Committee on
Climate Change

16 October 2019

Hydrogen for heat: insights from net zero (and elsewhere)

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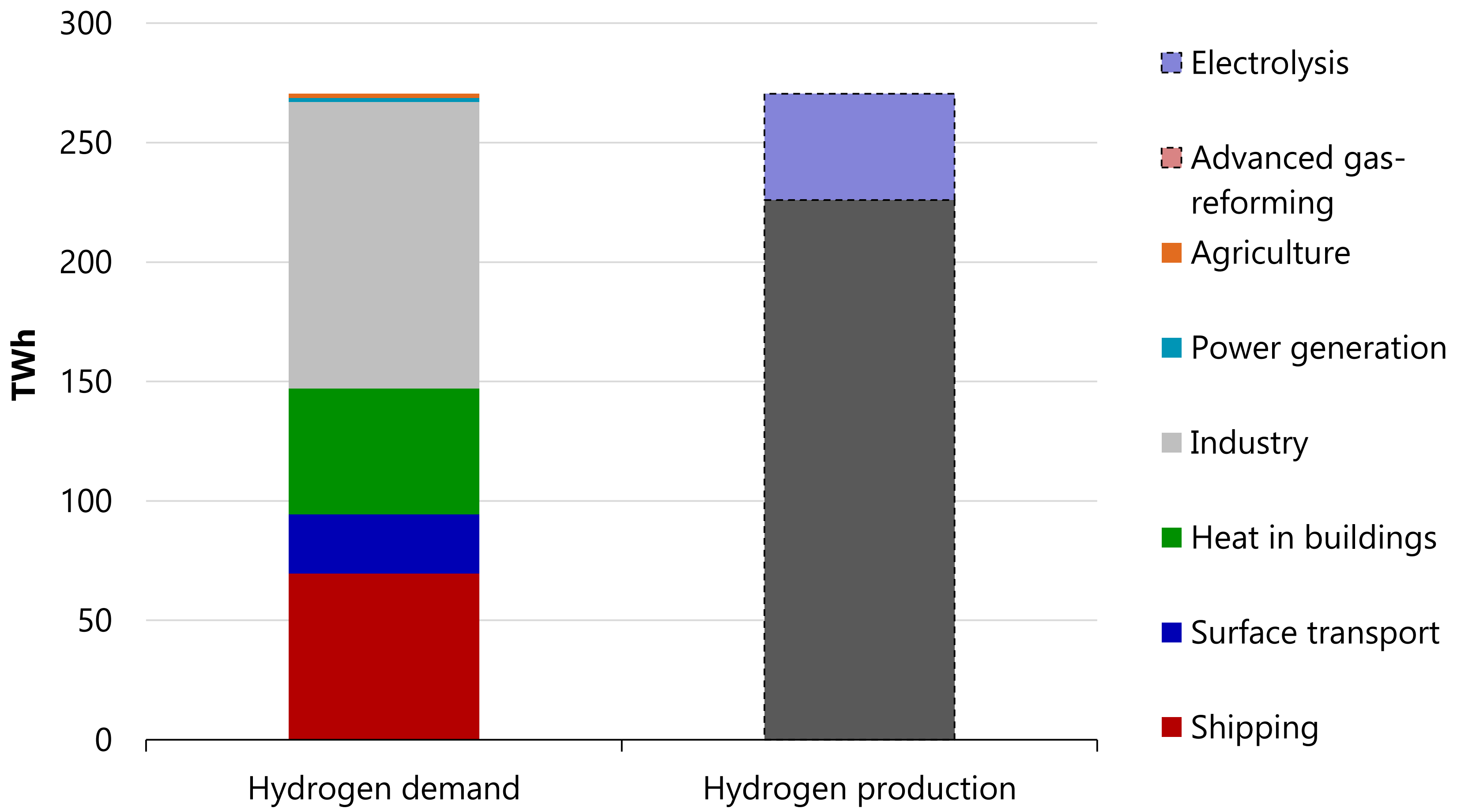
The CCC net zero scenario relies on hydrogen to get to net zero, particularly in industry

Use and production of Hydrogen in 2050

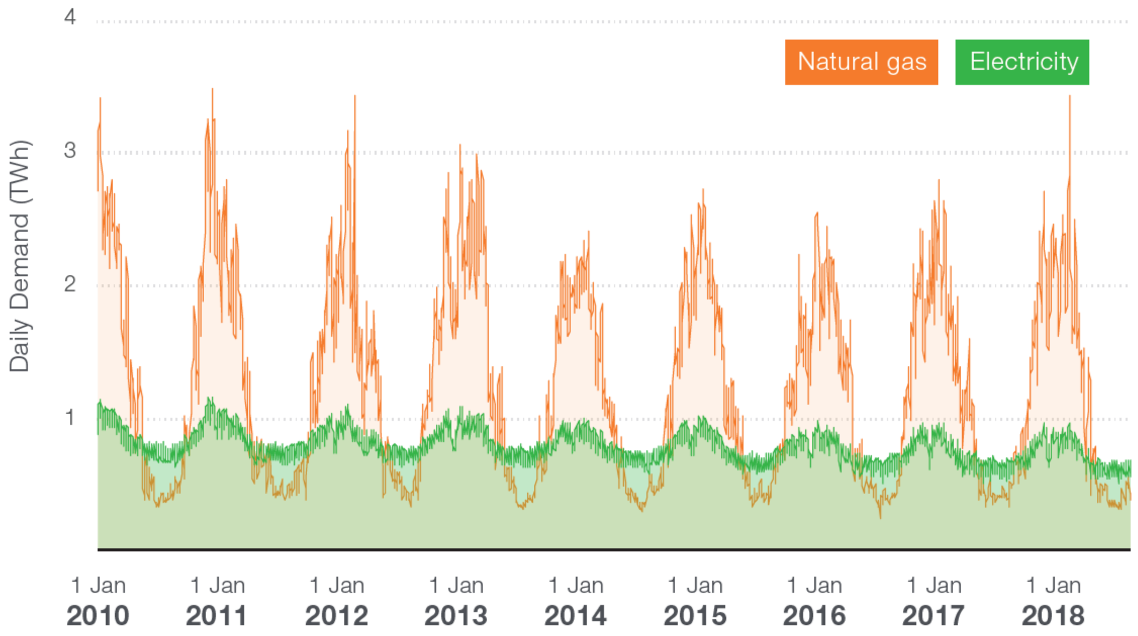


Source: CCC analysis

Hydrogen can be a strong complement to electrification and efficiency improvements

