

Potential Applications of Hydrogen as an Energy Vector in GB Decarbonisation

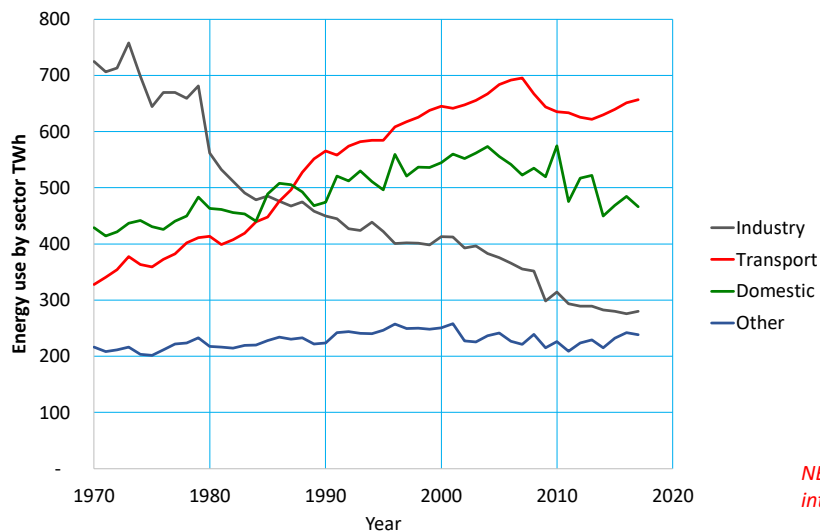
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UK energy use by sector

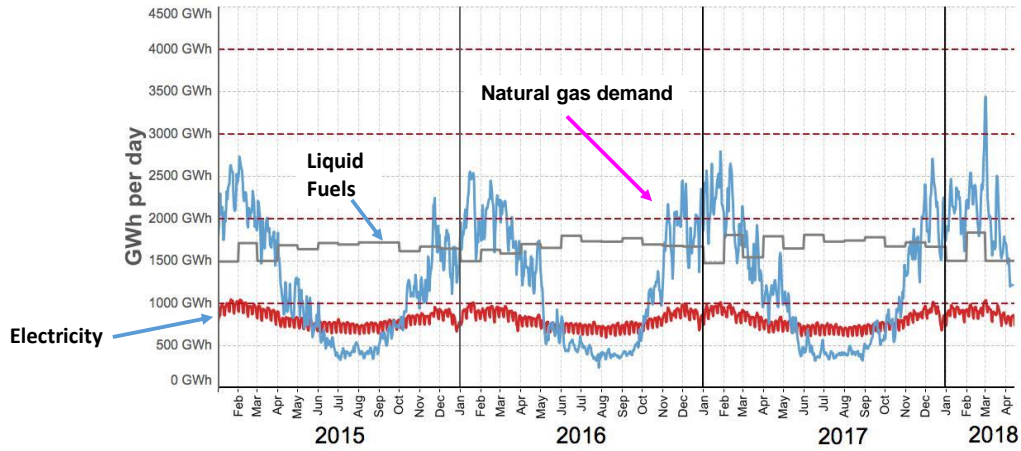


*NB: excludes
international transport*

Source: Digest of UK Energy Statistics (DUKES) 2018

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Daily energy demand



Data are from National Grid, Elexon and BEIS. Charts are licensed under an Attribution-NoDerivatives 4.0 International license
 Charts can be downloaded from <http://bit.ly/energycharts>



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Hourly energy use, 26 February to 5 March 2018

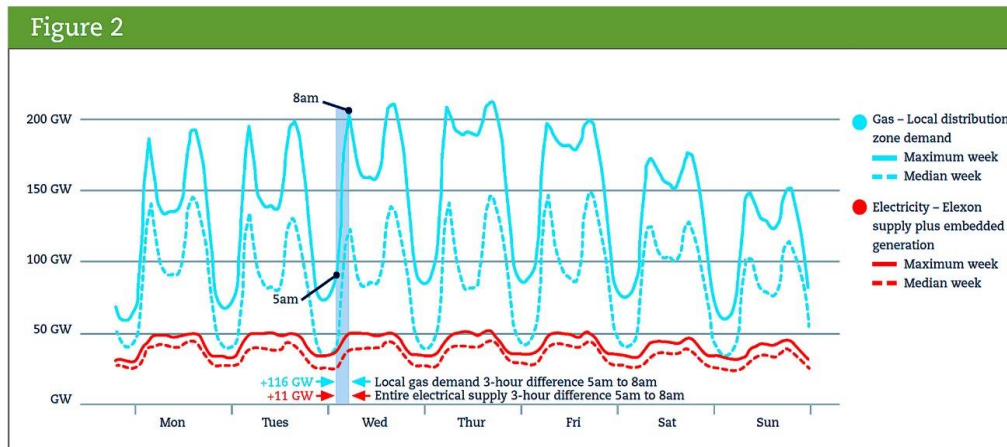


Figure 2: Britain's local gas demand and electrical system supply - median and maximum demand weeks. The week dating 22nd to 28th January is the median demand week for the 2017–2018 heating season. The week dating 26th February to 5th March represents the maximum demand week of the 2017–2018 heating season.

