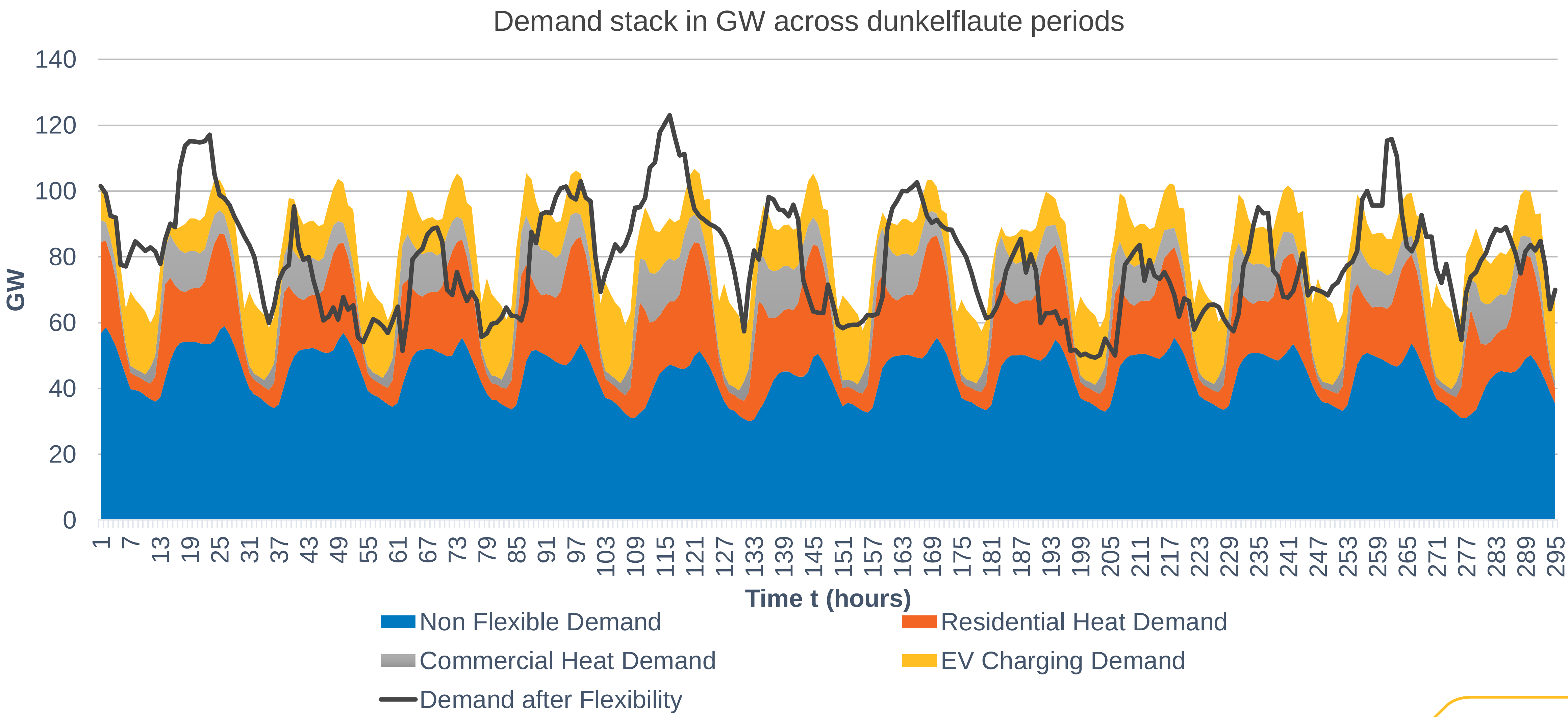
Demand reduction can help with the low renewable output period



Demand profile is periodic under normal conditions



Demand responds under extreme weather conditions



Main Takeaways

Flexibility is key to managing fluctuations in supply and demand in a future energy system

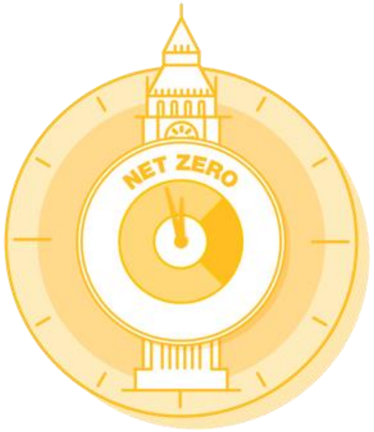
Both consumers and the system have vital roles to play