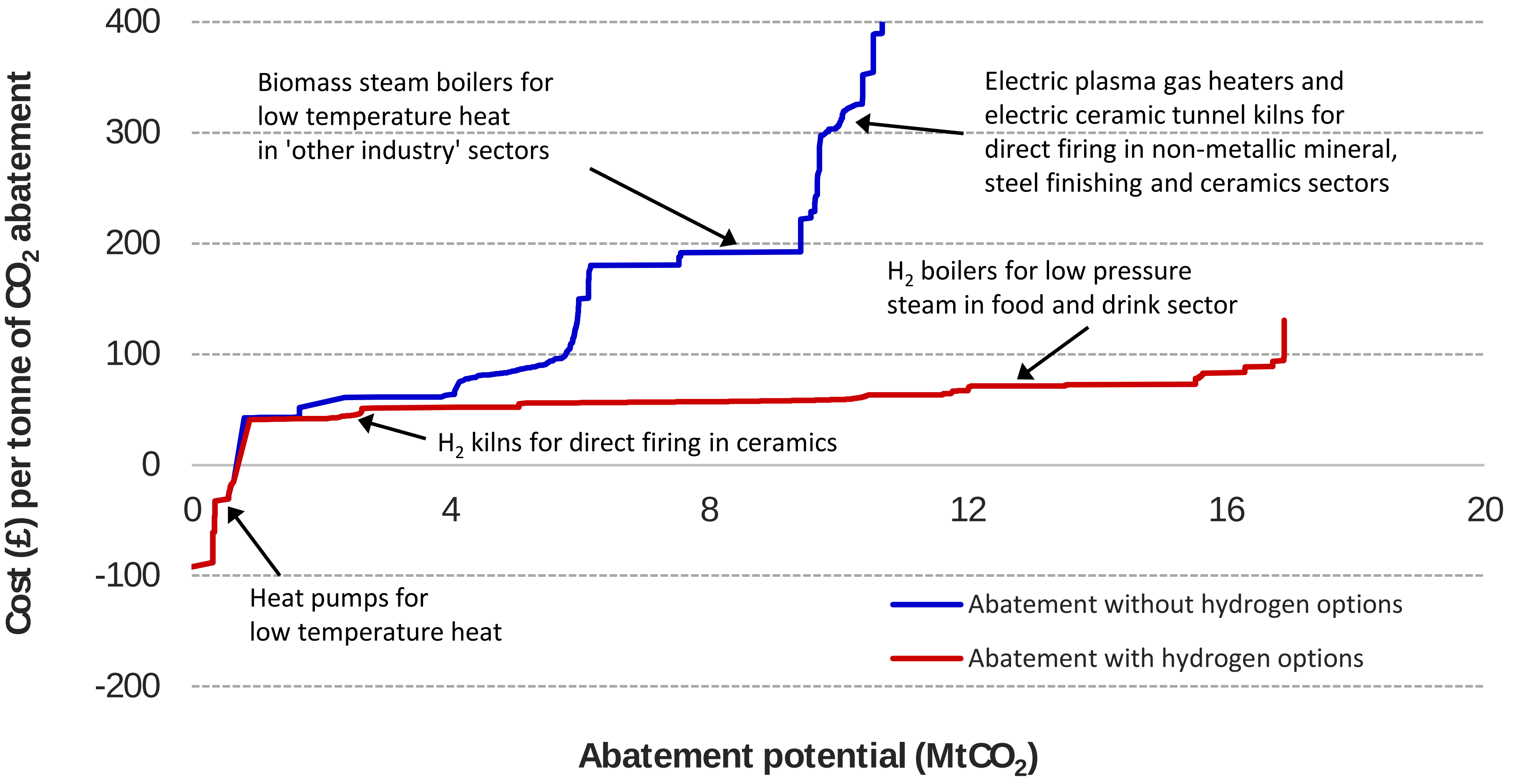
Low-carbon hydrogen is an important potential complement to electrification, especially in replacing natural gas (and potentially oil) in areas where electrification is not feasible:

- Heavy-duty / long-distance transport (e.g. HGVs)
- Industrial process heat
- Buildings heat for colder winter days
- Flexible power generation (e.g. for peaks)



BEIS (2018) 'Clean Growth – Transforming Heating'

