

Haldane Energy

Hydrogen-Derived Long Duration Electricity Storage (H₂-LDES)

Lawson Steele, CEO



Haldane Energy: overview

Haldane Energy is redefining energy storage to help deliver the secure, resilient and decarbonised energy system the UK needs.

Using established technologies, it's developing a portfolio of hydrogen-derived long duration electricity storage (H₂-LDES) – the missing piece of the energy system puzzle.



Part of the Windward Energy Group, the UK-wide next generation power business with a solution-focussed portfolio spanning renewable energy generation, grid networks and long duration electricity storage. Haldane Energy's sister companies are; Bute Energy, Wales's largest onshore wind developer with a portfolio pipeline of over 3GW and Green Gen Cymru, an Ofgem licensed independent distribution network operator (IDNO) that is building over 300km of new grid infrastructure.

Copenhagen Infrastructure Partners (CIP) recently invested £600m to support the development of Bute Energy and Green Gen Cymru with the aim to unlock a further c.£3bn of investment to deliver its projects in Wales and create over 2,000 jobs.



Market Overview and Backdrop

The need for flexibility in the GB power system

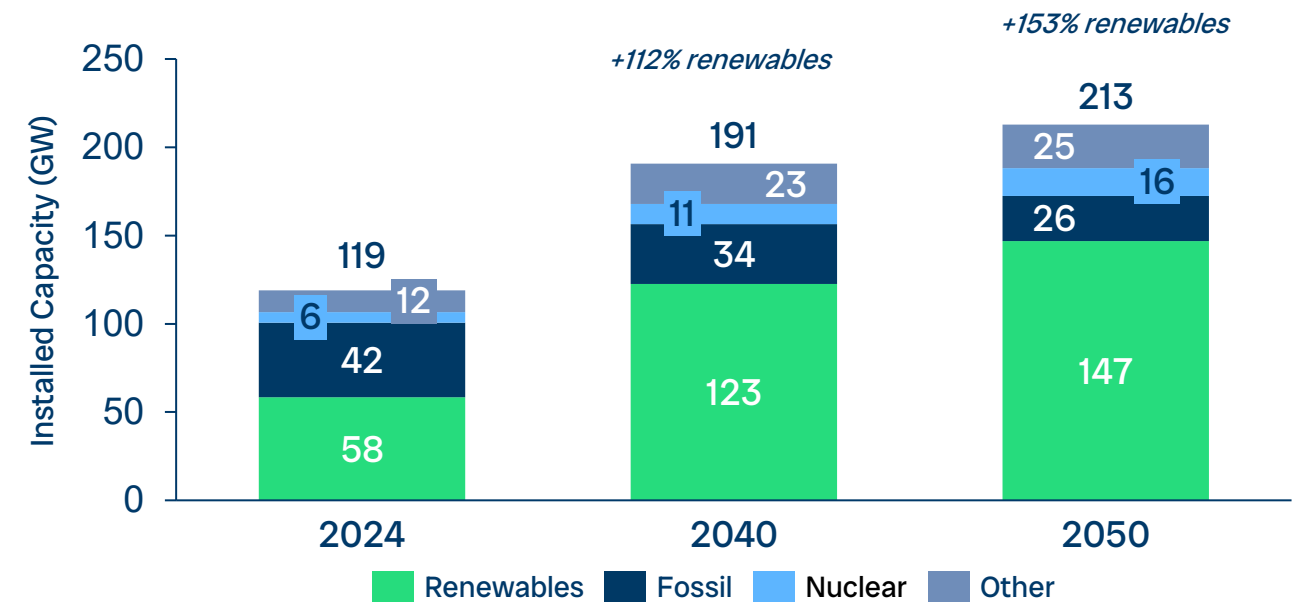
Structural Shift in the UK Power Market

- **Decarbonisation imperative:** UK committed to net zero by 2050; full power sector decarbonisation by 2035.
- **Renewable dominance:** Renewable deployment is forecasted to grow c.112%¹ by 2040, with wind and solar providing 70% of generation.
- **Bold policy targets:** Achieving Clean Power 30 targets is expected to increase the number of periods when renewable and nuclear generation exceeds demand tenfold².
- **System imbalance:** Increasing intermittency risk must be balanced by flexible solutions. It has been estimated that approximately 40 TWh of low carbon dispatchable energy is required by 2035³

