Aurora Keynote:

Hydrogen as a source of flexibility for the UK energy system

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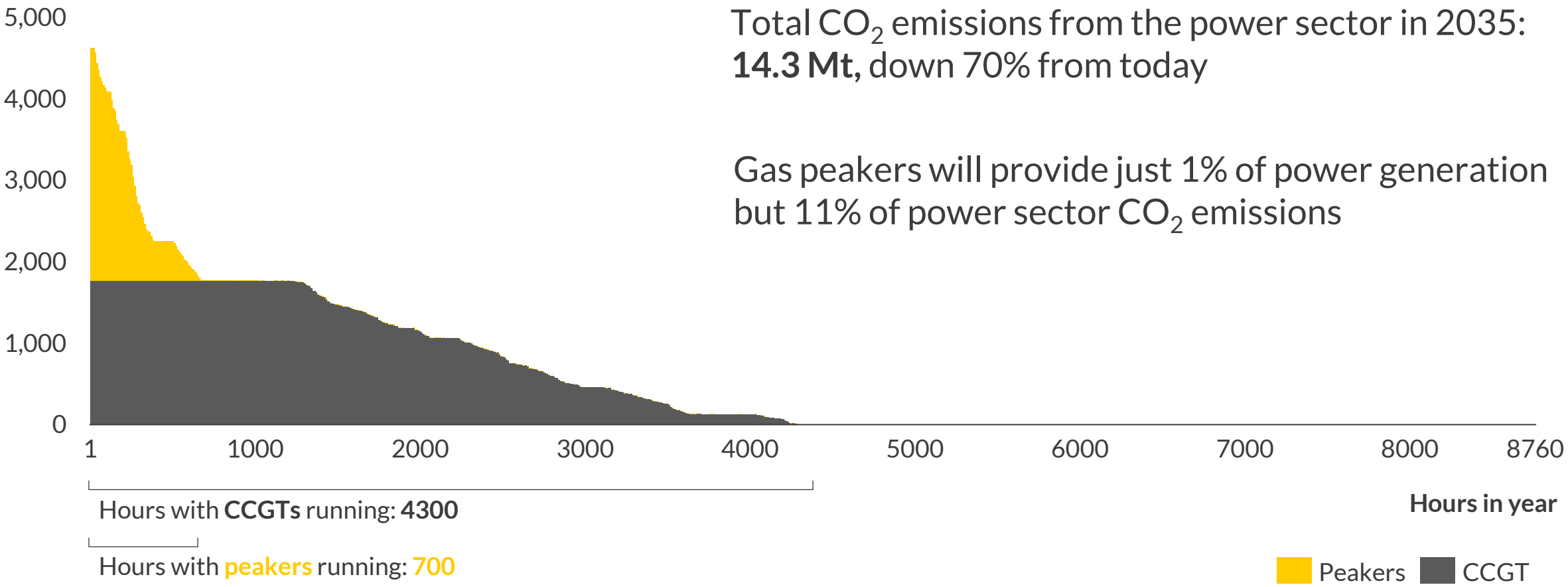
Panel Partners: CMS law·tax·future; H2E CHANGE THE GAME OF ENERGY!

We assume that by 2035, around 8% of power generated in Great Britain will come from unabated gas plants, of which 1% is from gas peakers