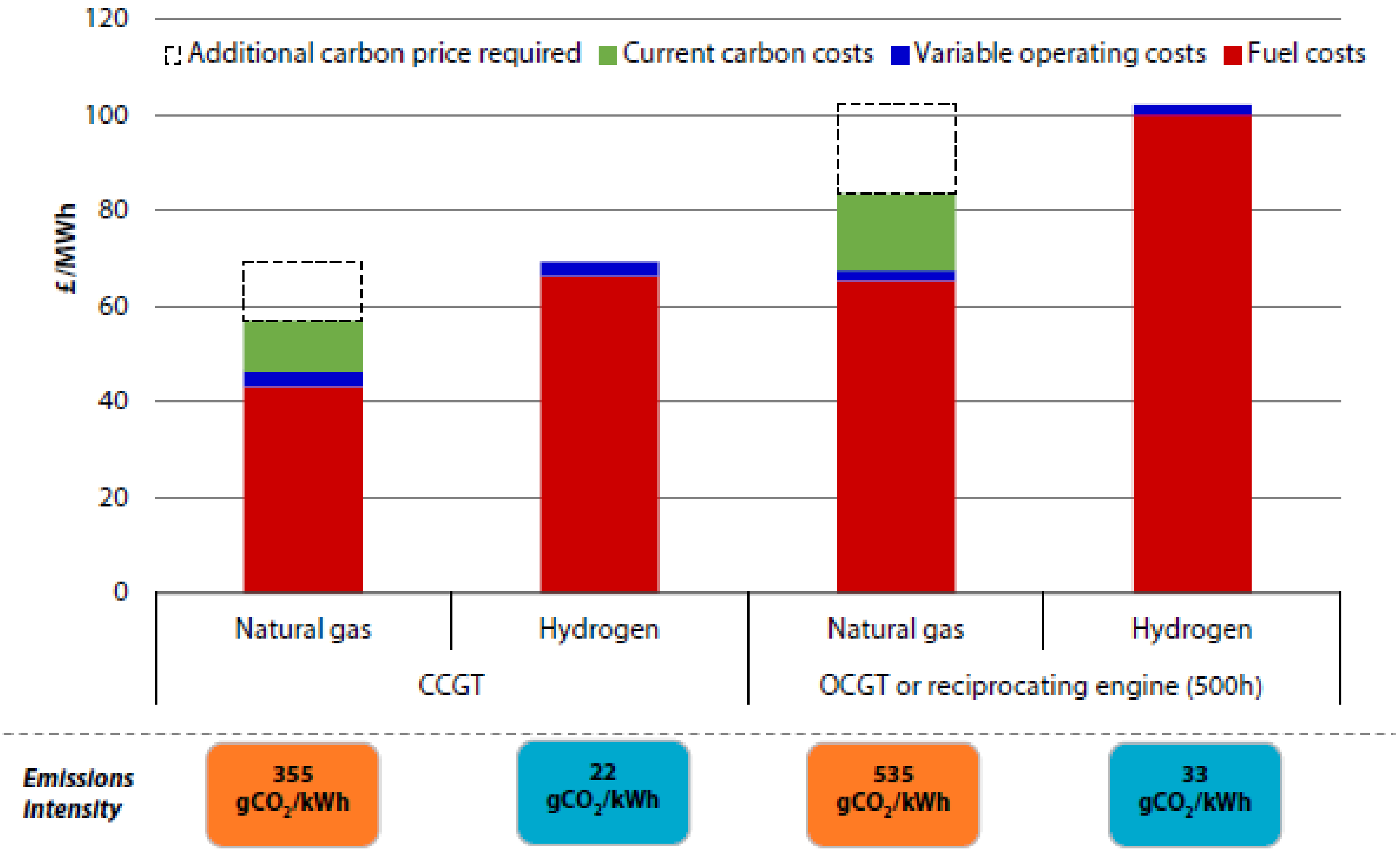
Use of hydrogen in industry can achieve greater emissions reductions at lower costs



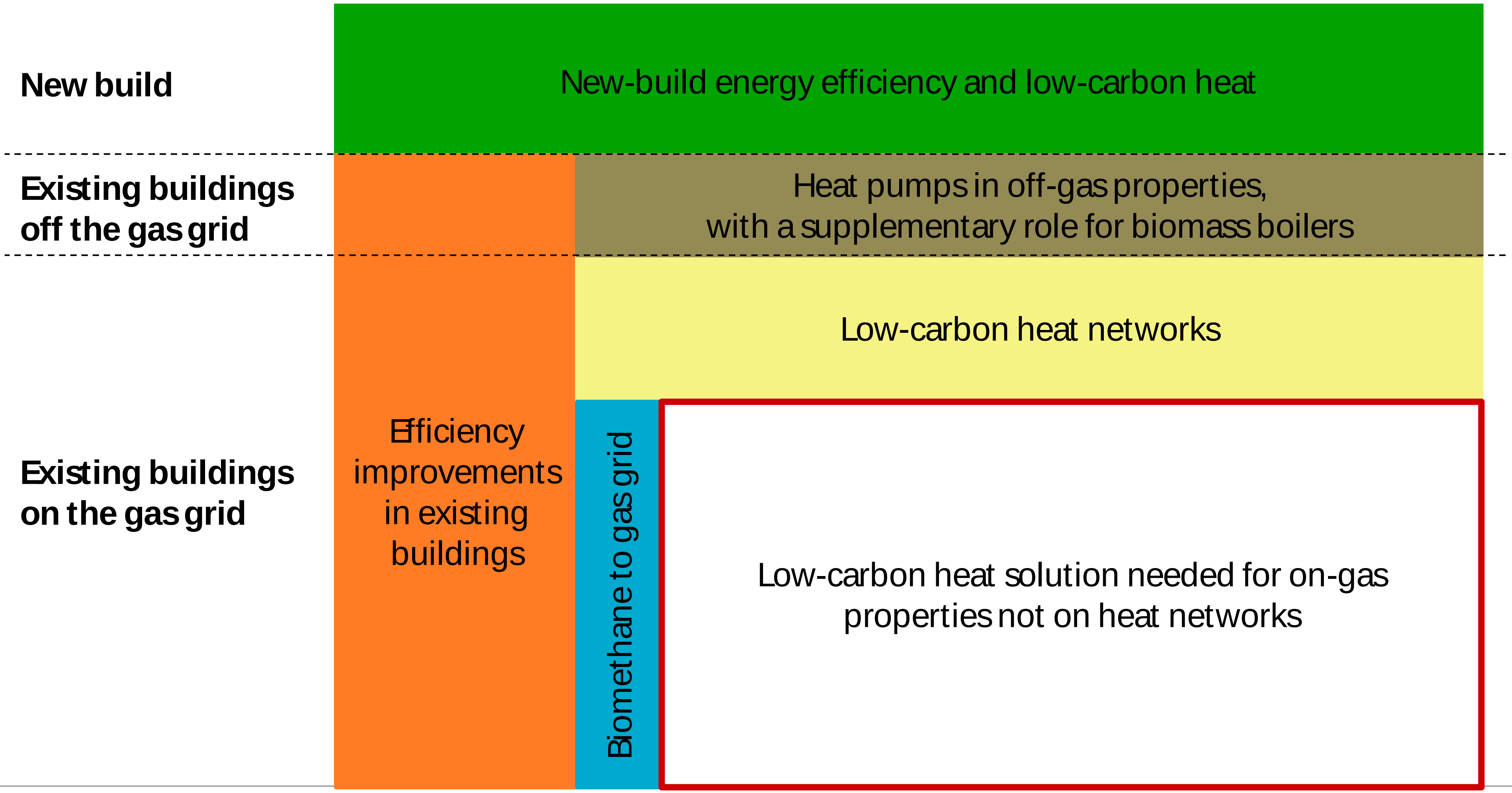
Source: Element Energy/Jacobs Industrial Fuel Switching Market Engagement Study (2018)