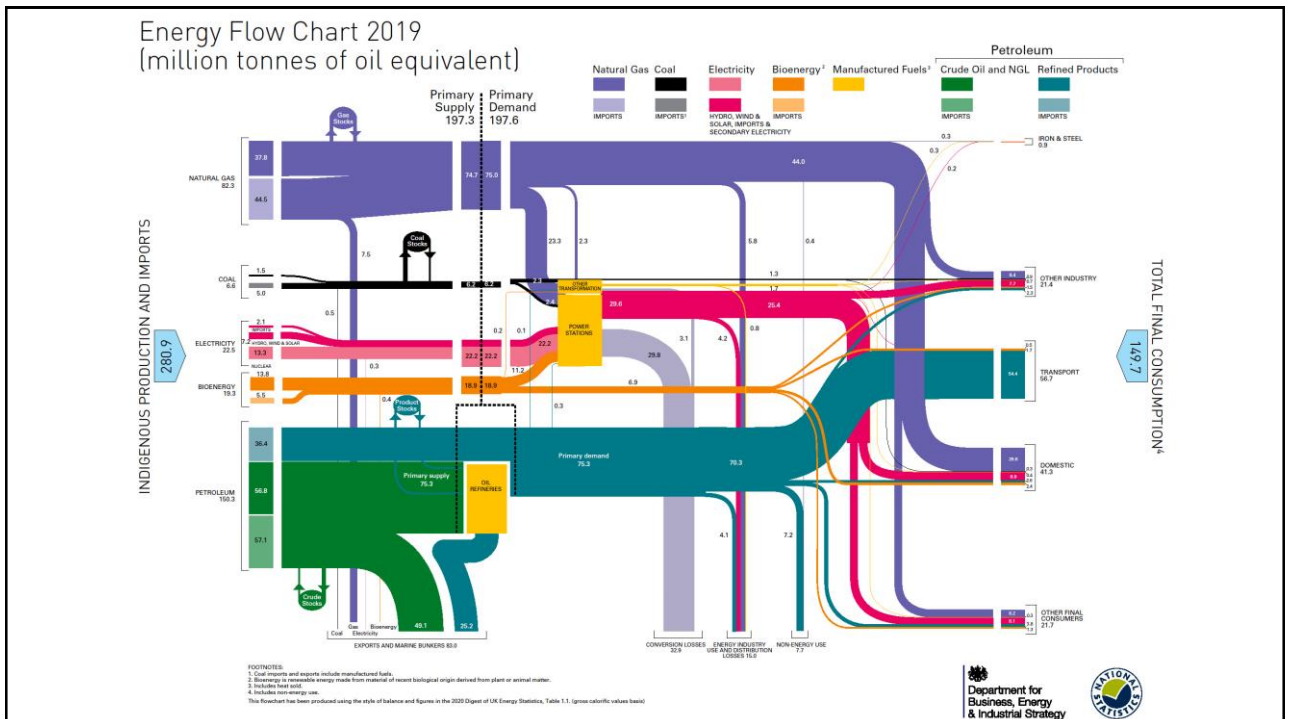
Source: *Challenges for the decarbonisation of heat: local gas demand vs electricity supply; winter 2017/2018*, UKERC.