Unabated hourly emissions from gas-fired power
tonnes CO_2



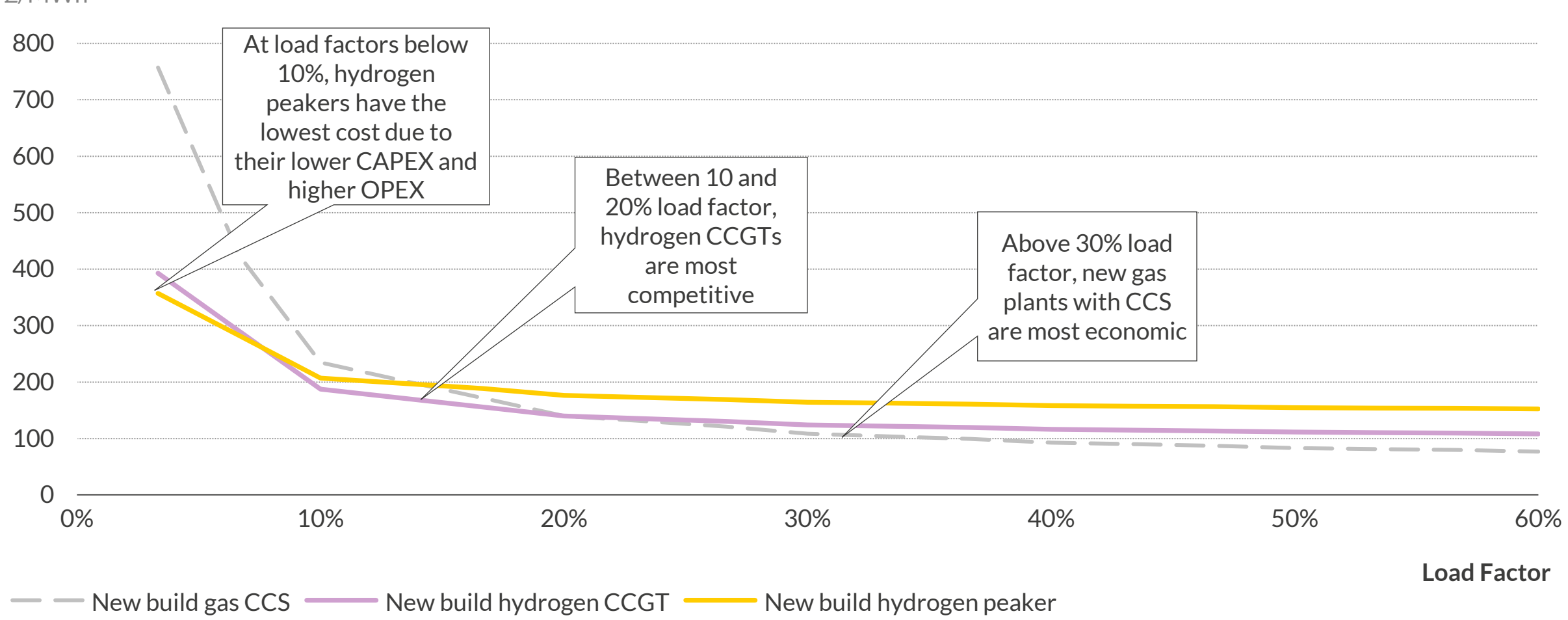
Total CO_2 emissions from the power sector in 2035: **14.3 Mt,** down 70% from today

Gas peakers will provide just 1% of power generation but 11% of power sector CO_2 emissions

Source: Aurora Energy Research

At low load factors, hydrogen-fired plants are likely to be more economical than gas-fired plants with Carbon Capture and Storage (CCS)

Levelised cost of electricity (LCOE) for plants becoming operational in 2030[1,2]