Hydrogen can cost-effectively replace natural gas for back-up power generation in the 2030s

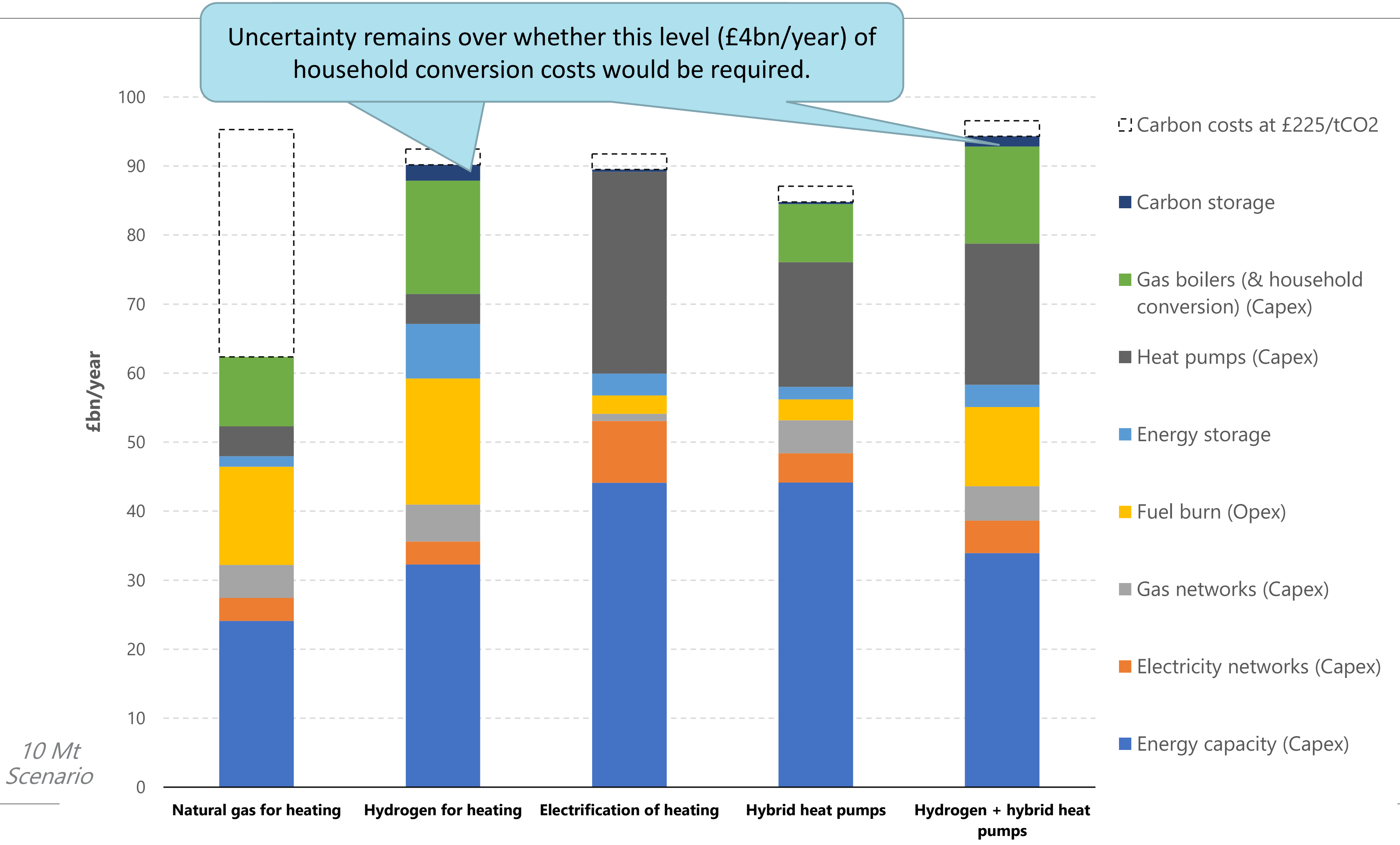
2040 gas plant operating costs



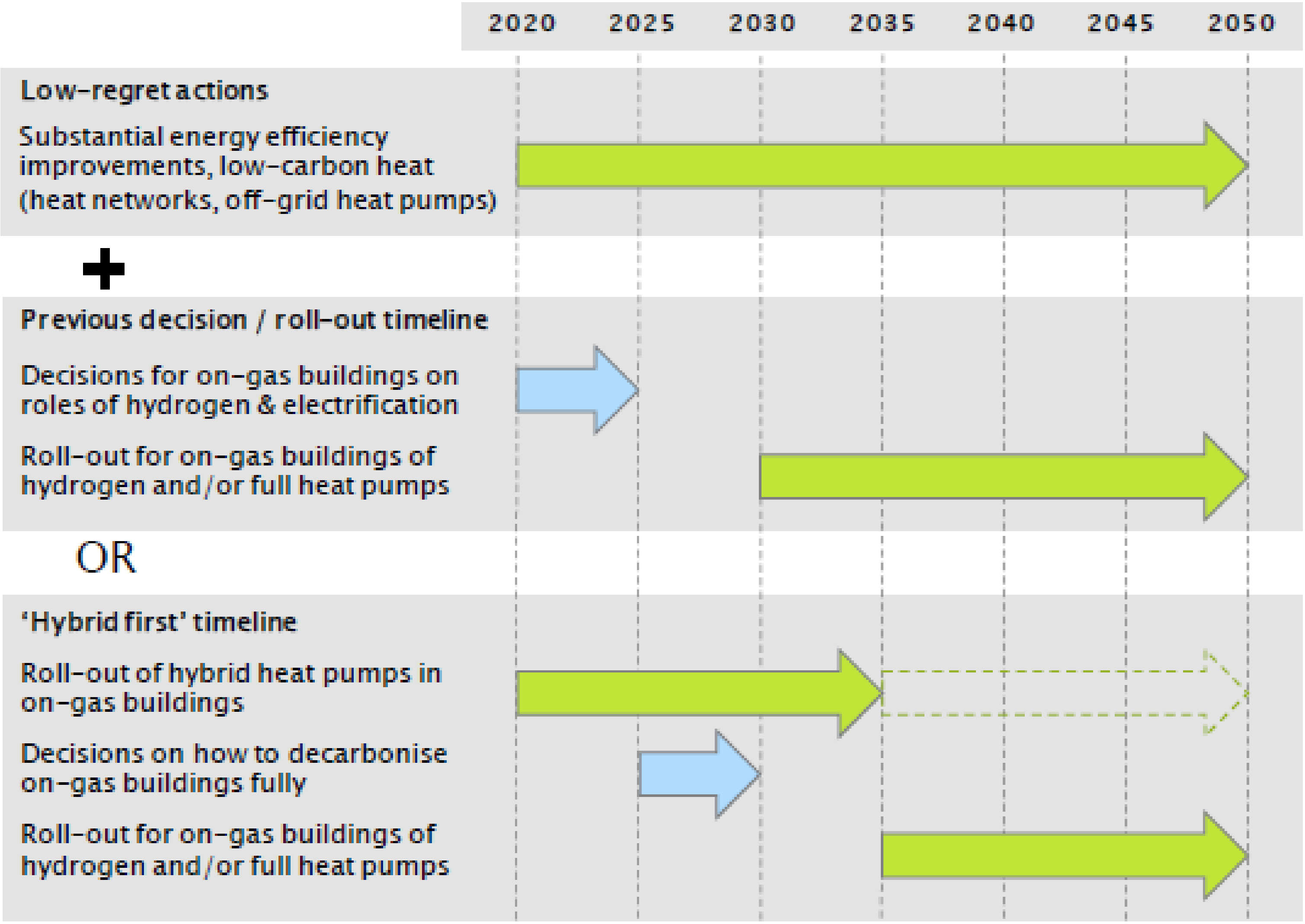