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GB energy demand

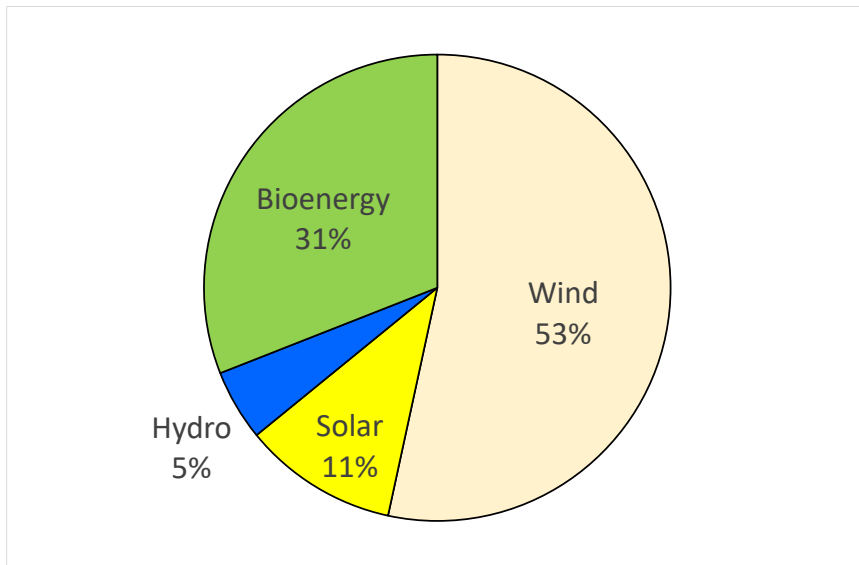
- Power demand varies between 25 GW and 250 GW
- Daily energy demand varies between 1000 GWh and 4500 GWh (including transport and heat)
- Large differences between winter and summer

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Renewable generation 2019



Source DUKES 2020

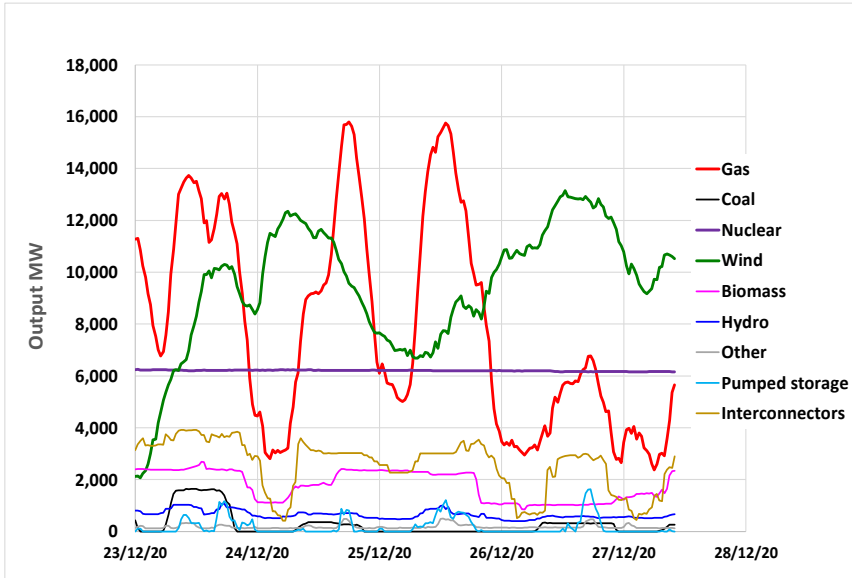
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Most UK hydro installations are small



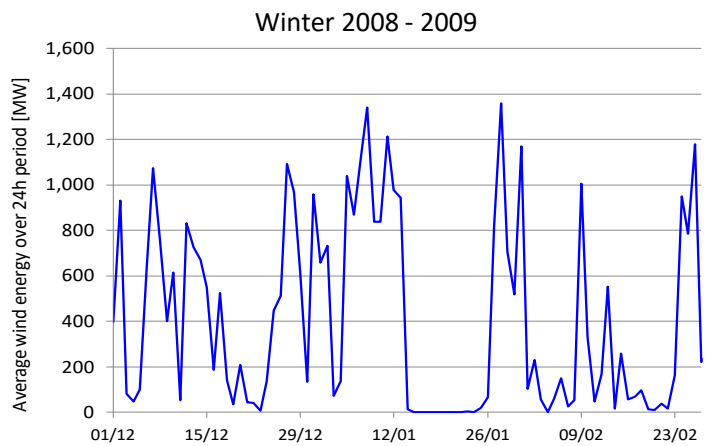
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Christmas 2020 – GB electricity supply