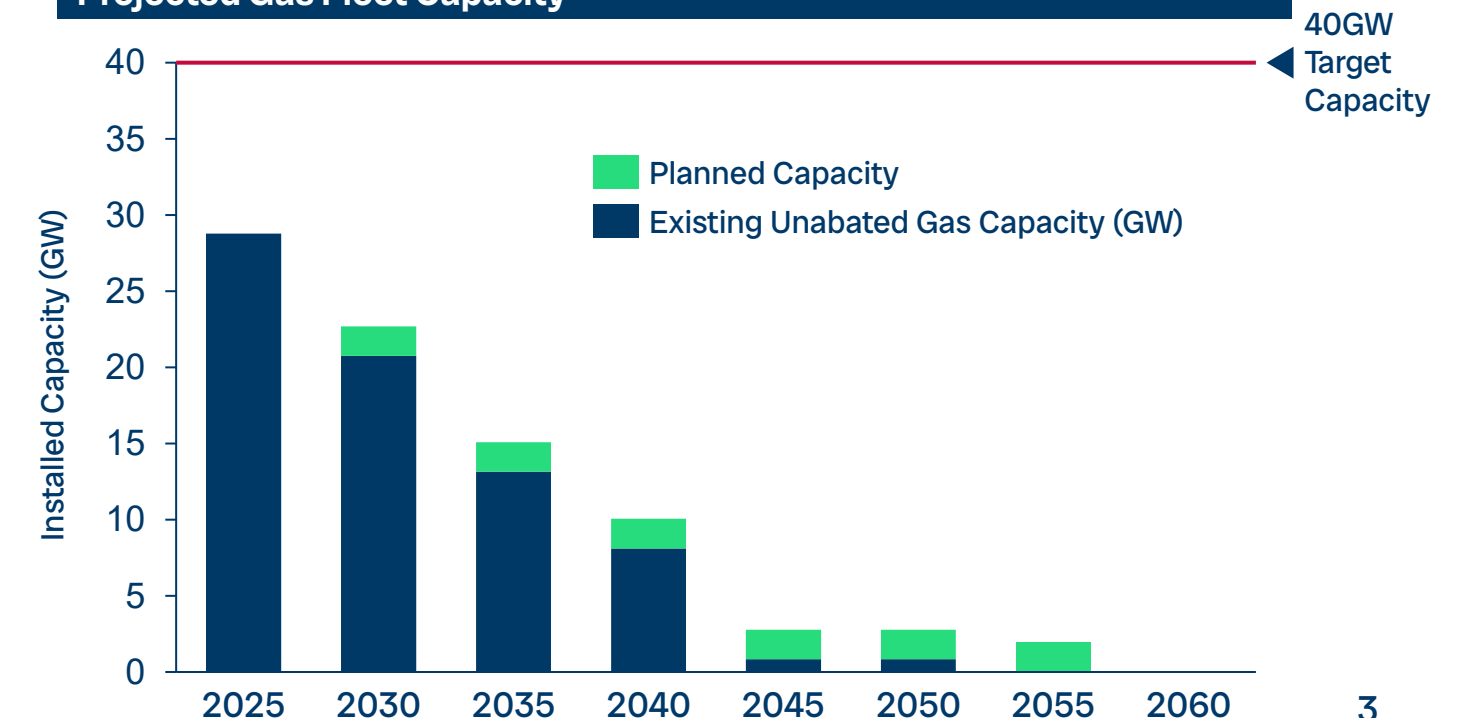
Reliance on Gas to Balance the System

- **Persistent reliance on gas:** Despite advancements in renewables, gas power stations still provided 35% (97TWh) of total electricity in 2024³.
- **Flexibility gap set to widen:** The need for flexible generation to cover periods of low renewable output is projected to reach 40GW
- **Ageing Fleet:** UK gas plants average 29 years per MW. Extending units beyond 30 years provides only a temporary solution, not a sustainable long-term strategy.