Market reform and locational signals important to further enable flexibility

Long duration energy storage contributes significantly under extreme weather conditions, as well as demand reduction

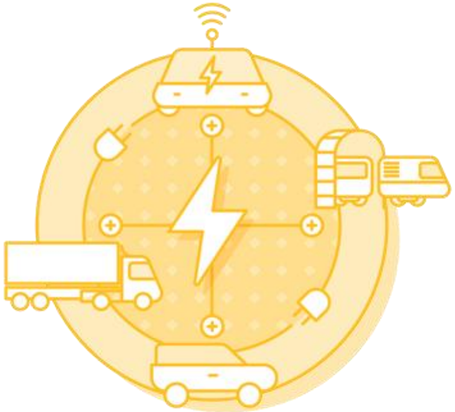
More research needed on consumer and system behaviours under extreme weather periods

What is needed over the next year?



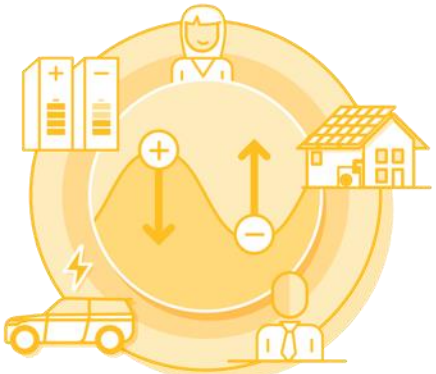
Net zero policy

Policy towards long-duration energy storage



Transport flexibility

Quicker charging infrastructure rollout, commercial trials of V2G



Distributed flexibility

Market reform to further enable flexibility

Location of large electricity demands

Coherent strategy required to provide most value where these are located

Empowering change

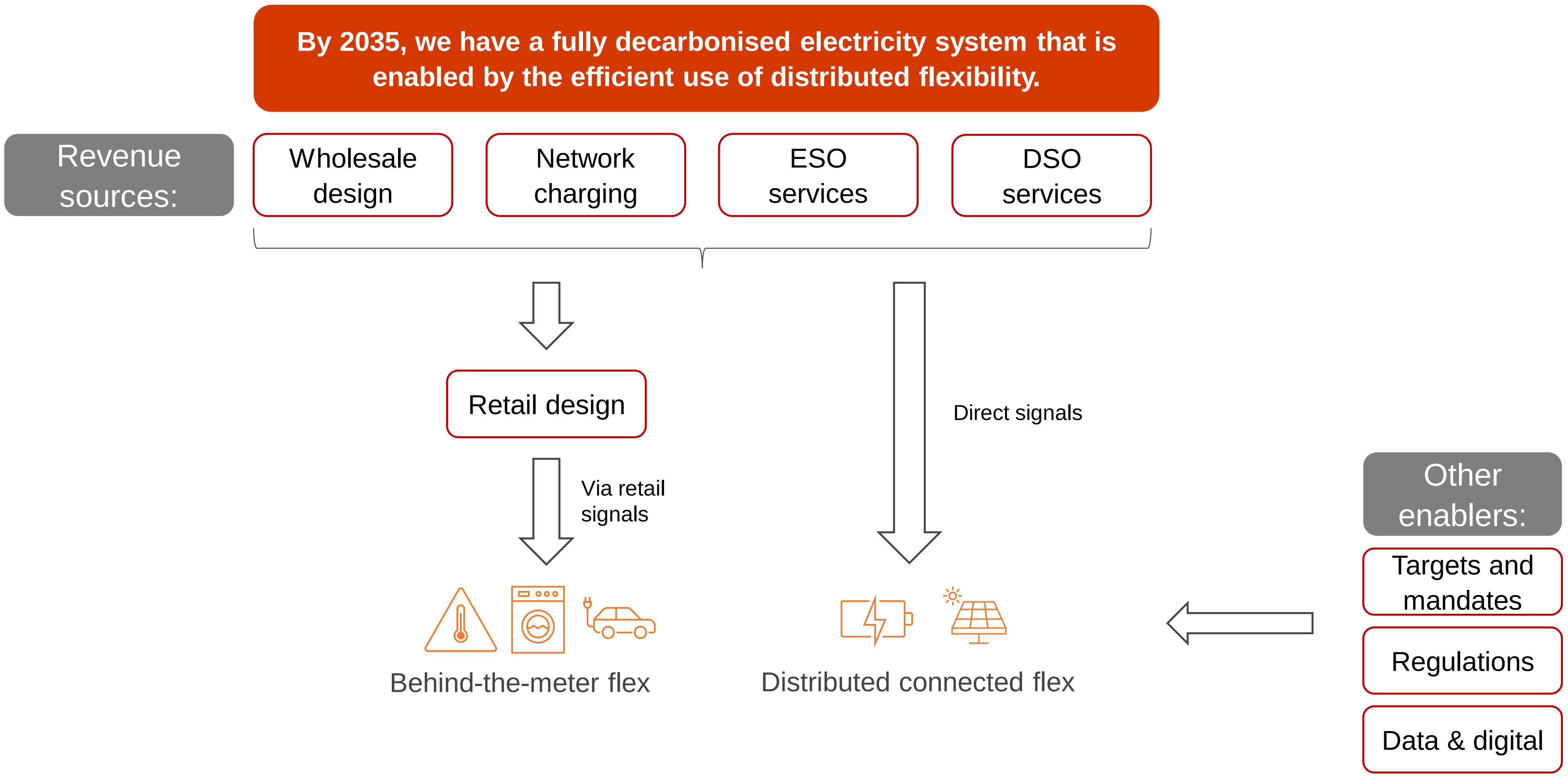
Consumer engagement towards demand flexibility management, half-hourly settlement required