Low-regret actions for buildings decarbonisation and key strategic decisions required



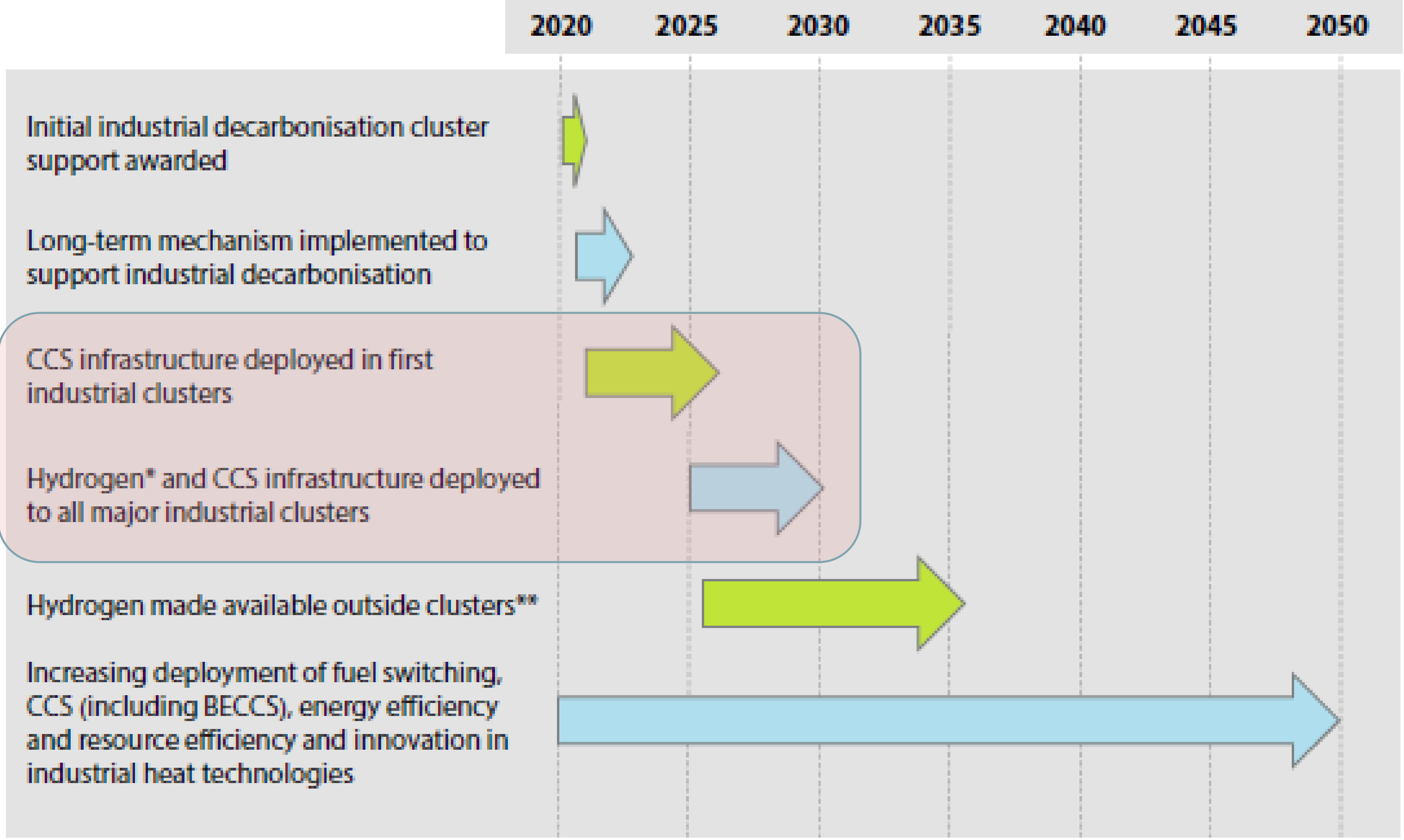
Costs of heat decarbonisation scenarios are within 10% of each other, across alternative heat pathways