GB Electricity System Evolution¹



Projected Gas Fleet Capacity



Hydrogen-Derived Long Duration Electricity Storage (H₂-LDES)

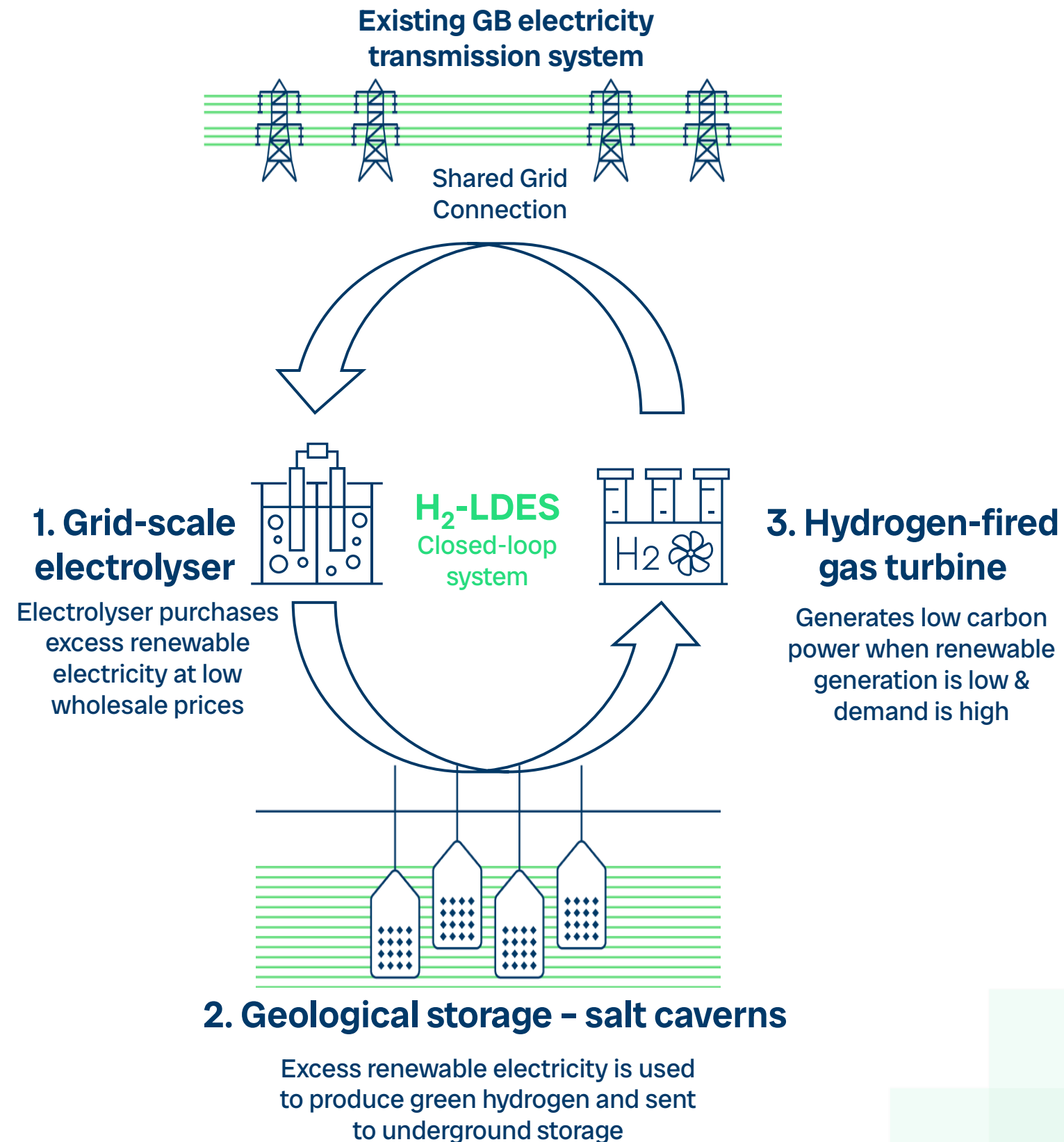
Key Facts



Long duration storage: at 19-days of continuous dispatch, H₂-LDES will have the longest duration of energy storage on the UK market.

Why Salt Caverns: can store large amounts of energy as hydrogen and release it significantly faster than gas reservoirs - delivering energy up to 12 times more quickly.

Seasonal peaks: assets charge throughout the year, reaching peak charge before the winter months – providing power in months when demand is high.



Portfolio: where and why?

