Hydrogen for heat: the good the bad and the ugly.

UKERC
UK Energy Research Centre

Dr Richard Lowes

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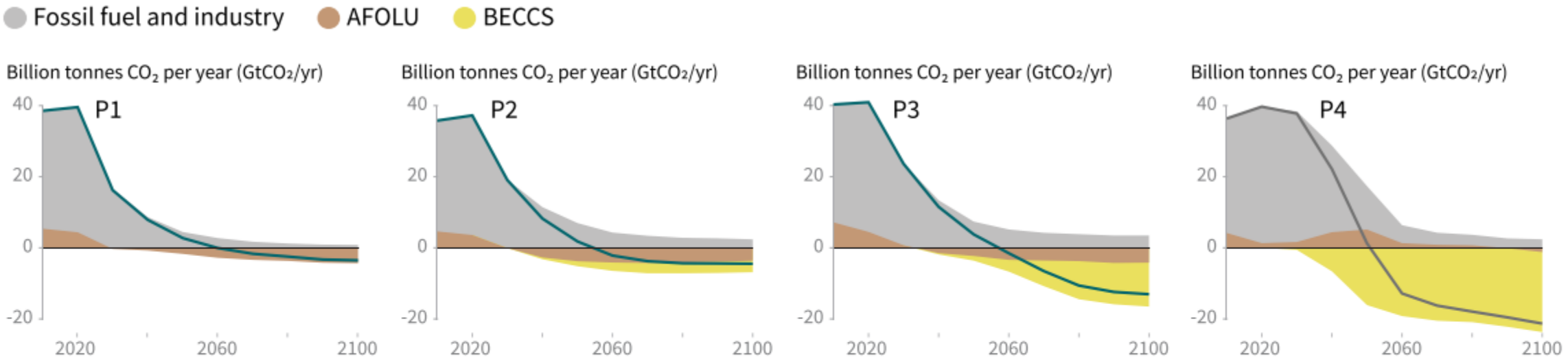
IPCC 1.5 degrees special report

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

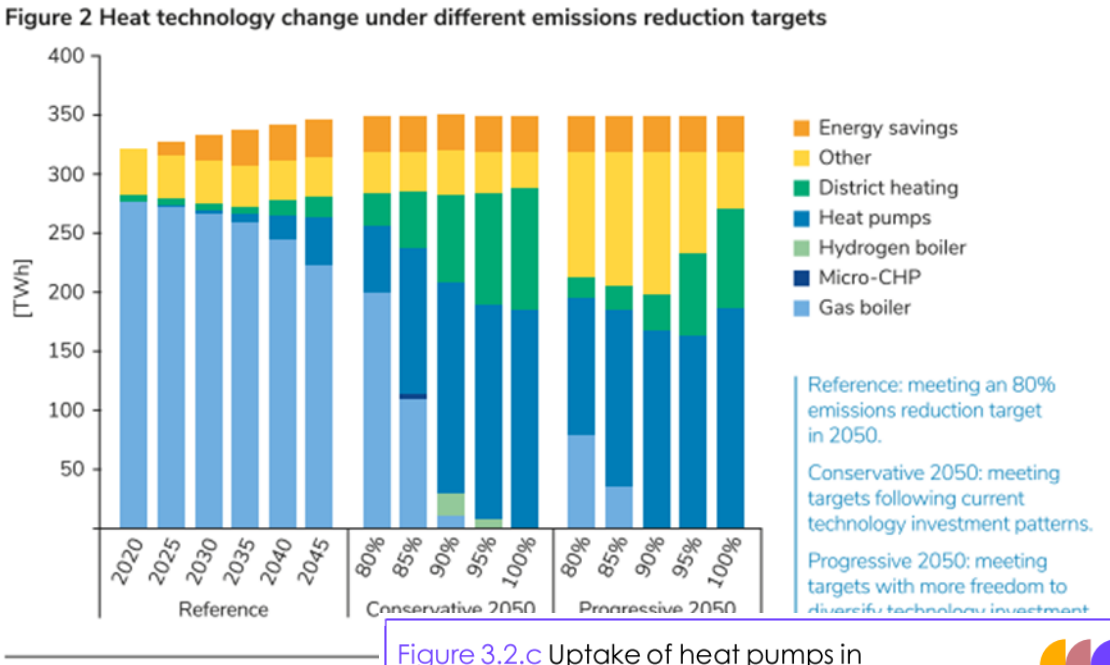
What is potentially good about hydrogen for heat?