Dr Zohreh Mohammadi

Markets, National Grid ESO

Strategy Lead

Distributed Flexibility landscape



What can we do to facilitate distributed flexibility

By 2035, we have a fully decarbonised electricity system that is enabled by the efficient use of distributed flexibility.

Revenue sources:

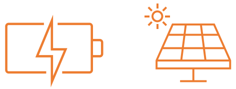
- Wholesale design
- Network charging
- ESO services
- DSO services

Retail design

Via retail signals

Direct signals

Behind-the-meter flex



Distributed connected flex

Other enablers:

- Targets and mandates
- Regulations
- Data & digital

1. Develop a strategic plan to reform **ESO services** so they are inclusive of distributed flexibility.

2. Support **DSO services** development so they contribute to the investment case of distributed flexibility.

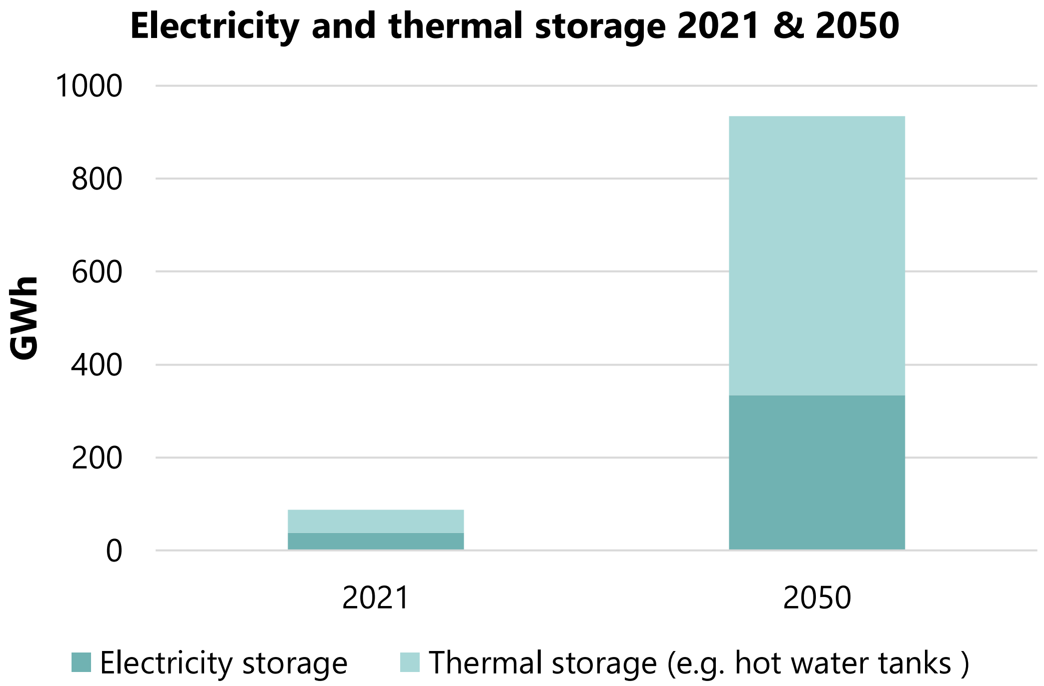
3. Drive alignment across wider **markets** and **enablers** to deliver a stable and coherent market environment.