Location scope



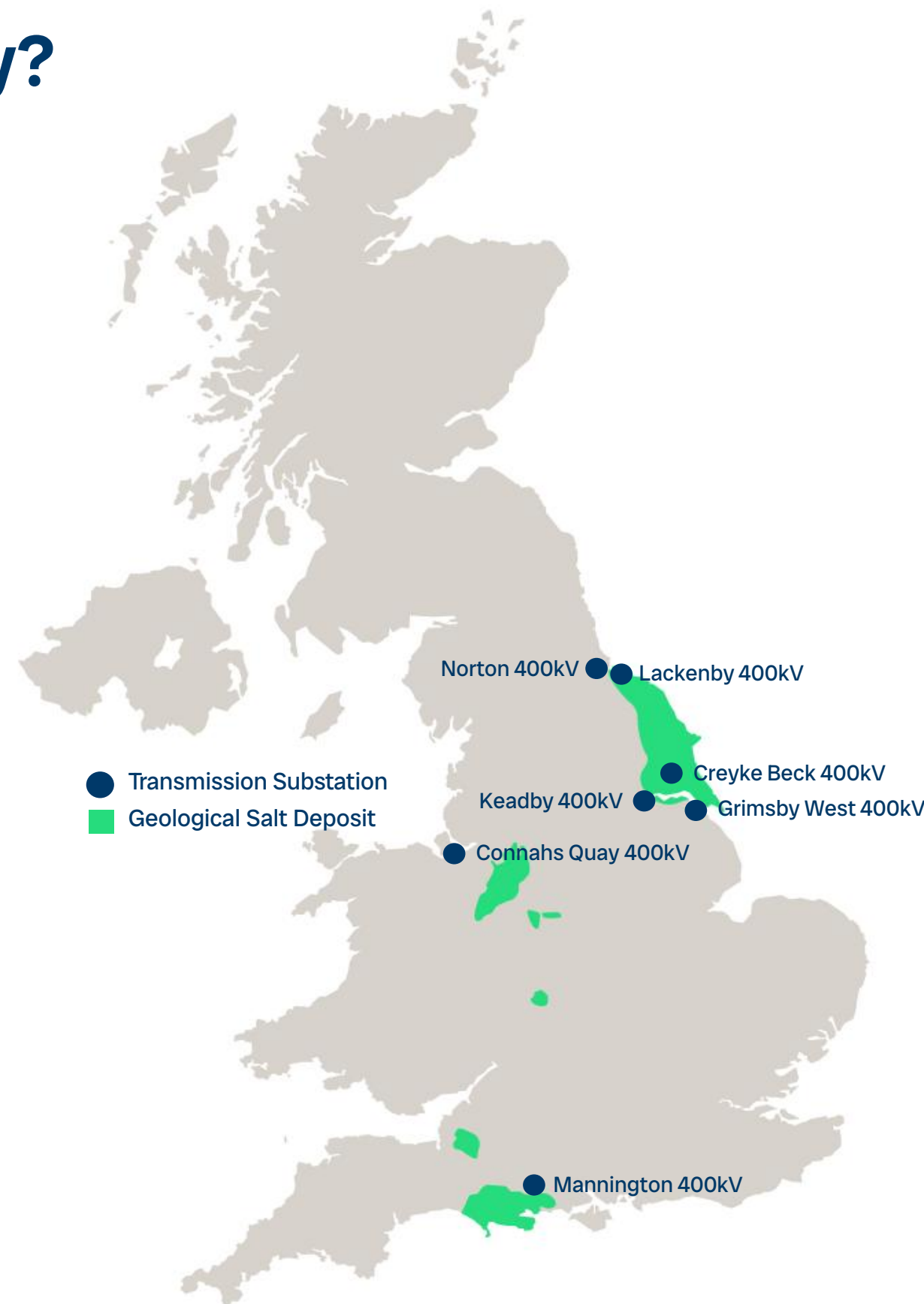
Haldane Energy has worked with AtkinsRealis to identify sites across England and Wales based on:

- Proximity to best salt cavern site
- Ability to export electricity during times of low or no wind
- Electrical proximity to existing or new offshore wind capacity

Why salt caverns?



Solution-mined salt caverns can store large amounts of energy as hydrogen and release it significantly faster than other geological storage options, such as gas reservoirs—delivering energy up to 12 times more quickly.



Current status



Timeline

For the lead project, FID is set for early 2030s and COD set for mid 2030s.

NESO

Connection agreements have been secured with NESO for all projects to access the National Energy Transmission System.