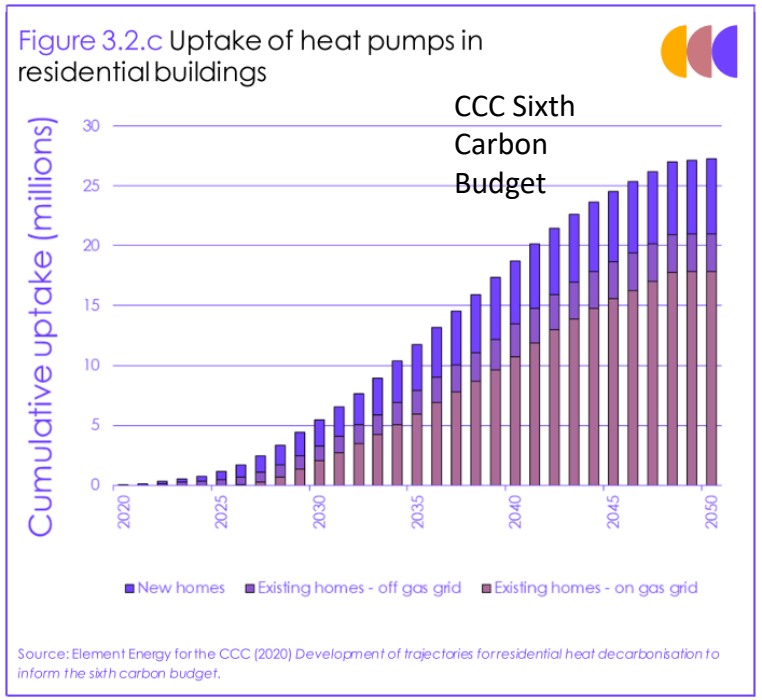
- ✓ Can be a low carbon energy vector.
  - Must be produced from low carbon electricity
  - Could be produced from fossil fuels **IF** CCS works
- ✓ Can use existing pipes
  - Subject to major investment in the gas grid
  - Subject to tests over safety
  - Would need geographical switch-over
- ✓ Could reduce the need for internal modifications to buildings
  - ✓ Subject to all the previous elements coming together.

The bad

- Using hydrogen en-mass for heating looks like an expensive option.
  - Going from 80% to net zero killed blue hydrogen at scale. Green is $
- Even with the repurposing of the gas grid, heat pumps (and district heating) always appear to be more cost effective.
  - Continued high opex costs
- Potentially some cost-effective role for hybrids near industrial areas

https://ukerc.ac.uk/publications/net-zero-heating/





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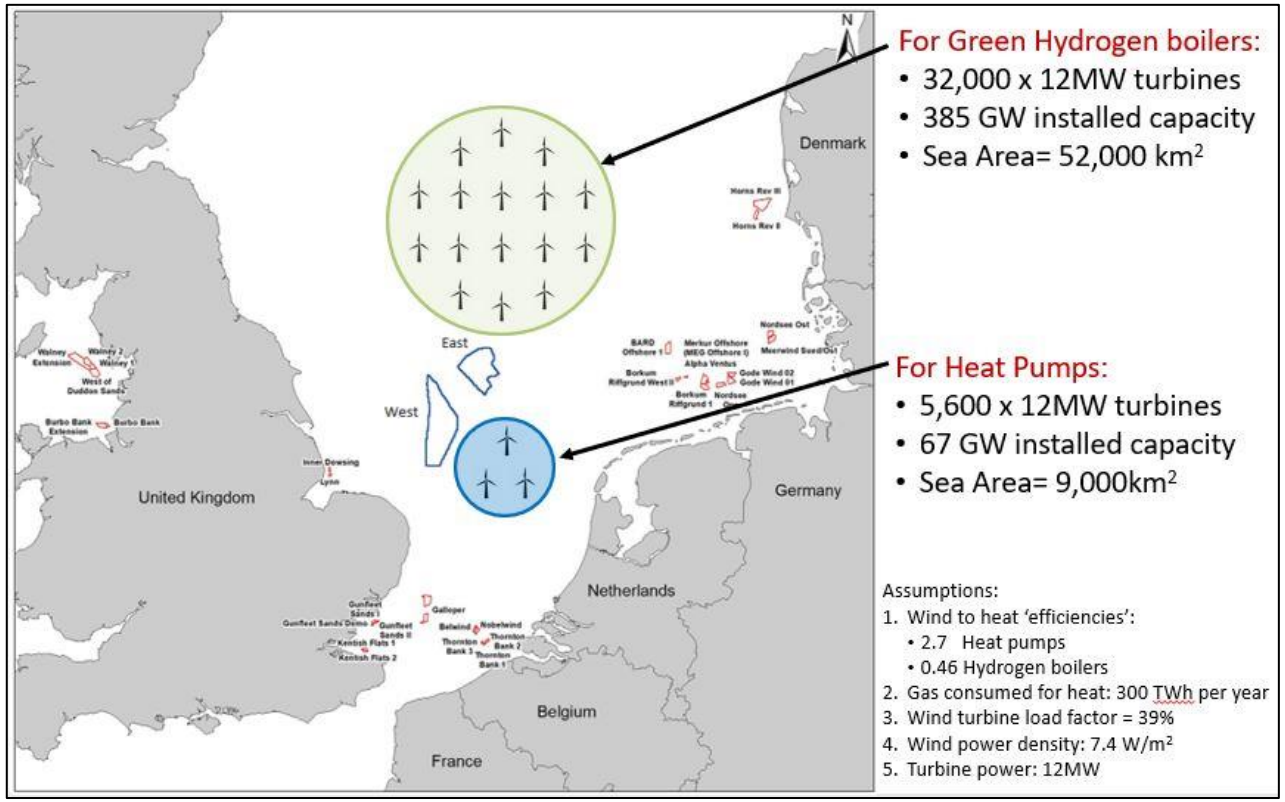
The bad continued