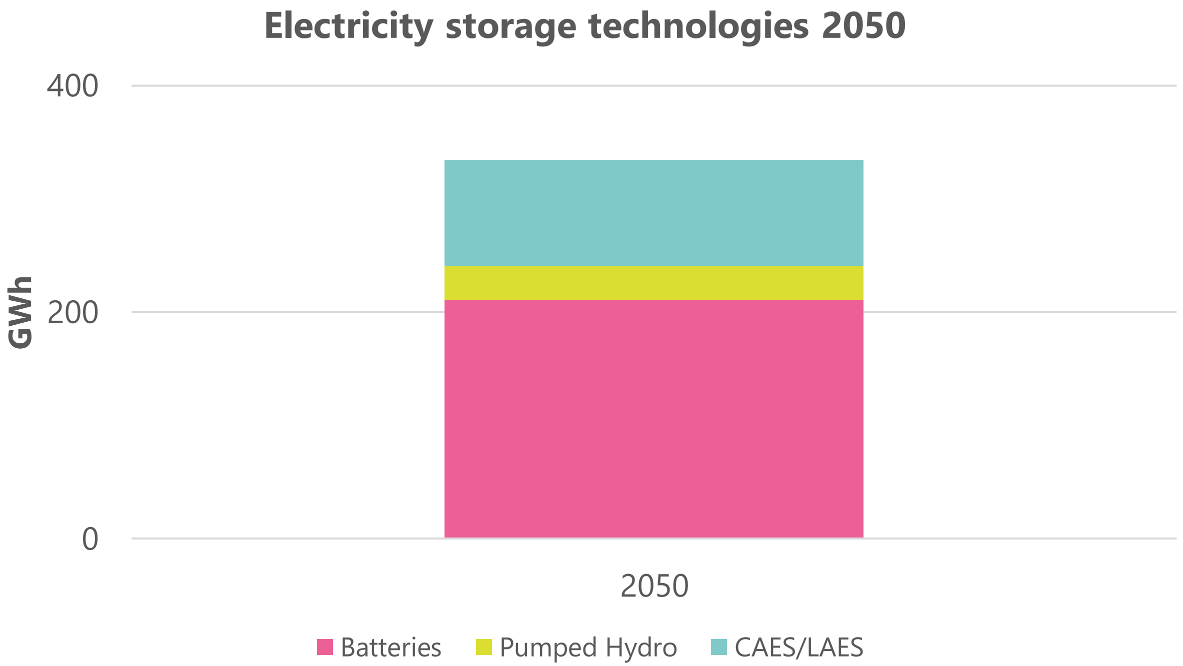
Dr Dan Murrant

Energy System Catapult

Networks and Energy Storage Practice Manager

The future energy system will require an enormous increase in non-gaseous storage and flexibility





Illustrative results for one scenario only - from ESC's ESME modeling suite

Note: Non-gaseous energy storage in current system is mainly made up of electricity storage (pumped hydro storage (~26GWh) and batteries (~2GWh), and thermal storage (largely hot water tanks but in the future could include other technologies such as phase change materials.) By 2050 there will likely be a requirement for additional electricity storage, potentially met by technologies such as **compressed air energy storage** and **liquid air energy storage.**

Today, the vast majority of flexibility in the UK energy system is provided by gas with ~17TWh of natural gas storage.

Increased electrification and renewables, plus reduction in nat.gas means new sources of flexibility are needed.

Multiple flexibility solutions over multiple vectors will be needed to meet the needs of the future system

Typical Duration	Role	Vectors	Example technologies
Up to 4 hrs	Within day balancing of renewables, peak reduction, fast demand response, reserve (managing contingency events)	Electricity	Batteries, flywheels, supercapacitors, gravitational storage
Up to 4 hrs	Peak shifting	Heat	Thermal storage including: sensible thermal storage (i.e. hot water tanks), phase change materials and thermochemical storage.
Hours/ within day	Peak shifting	Electricity/DSR	EV smart charging
Up to 24 hrs	Within day balancing of renewables, inter day balancing of renewables, peak reduction reserve	Electricity	Pumped hydro storage, Compressed air energy storage, Liquid air energy storage, redox flow batteries
Seasonal	Meeting seasonal peak demands, energy security	Gas	Hydrogen (*storage facility + H2 turbine/ fuel cell, boiler)*

Many technologies can provide a combination of these roles but **no single solution can efficiently meet them all**. This means there is no "one-size fits all" solution to flexibility in the energy system. Many of these options represent "**distributed flexibility**", i.e. flexibility below the transmission level.

