HYDROGEN 2030

COMBATTING INTERMITTENCY OF RENEWABLES

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The Politics

In a recent article for the Guardian, our new Prime Minister, Andy Burnham, wrote:

“The only lasting way to bring down bills is to produce more of our own clean, renewable energy at home.”

The Leader of the Opposition, Kemi Badenoch, disagrees. In a speech in August, she said:

“The targets to cut greenhouse gas emissions…are making electricity so expensive barely anyone can afford to adopt clean technologies.”

It is not unusual for politicians to look at the evidence and reach diametrically opposed conclusions. But this disagreement extends well beyond politics. The Climate Change Committee, NESO, DESNZ and the Royal Society broadly support the proposition that a power system dominated by renewables can deliver lower-cost electricity. The Tony Blair Institute reaches a different conclusion, as does the energy economist Dieter Helm.

The disagreement is not principally about whether wind and solar are cheap to generate. They are. It is about the additional cost of matching intermittent supply with more consistent demand for power. A renewable-dominated system requires generating capacity significantly above peak demand, leading to periods of curtailment, while also requiring sufficient flexible capacity to meet demand when renewable output is low. More distributed generation can also require substantial additional investment in respect of new and upgraded electricity networks. The relevant comparison is therefore the whole-system cost of providing reliable, low carbon electricity, rather than simply the cost of generating each MWh.

Hydrogen could have a role to play in addressing both sides of this problem.

Dispatchable Hydrogen Generation

There are four elements needed to enable successful dispatchable generation – fuel production, transport and storage along with power generation. Fossil (or ‘natural’) gas makes up most of the dispatchable generation today. Gas is extracted from the North Sea or delivered as LNG, transported using our extensive existing gas network, stored offshore or in salt caverns and then power is generated using turbines or engines. Hydrogen decarbonises this approach.

In the absence of ‘geologically sourced’ hydrogen, production will rely on both reforming of fossil gas with carbon capture and storage (CCS) or water electrolysis. Both are mature technologies

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with several projects, such as the EET Hydrogen and Trafford Green Hydrogen representing projects under development in the North West of England. These can produce a supply of hydrogen that requires storage in large quantities to enable meeting of demand from hydrogen to power (H2P) facilities, which are essentially switched on when customer demand for power outstrips renewable production.

A network is required to carry hydrogen from production to storage and generation. Transport of hydrogen is well understood. It has been distributed by pipeline across chemical and refinery dominated regions for decade. Gas distribution network operators such as Cadent are developing new build systems to enable hydrogen power generation and to deliver hydrogen to industrial users, for example as part of the HyNet project in the North West of England.

Hydrogen's primary advantage in the energy system is the relatively low cost of storage. Large scale storage of hydrogen is orders of magnitude cheaper than storing electricity in batteries or pumped hydro systems. Offshore systems can store hydrogen across seasons or years, whilst onshore salt caverns can store hydrogen for days or weeks to meet demand for power, much as they have done for decades in respect of storing fossil gas. Companies like Storengy are currently developing caverns for hydrogen storage in Cheshire as part of HyNet.

Hydrogen generation can play many roles in the power system. Firing of hydrogen in combined cycle gas turbines (CCGTs) could operate on a mid-merit basis in the same way as existing fossil gas-fired CCGTs while open cycle turbines or reciprocating engines are more likely to operate at low load factors to provide system resilience.

Hydrogen's flexibility is important. The generation, network and storage infrastructure allows it to be used in a range of system scenarios. This gives it a role in either the Burnham or Badenoch future.

The Longer Term

Periods when renewable generation exceeds demand are already a growing feature of UK, European and US power systems, creating periods of very low or even negative wholesale prices. Technologies able to exploit intermittent low-cost electricity should become increasingly valuable as renewable capacity grows.

Green hydrogen is a strong candidate, provided that electrolyser costs fall sufficiently. Cheap storage allows hydrogen production to be separated in time from its eventual use, potentially converting surplus renewable generation into energy that can be stored across days, seasons or even years. Infrastructure developed now for dispatchable hydrogen generation would therefore have significant option value: it can support firm low carbon generation in the near term while providing the infrastructure needed to exploit much larger quantities of renewable electricity in the future.

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Making It Happen

The potential role is already recognised across the political divide. In her 2024 Chatham House speech, Claire Coutinho, now the Shadow Secretary of State for Business and Trade, identified hydrogen-fired generation as one potential solution to the intermittency of renewable generation.

The challenge is coordination. Dispatchable hydrogen generation requires production, transport, storage and power generation to develop together. Companies are investing across each part of that value chain, but no individual project can create the system alone. Progress now depends on Government establishing the commercial frameworks that allow those investments to proceed concurrently.

The next step is imminent. Government has committed more than £500 million to support the UK's first regional hydrogen transport and storage network, with the first contracts under the Hydrogen Transport and Storage Business Models to be awarded through the Regional Hydrogen Network competition. The competition provides an opportunity to bring together hydrogen production, transport, storage and users – including dispatchable power generation – into the UK's first integrated hydrogen system. After several years spent developing the policy and commercial frameworks, the building blocks are now largely in place. The priority is to move decisively from designing the hydrogen system to building it.

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