- Discounting ‘blue’ hydrogen, producing green hydrogen at scale would be extremely resource intensive compared to electrification.
  - This is fundamentally due to systemic inefficiency.
- A lot more resource and embodied carbon and obvious cost knock-ons.



http://www.csrf.ac.uk/2020/09/hydrogen-for-heating/

The ugly?

Energy giants' lobbying fuels the rise of hydrogen

Shell and BP want the controversial gas in families' boilers. They're pushing hard. By John Collingridge

Sunday May 02 2021, 12.01am, The Sunday Times

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Heating in Great Britain: An incumbent discourse coalition resists an electrifying future

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ABSTRACT

The power of incumbent actors to affect sustainability transitions is increasingly recognised as a central issue associated with systemic change. However, incumbent's approaches and the outcome of their influence is rarely examined in academic literature. Using a novel approach which combines the lens of 'discourse coalitions' with an explicitly critical discursive stance, in which the coalition's storyline is scrutinised, this interdisciplinary analysis investigates a pro-gas, incumbent led coalition present in the Great Britain (GB) energy system. In response to the threat of electrification, the coalition presents decarbonising the gas grid with replacement gases as the optimal route for heat decarbonisation. However, much analysis suggests a significant need for heat electrification and our review highlights major uncertainties with a decarbonised gas pathway. Incumbents are over-selling 'green-gas' to policy makers in order to protect their interests and detract from the importance and value of electrification. Policy and research recommendations are made.

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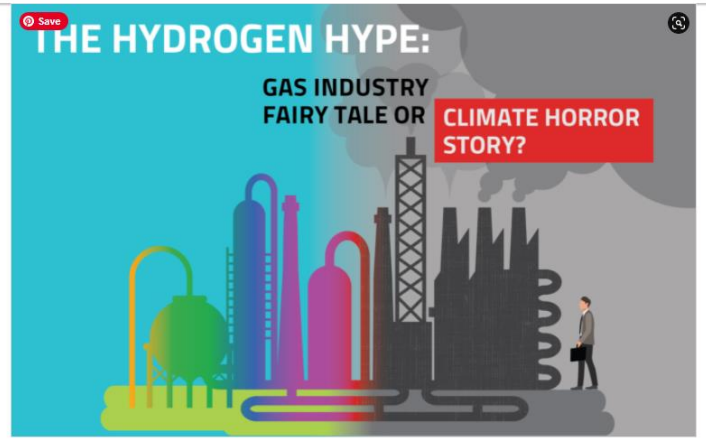

The value of hydrogen

- 1. Provides instantaneous high temperatures when burnt.
- 2. Storage of energy.
- But inefficient and pricey.
- Therefore for heating it should be targeted at peaks or niches:
  - Hybrid heat pumps
  - Electricity and heat network balancing

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Ignore hype over hydrogen heating, government told

By Roger Harrabin
BBC environment analyst

3 days ago

Climate change

Conclusions

SPIEGEL climate report

The (too beautiful) dream of green hydrogen

*By **Kurt Stukenberg** , Deputy Head of Science*

"Hydrogen is the very expensive champagne of the energy transition" - but you don't drink it at every opportunity, only on special occasions. As a thirst quencher, it would be too expensive.