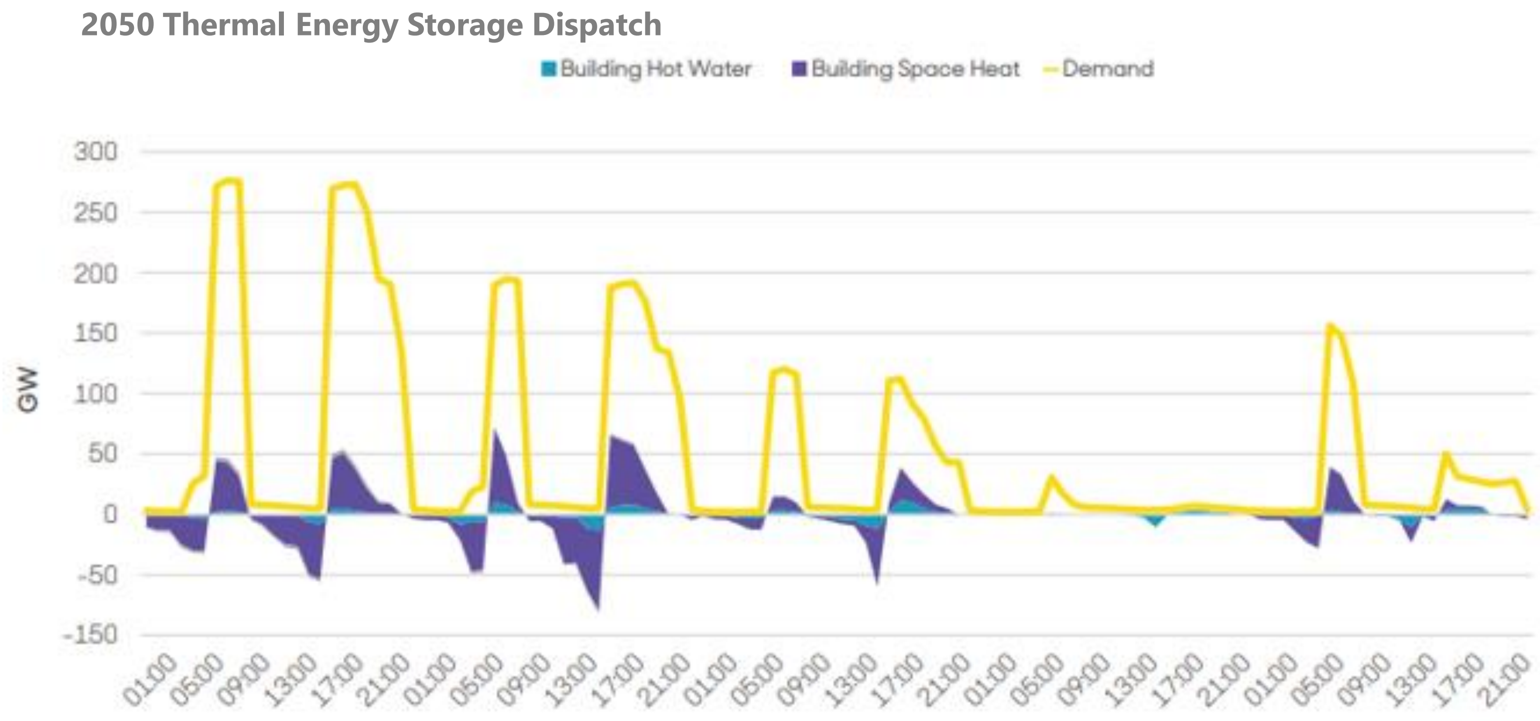
Distributed Flex example 1 - EV smart charging

Smart charging vs no smart charging 2035

Scenario exploring smart charging found introduction of smart charging sees a 7% decrease in whole system peak demand in 2035.

Illustrative results for one scenario only – Results FOR 2035 from ESC's ESME Transport analytical framework.

Distributed Flex example 2 - Smart heating via thermal storage



By 2050, modelling suggests thermal storage is used extensively when demand is high, to reduce peak electricity demand on the system.

This helps to reduce generation capacity needed to meet total system demand.

Illustrative Results only - from ESC's ESME Flex modelling, published in: *Good Energy, Renewable Nation report*

Thank you for joining us today

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