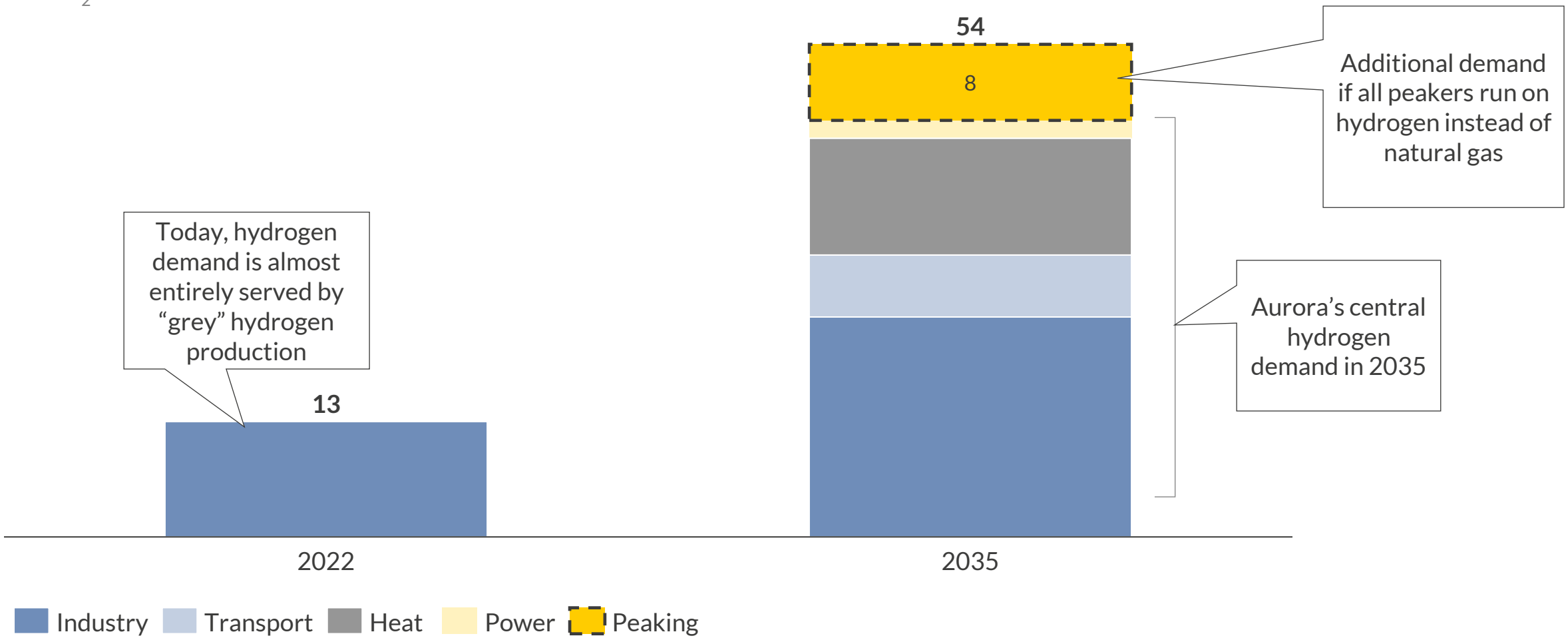


1) Assuming lifetime of 30 years for new build CCGTs and CCS and 25 years for peakers. 2) Analysis done without assuming any policy support and including carbon prices.

Source: Aurora Energy Research

If we replaced the remaining gas-fired peakers with hydrogen peakers in 2035, 8 TWh of extra hydrogen fuel would be needed

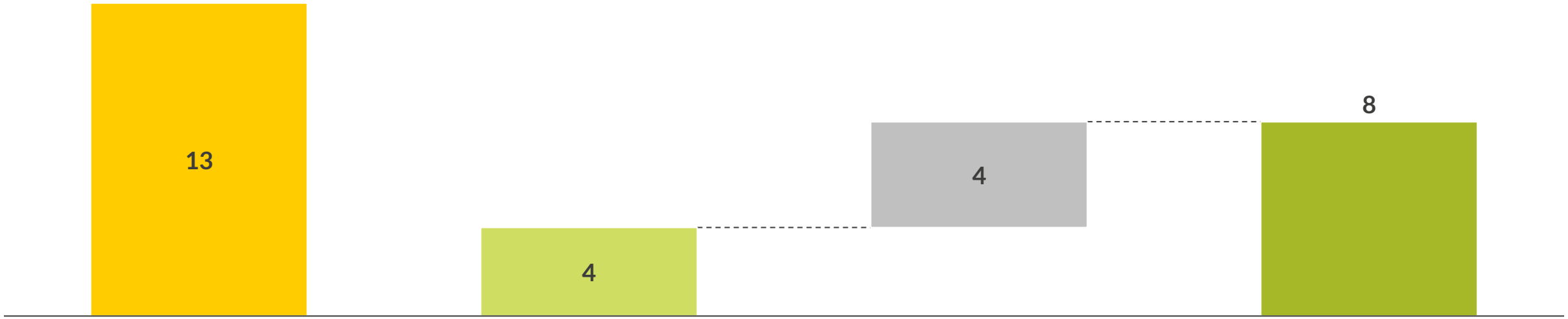
Hydrogen consumption in GB
TWh H_2



Source: Aurora Energy Research

Just using curtailed renewable electricity would not be enough to produce the needed hydrogen for peakers…

Curtailed renewable generation and electrolyser demand[1]
TWh electricity, 2035



To make the **8 TWh** of extra hydrogen needed to replace gas in peakers in 2035, we would need 13 TWh of input electricity[1]

When the amount of low-marginal-cost generation exceeds demand and **prices drop to zero**, some renewables will turn down economically

When renewable generation cannot all reach demand because of **network constraints**, the system operator will instruct some renewables to turn down

We currently expect this curtailed generation to be wasted, but it could be more usefully employed to run electrolysers

1) Electrolyser electricity demand for H_2 peakers assumes 38% efficient peaker and 65% efficient electrolyser.