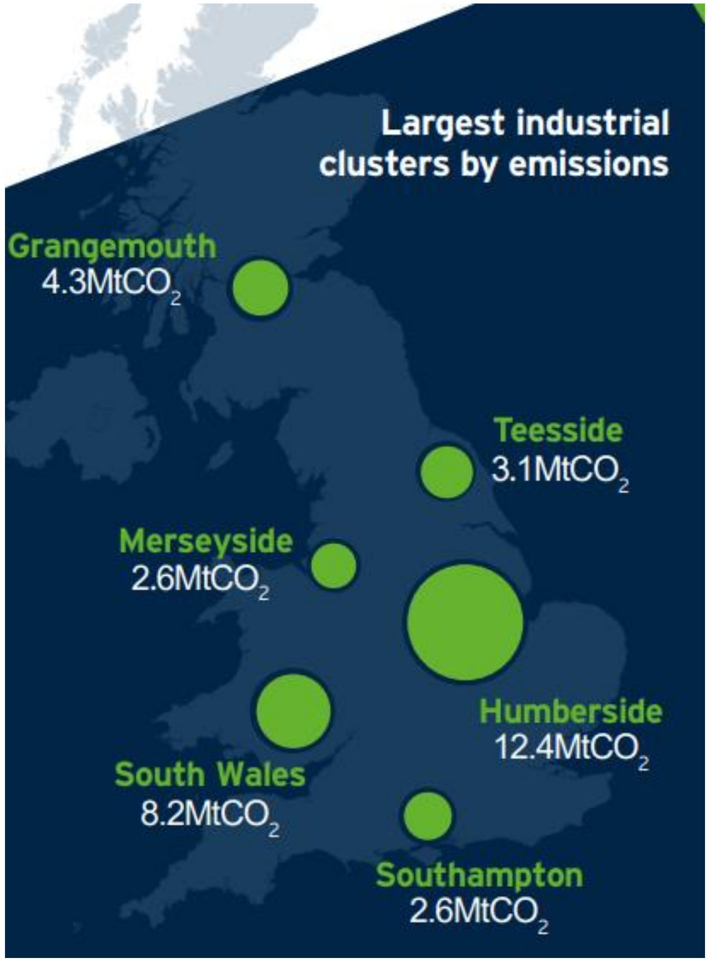


A way forward on heat decarbonisation



Decarbonise industry, don't offshore. Industry-led hydrogen rollout?





Sources: CCC (2019) Net zero technical report; BEIS Grand Challenge Industrial Clusters Mission