Land access

Haldane Energy has focused on assembling land to secure development rights for salt cavern storage. We have secured 8,000 acres and is actively negotiating with landowners to acquire additional sites.

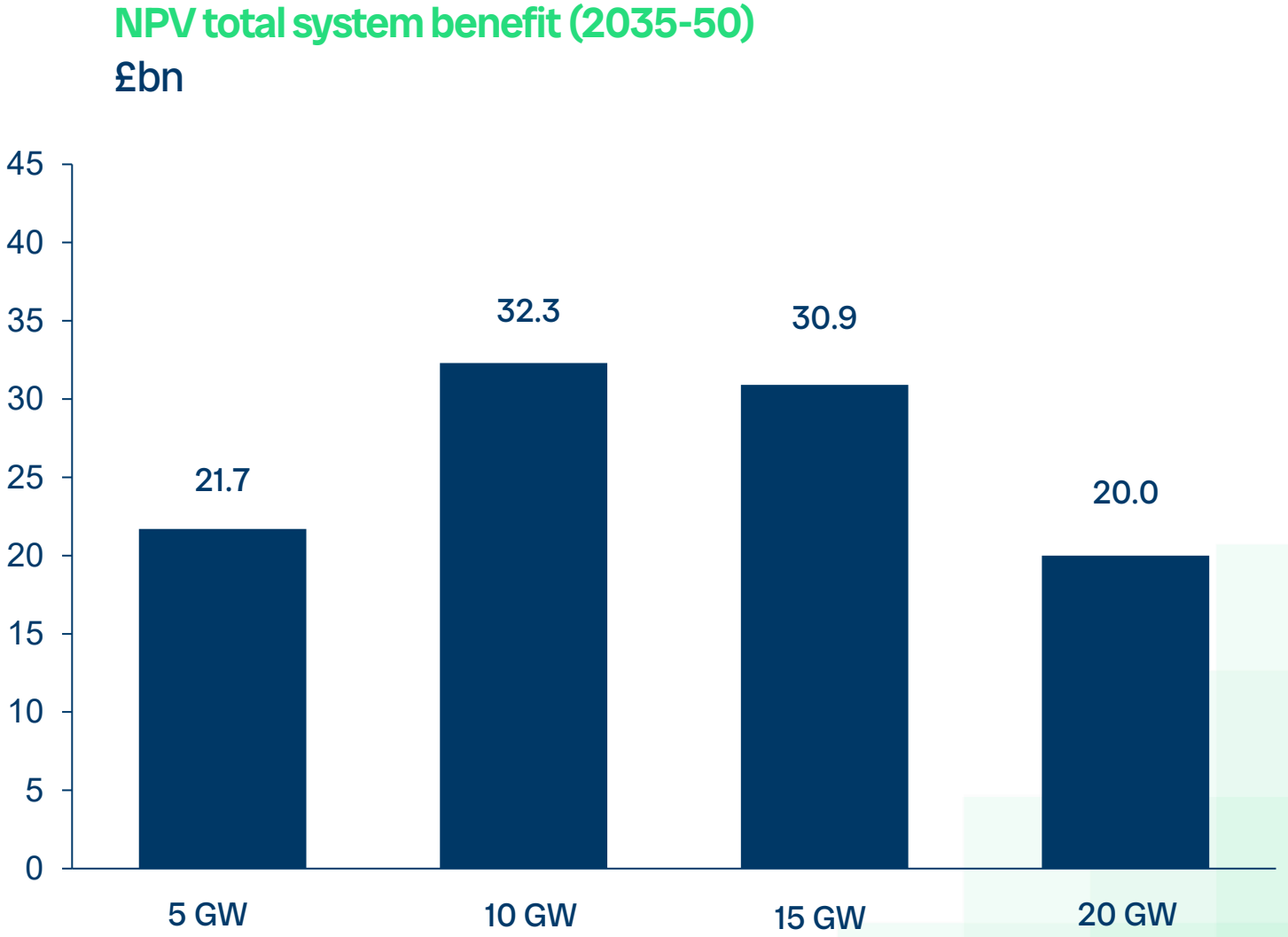
System benefits: an efficient use of intermittent renewables

The following findings are from Haldane Energy's commissioned modelling analysis carried out by LCP Delta, based on a Clean Power 2030 scenario (2035-2050 timeframe).