Source: Aurora Energy Research

… instead, there is an optimum amount of zero-carbon capacity that could be added to the system to meet hydrogen demand

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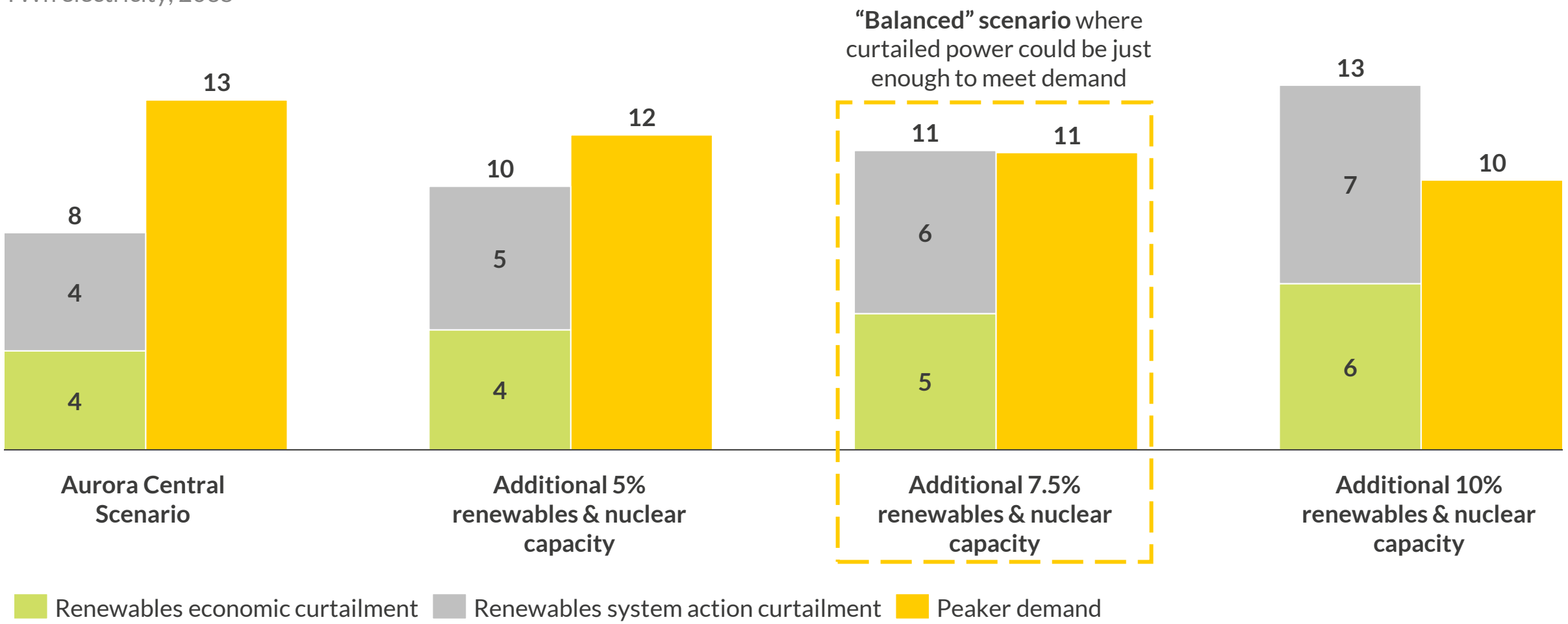
Curtailed renewable generation and electrolyser demand[1]
TWh electricity, 2035



1) Electrolyser electricity demand for H_2 peakers assumes 38% efficient peaker and 65% efficient electrolyser

Source: Aurora Energy Research

Using hydrogen for power system flexibility would also require interseasonal hydrogen storage