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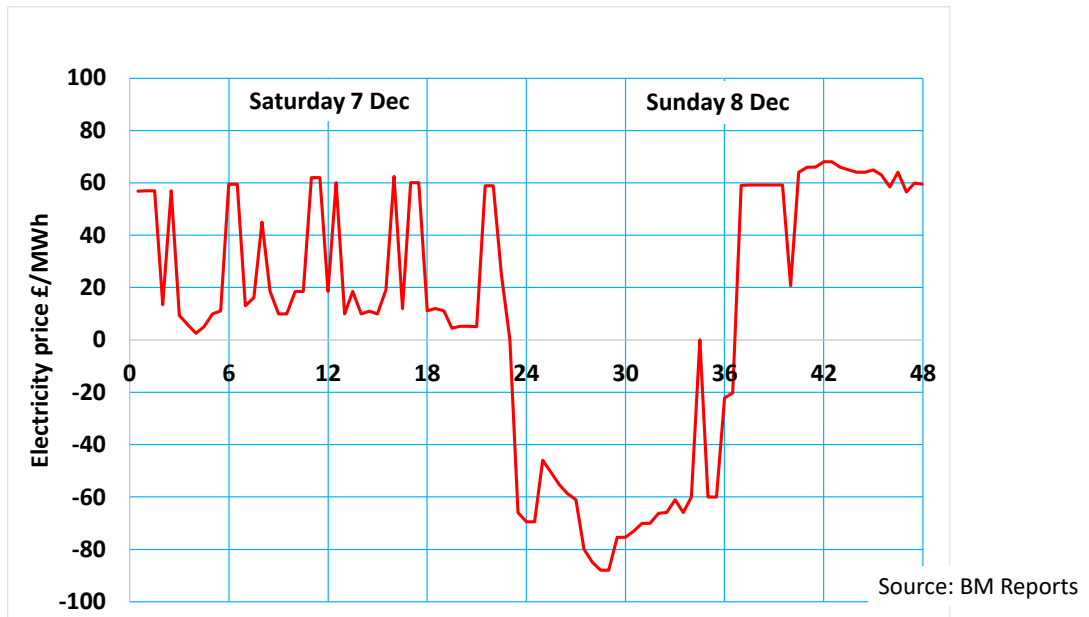
Coping with intermittency



Data for grid-connected wind farms from BM Reports

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Negative electricity prices 7 – 8 December 2019



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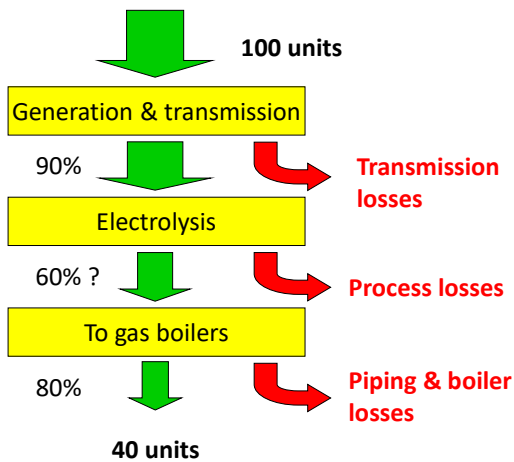
Decarbonisation challenges – GB energy supply

- Most zero-carbon renewable electricity is from wind and solar
'Use it or lose it'
- Energy demand varies by season and time of day
- It would be too expensive to build enough renewable capacity to meet peak demand
- Energy storage is essential – hydrogen is a good way of providing it

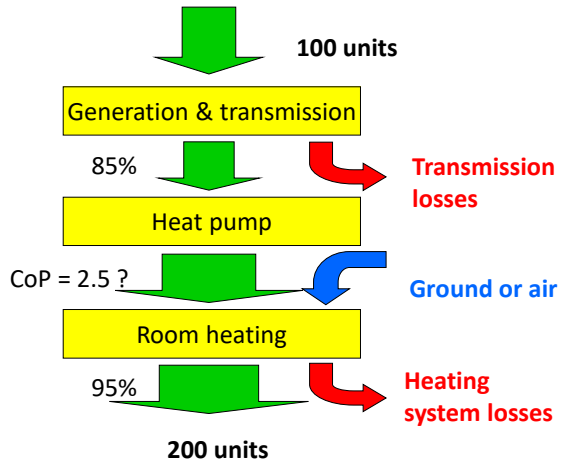
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Using wind for domestic heating

Convert electricity to H₂
and burn it in a gas boiler



Use electric directly in a heat pump
(no storage ability)



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How best to use hydrogen (H₂) – five questions

- Hydrogen (H₂) made by electrolysis is a good way of storing surplus renewable energy.
- Should the country also generate large quantities of H₂ from natural gas, using carbon capture and storage (CCS)?

$$\text{CH}_4 + 2\text{H}_2\text{O} \rightarrow \text{CO}_2 + 4\text{H}_2$$
- Should H₂ be compressed and used for transportation?
- Should H₂ be injected into the natural gas (CH₄) grid for industrial and domestic use?
- Should H₂ be converted back into electricity, when needed, using a fuel cell, and fed into the grid?

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Questions?