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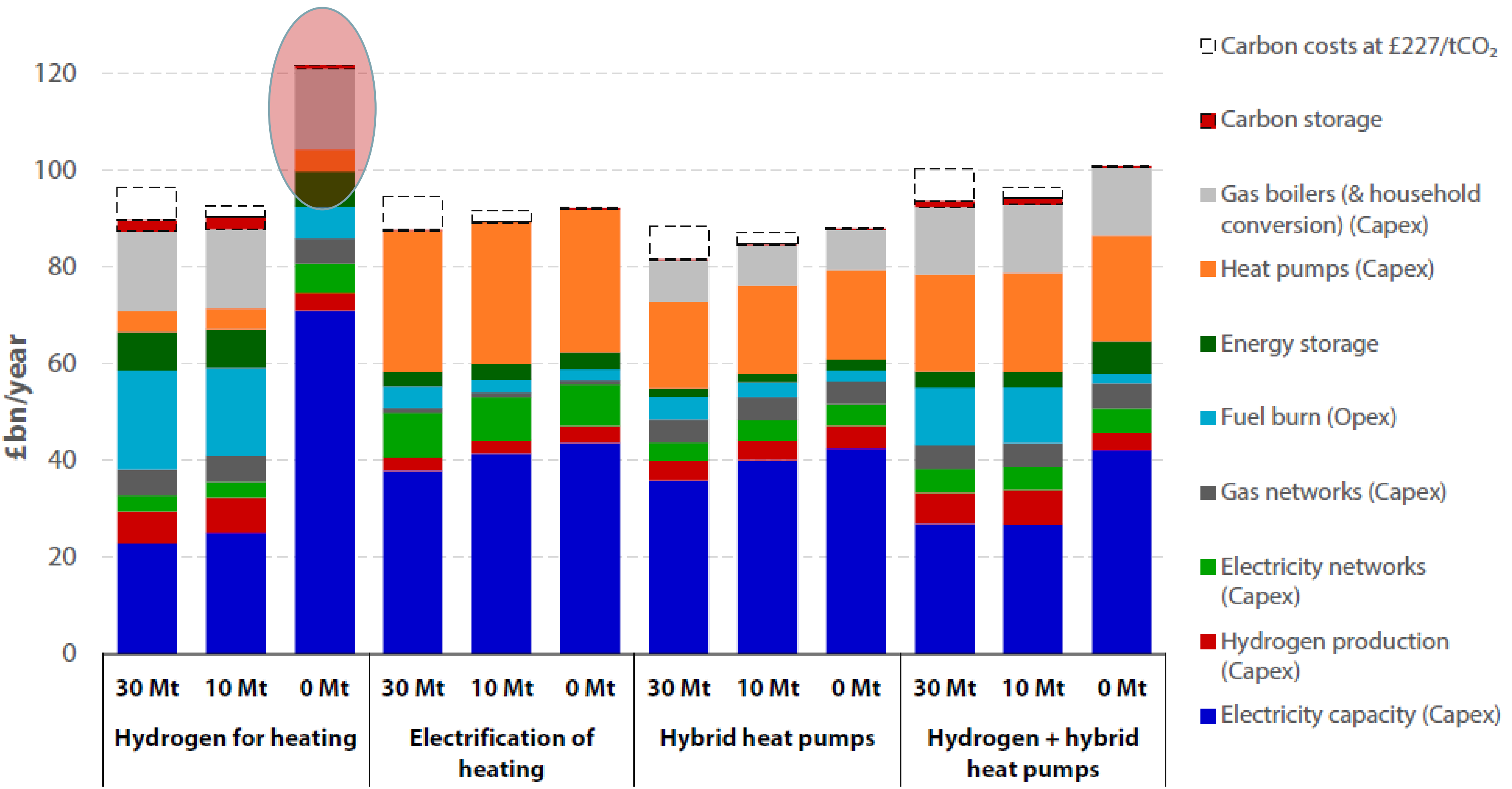
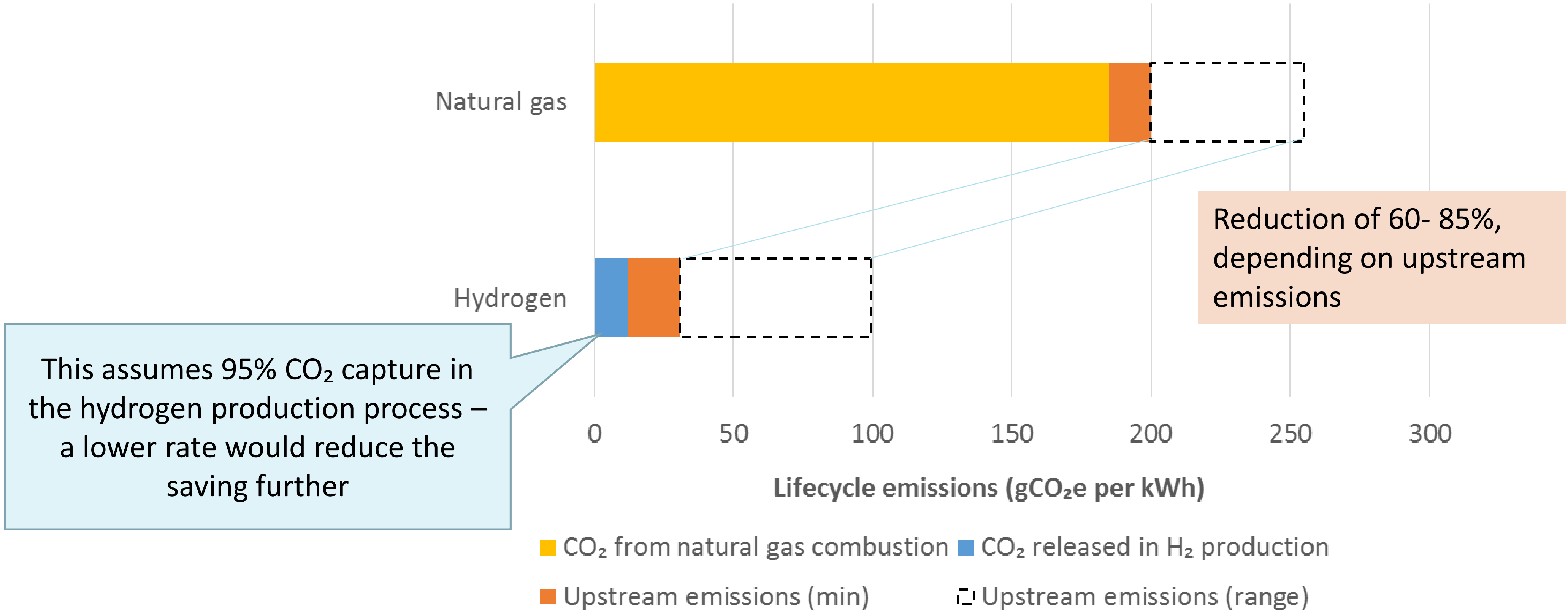
Three insights on supply

1. Full reliance on electrolysis would also have considerably higher costs

Figure B1.6. Annualised system costs for alternative heat decarbonisation pathways.