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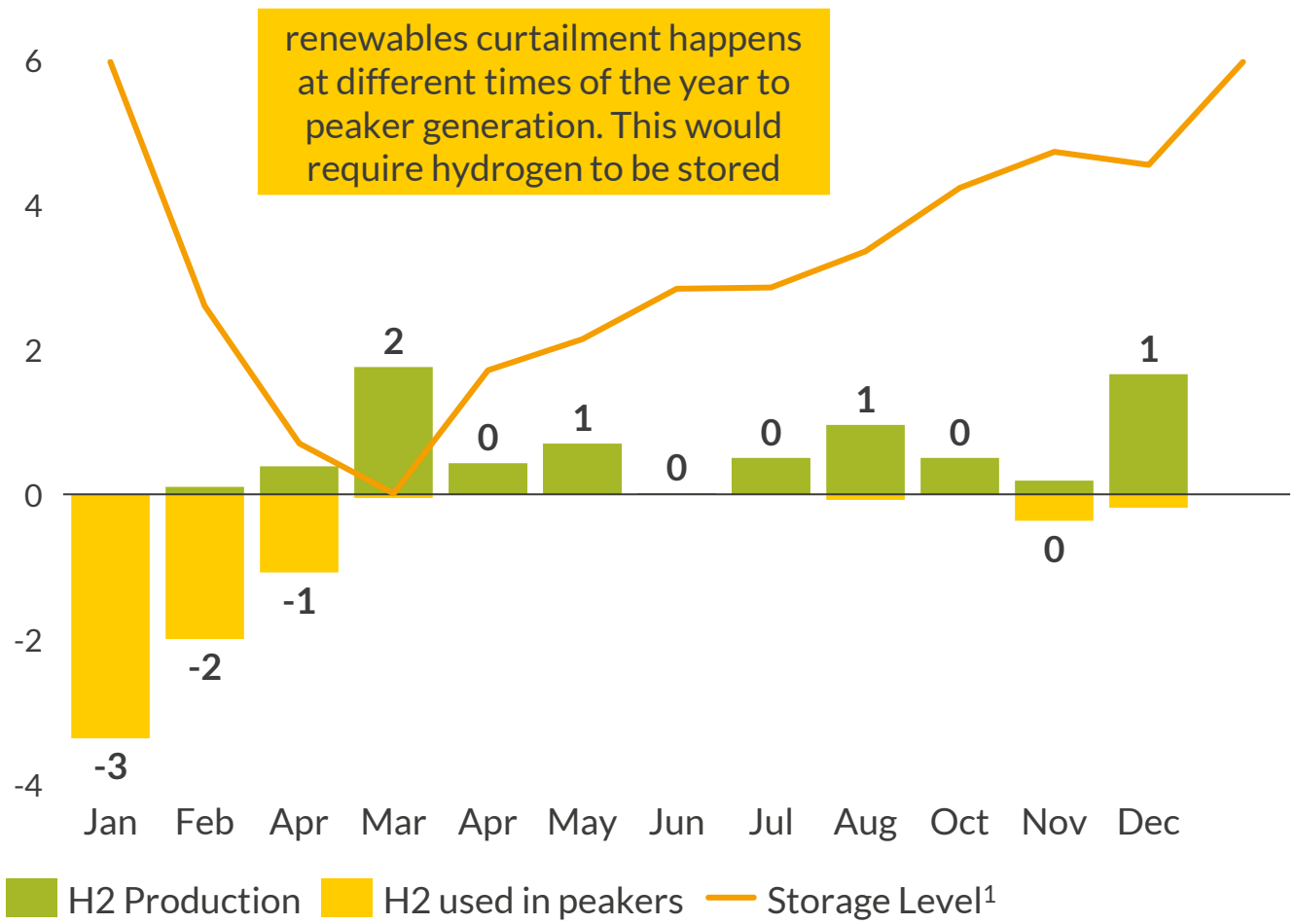
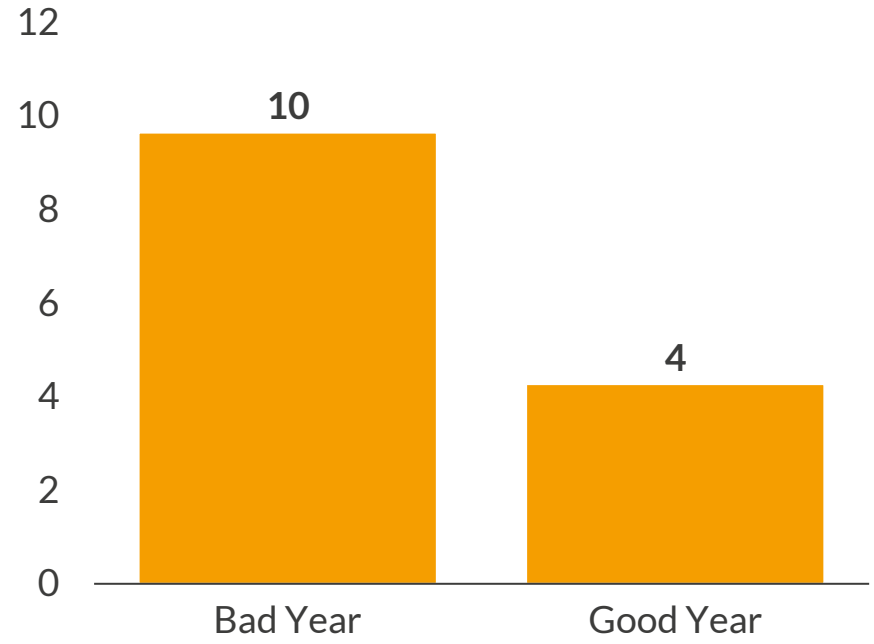
Monthly curtailed renewable generation and peaker demand[1]