H₂-LDES delivers system-wide value to the UK power system:

- Generates a substantial NPV benefit at both 6% and 10% hurdle rates
- Improves the efficiency of intermittent renewable generation
- Reduces the volume of wind capacity required to achieve the same level of emissions reduction

In a Clean Power 2030 system, deploying 10 GW of H₂-LDES could unlock £32.3 billion in cumulative system benefits over the life of the assets.



System benefits: reduction in total system costs

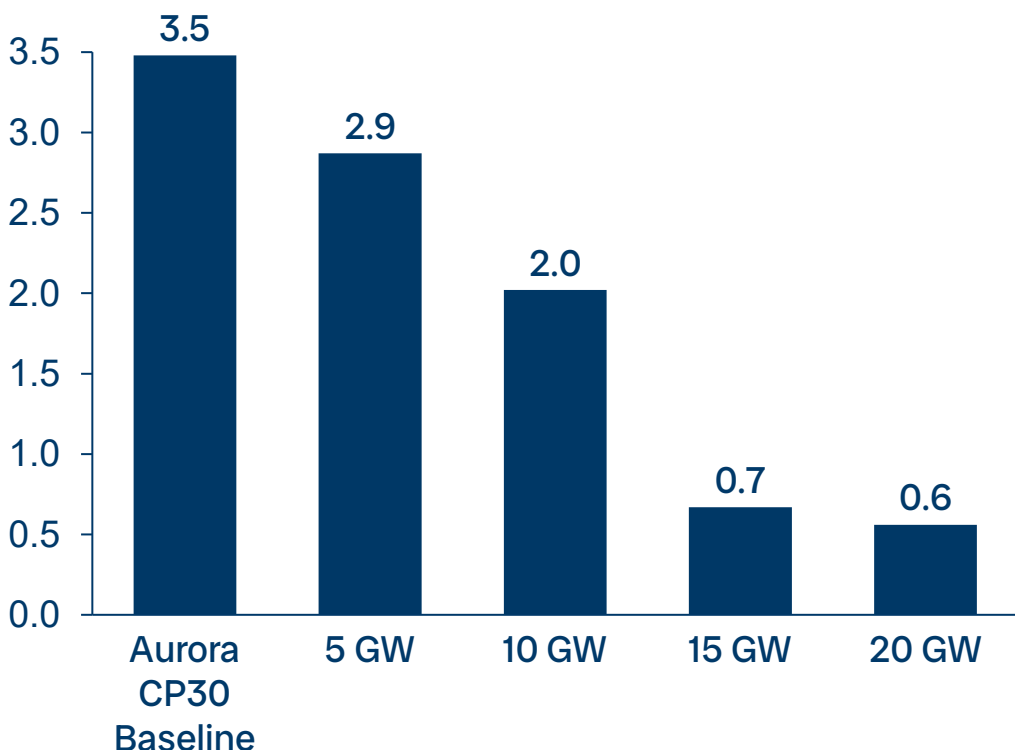
The following findings are from Haldane Energy's commissioned modelling analysis carried out by Aurora Energy, based on a Clean Power 2030 scenario (2035-2060 timeframe).

Subsidies for unabated thermal assets



15 GW of H₂-LDES entirely negates the need for new unabated gas peakers, leading to a substantial saving of approx. **£2.9 billion in CM costs.**

Annual average Capacity Market spend (2035-60)
£bn (real 2024)