Hydrogen – demand side merit order by sector

Liebreich Associate

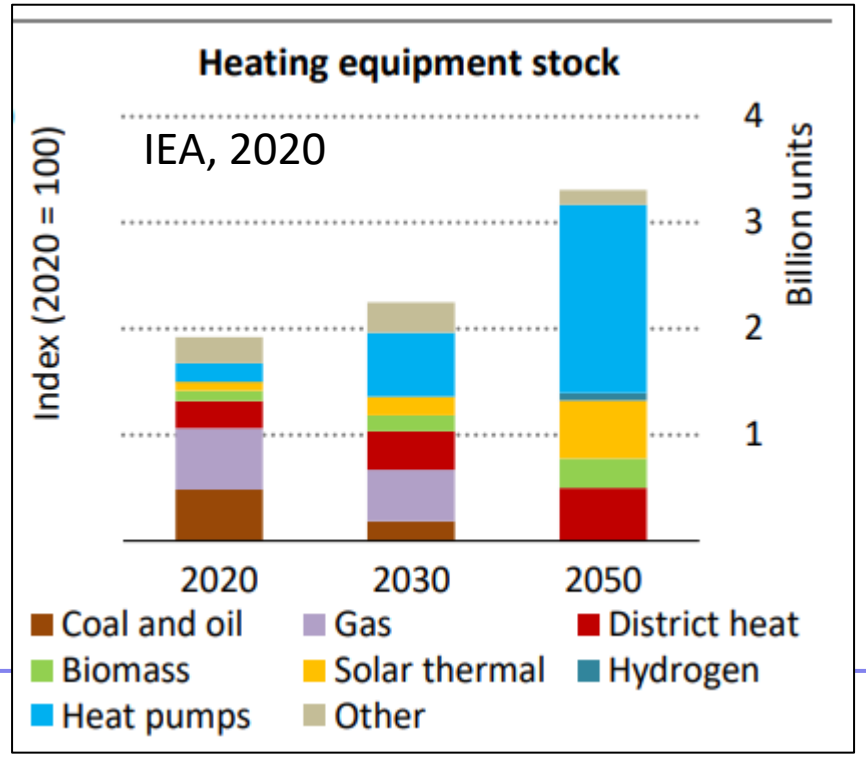
ENERG

HYDROGEN Use Cases

A	Fertiliser	Methanol	Olefins	Hydrocracking	Desulphurisation	Food industry
B	e-Fuels, long-haul aviation	e-Fuels, shipping	Steel	Local CO2 remediation		
C	Transcontinental trains	Seasonal power storage	e-Fuels, specialist and legacy vehicles			
D	High-T industrial heat	Long distance trucks	Coastal and inland vessels			
E	Commercial heating	Island grids	Clean power imports	Local ferries		
F	Mid/Low-T industrial heat	Domestic heating	Regional trucks	Regional and metro trains		
G	H2FC cars	Urban delivery	Bulk e-fuels	Light aviation	Power system balancing	

Source: Michael Liebreich/Liebreich Associates Concept: Adrian Hiel/Energy Cities

16 09 May 2021



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References

- Climate Change Committee, 2020. The Sixth Carbon Budget The UK's path to Net Zero. London.
- IEA, (2020), Net zero by 2050, https://iea.blob.core.windows.net/assets/4719e321-6d3d-41a2-bd6b-461ad2f850a8/NetZeroby2050-ARoadmapfortheGlobalEnergySector.pdf
- IPCC, (2018), Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C
- Lowes, R., Woodman, B., Speirs, J., 2020. Heating in Great Britain: An incumbent discourse coalition resists an electrifying future. Environ. Innov. Soc. Transitions 37, 1–17. https://doi.org/10.1016/j.eist.2020.07.007
- Our World in Data, 2020. Why did renewables become so cheap? https://ourworldindata.org/cheap-renewables-growth
- Rosenow, A.J., Lowes, R., Hawker, G., Wu, J., Gross, R., 2020. The pathway to net zero heating in the UK. London. https://doi.org/10.5286/ukerc.edc.000941