2. Residual emissions of gas reforming are significant even with high CO_2 capture rates



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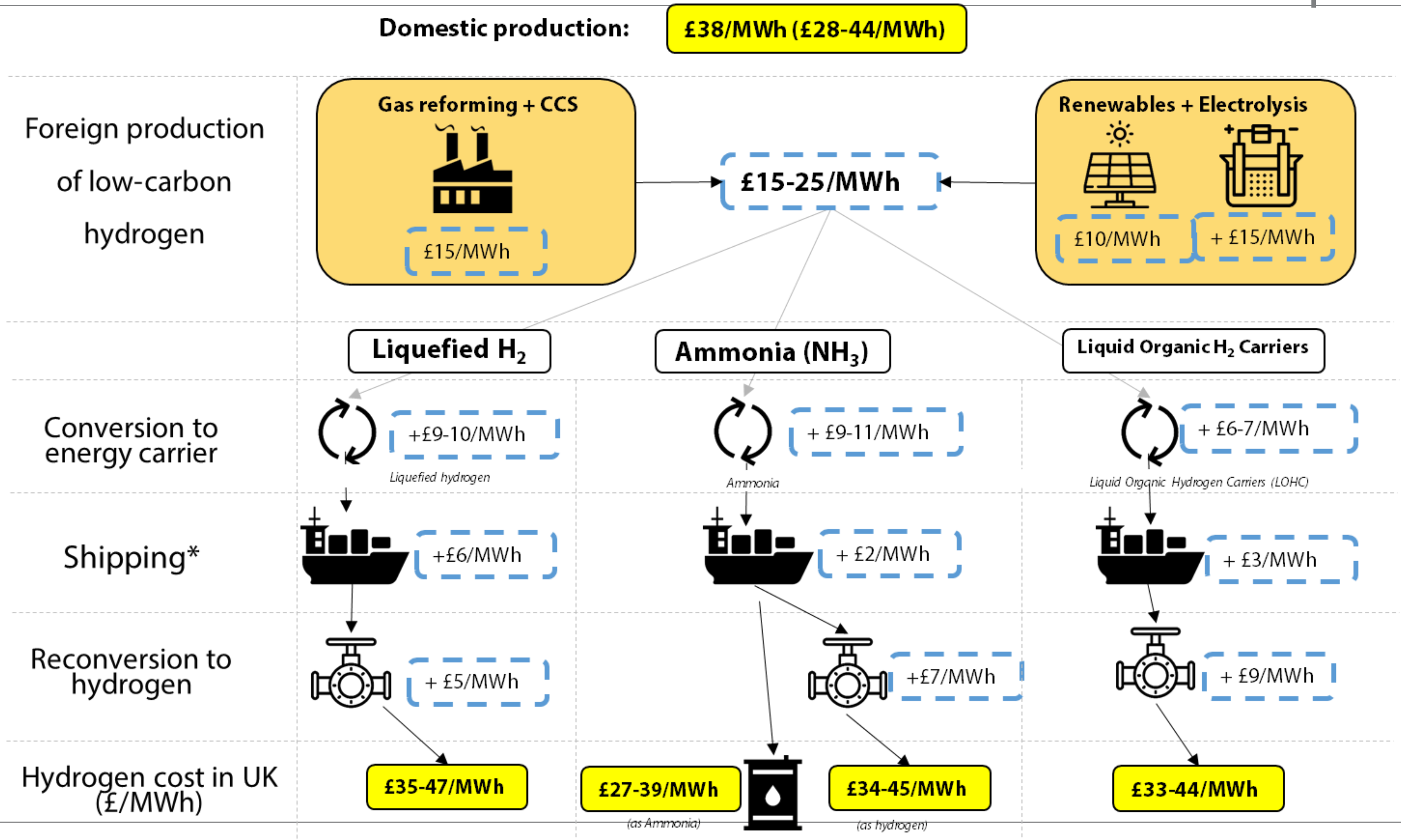
3. It may be possible to import electrolytic zero-carbon hydrogen but this is unlikely to be cheaper than domestic production



*including loading onto ship, assumed 10,000km journey from Middle East (via Suez Canal)

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And one on global future demand

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Relative to the UK, other countries will mostly be less well suited to hydrogen as a pathway; however within countries certain regions could be well suited

Variable	Position of UK relative to other countries
	*improves case for **electrification*** ← ***"average" country*** → *improves case for **hydrogen***
Infrastructure: **Gas grid** & CCUS sites	**US** ~50% · **certain regions of US** ~70+% · **UK** extensive gas grid (85%), CCUS in North Sea Certain **regions** could be well suited if extensive gas grid & overlap with **industrial cluster**
Building stock efficiency	**North America** Majority post-war · **UK** Poorly insulated old building stock
Climate – heating & cooling	**Italy** Material cooling demand (16% v. heating); reversible heat pump could serve both · **UK** Limited cooling demand (3% v. heating)
Fuel costs: gas v. elec. *[NOTE: relevant where SMR/ATR for H_2 production, not long-term structural]*	**US** Low gas prices (shale) but also low elec. · **UK** Gas prices low-med elec. prices high

Source: Energy Transition Commission [draft]

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Wrapping up

Hydrogen myth-busting

- The **sunk costs of the gas grid** do not mean that economically it's a no-brainer to switch it over to hydrogen and use it to serve boilers as we do at the moment
- There is not enough '**surplus**' low-carbon electricity to meaningfully contribute to hydrogen supply at scale
- **Gas reforming with CCS may well not be low-carbon enough** for very large-scale use by 2050 (although it has an important role in the transition and at more moderate scales)
- An international market in hydrogen may well develop in time, but it is not a certainty and these **imports may be no cheaper than domestic production**
- Hydrogen is **best used selectively**, alongside mass electrification – it is not a silver bullet

The need for strategy

In order for hydrogen to become an established option for decarbonisation during the 2020s, we recommend:

- **Heat decarbonisation strategy.** A commitment should be made now to develop a fully-fledged UK strategy for decarbonised heat within the next three years, including clear signals on the future use of the gas grid and supporting requirements for carbon capture and storage (CCS) in the UK.
- **Strategy for decarbonising HGVs.** By 2050 it will be necessary for HGVs to move to a zero-emissions solution, requiring decisions in the second half of the 2020s.This will necessitate small-scale trial deployments of hydrogen HGVs in a variety of fleets prior to this, in the UK or elsewhere.

The need for action

Deployment of hydrogen should start in a 'low-regrets' way over the next decade, recognising that even **an imperfect roll-out is likely to be better than a 'wait-and-see' approach** that fails to develop the option properly

- Hydrogen production should start at scale as part of a CCS cluster, for use in a range of ways that would not initially require major infrastructure changes
- Hydrogen-ready technologies (e.g. boilers, turbines) should be developed in parallel and their deployment supported by policy.

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Summary insights – hydrogen for heat

- Recap – costs are uncertain but seem less key.
- Make the problem less of a problem.
- Role of hydrogen for managing peak at system or household level
- Industry-led rollout.
- Readiness and optionality.

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Thank you!

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Our Further Ambition scenario requires a huge amount of CCS by 2050 – in practice it is likely to be possible to manage with less