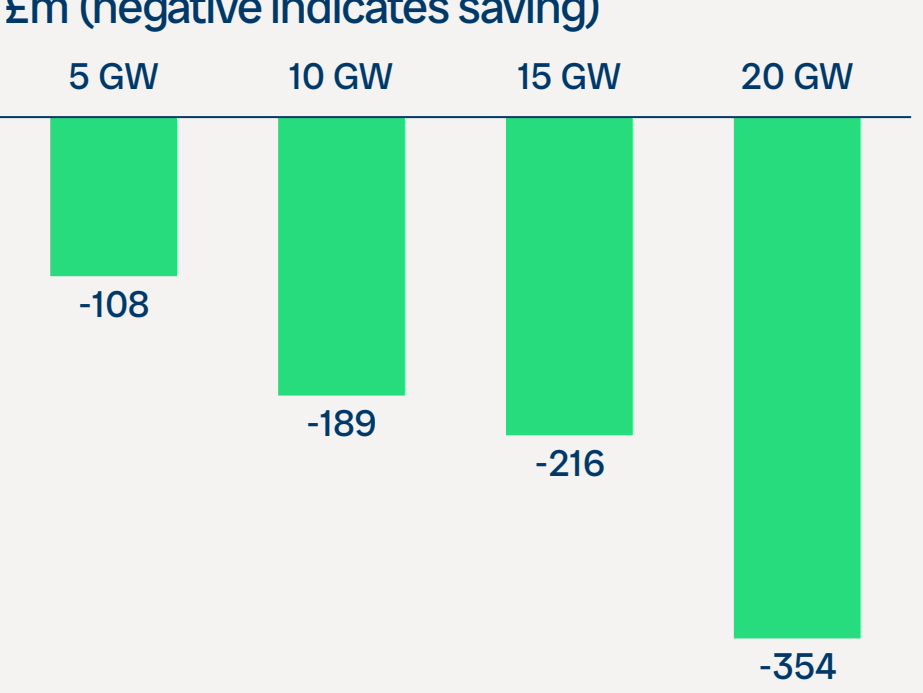


Renewables subsidy reduction



20 GW of H₂-LDES reduces the cost to support renewables by **£350m.** Enabled through the reduction in 20 TWh of curtailment.

Annual average renewable subsidy reduction (2035-60)
£m (negative indicates saving)

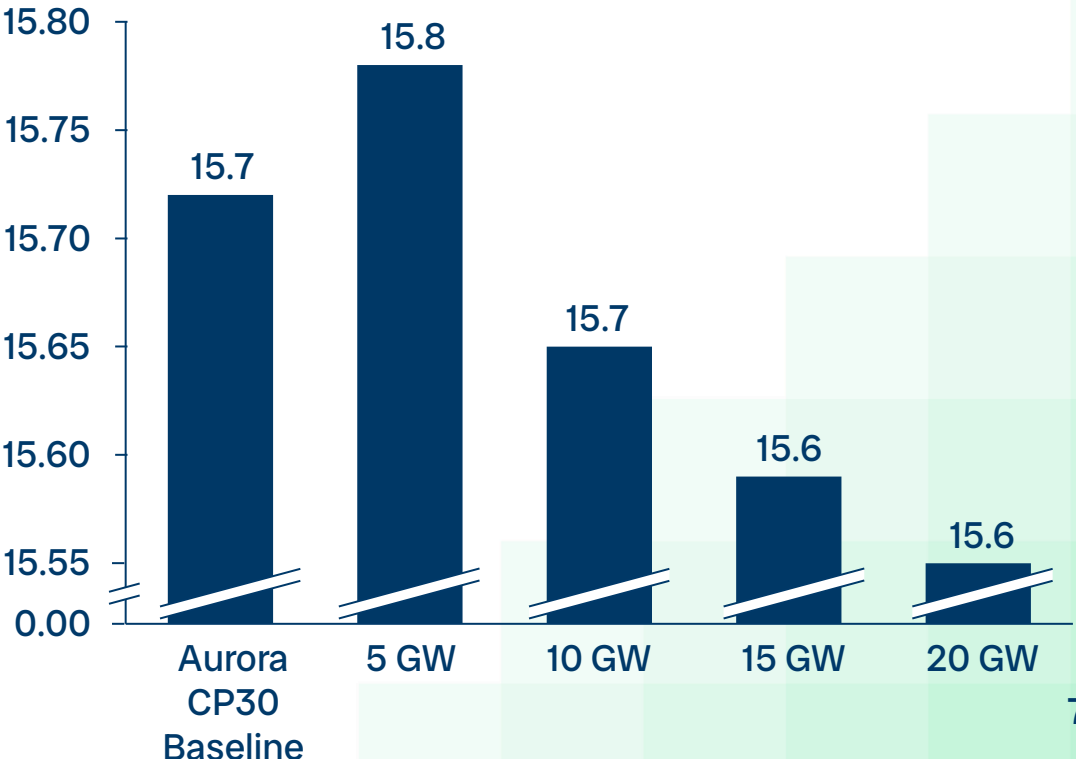


Network upgrades



H₂-LDES can provide grid stability services, reducing the need for expensive network upgrades, such as new substations, **reducing system costs by up to £160m.**

Annual average Network Cost (2035-60)
£bn (real 2024)



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