

**Response from Dr Jonathan Radcliffe and Dr Tom Fender,  
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***Question 11: What barriers exist to the long term growth of the hydrogen sector beyond 2030 and how can they be overcome? Are any parts of the value chain (production, storage, transportation) more challenging than others and if so why?***

**Key points:**

- **Any growth in hydrogen infrastructure needs to be based on a better understanding of dispersed industrial energy use, and other local contextual factors.**
- **Interdependencies between industrial and domestic energy use make cross-sector and cross-scale analysis essential when considering decarbonisation options.**
- **Dispersed and small industrial energy users lack information on the merits of hydrogen vs electrification vs CCS for decarbonisation, the timescales over which different options might be available and how to prepare for the future.**

Industry is recognised as a sector in which hydrogen can play an important role for decarbonisation, but there is a lack of understanding as to how different sub-sectors use energy across the country, particularly amongst the smaller clusters and manufacturing base away from the large coastal sites. These dispersed sites are responsible for about half of industrial GHG emissions.

In order to decarbonise industry with hydrogen (or other appropriate solutions) and plan infrastructure requirements, we need first to assess what the local/regional energy demand is, and how it is consumed. Setting this alongside the energy demands from other sectors, and examining how demand and technology could change over time, will help avoid investment in under-used infrastructure or lock-in to inefficient/ineffective technology pathways.

As part of 'Repowering the Black Country', an industrial cluster decarbonisation project funded by UKRI and BEIS, several developments have been earmarked as potential 'zero carbon hubs' where businesses and industries co-locate. One potential hub is a brickworks in Walsall, a high CO<sub>2</sub> emitter that could be decarbonised by replacing natural gas with hydrogen. Electrification is unlikely to be a solution due to the high temperature processes entailed within the manufacturing process. The brickworks is located near to an industrial estate, but not other energy-intensive industries. As such the natural gas network supplying the industrial complex is the same one supplying surrounding businesses and domestic properties. Therefore, to decarbonise this firm, possible solutions would be:

- a) Decarbonise the local gas network, requiring conversion of all local domestic and industrial consumers to hydrogen, synthetic gaseous fuels or blends.
- b) Lay a pipeline for low carbon fuels from a central supply point to the site of the brickworks, which could act as a local zero carbon hub.
- c) Relocate the brickworks to a planned (or existing) supply of low carbon fuel.
- d) Produce hydrogen on site, through electrolysis or SMR with CCUS.

Each option has implications for infrastructure that go beyond isolated consideration of hydrogen as a vector to meet an identified demand, or industry as the consumer – the analysis needs to include wider socio-economic factors and impacts that take into account cross-sector and cross-scale interdependencies.

Though this is a specific case, it is an example of an endemic challenge for UK energy infrastructure development, and a barrier to the decarbonisation of smaller distributed emitters, that are significant when aggregated. Finding solutions requires collaboration across that reflect local and national priorities.

Whilst hydrogen is one possible solution to decarbonising smaller industry, current ongoing research is aiming to provide a robust framework in which smaller industrial units can assess which option is best for them. It may be that for many smaller sites, carbon capture, or electrification is a more economically viable option. However, currently there is no one 'catalogue' of options, describing the dis/advantages of each decarbonisation solution, and we find that firms are unclear what steps to take to prepare for the future.

Our ongoing research, through the Black Country project and with the Industrial Decarbonisation Research and Innovation Centre (IDRIC), aims to identify where and how similar challenges present themselves geographically across the United Kingdom. This more granular analysis of energy use will inform our conclusions on infrastructure needs. We will be happy to discuss further and share our emerging results with you as the projects progress over the next two years.

*Submitted by Dr Jonathan Radcliffe, 4<sup>th</sup> February 2022*

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