TWh electricity, 2035



Storage Requirements in different weather years[2]

TWh hydrogen, 2035



Dependent on the weather, renewables generation and peaking demand vary leading to different storage requirements; ranging between **4-10 TWh**

1) Storage Level beginning of the month. 2) In the absence of a global hydrogen market

Source: Aurora Energy Research

This route to low carbon flexibility is comparable to building 12 GW of new gas with CCS

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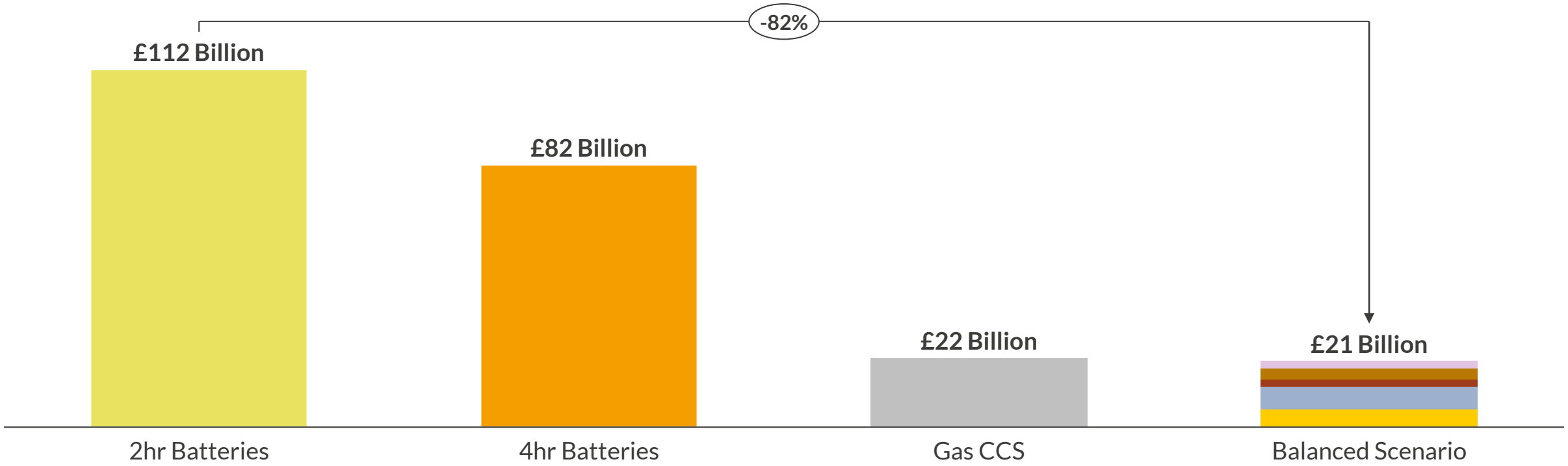
Capex spend to replace peakers with low carbon alternatives in 2035
£ billion, real 2021



Generation Capacity needed in addition to Aurora Central

2hr Batteries 4hr Batteries Gas CCS Hydrogen Peakers RES Nuclear Electrolysers Hydrogen Storage

Source: Aurora Energy Research

Takeaways

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Gas peakers are meeting less than 1% of power demand in 2035 but emit 11% of power sector emissions. Hydrogen peakers could be economical as a low-carbon alternative to gas peakers. Hydrogen peakers would allow the system to shift excess renewables generation to tight low-renewables generation periods

In order to generate enough low-carbon electricity to produce hydrogen for peakers, we have found a balanced scenario where 7.5% more renewable and nuclear capacity is needed on top of Aurora Central. This is combined with the need for 4-10 TWh of seasonal hydrogen storage

£

This would cost around £20 billion, which is similar in cost to installing 12 GW of new gas CCGTs with CCS on top of Aurora Central


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