Hydrogen

A Friends of the Earth Scotland briefing

September 2020

Summary

Friends of the Earth Scotland has deep concerns about large scale plans to develop hydrogen in Scotland. The following brief outlines that:

- Blue Hydrogen (from gas) should not be developed or relied upon to decrease emissions due to its reliance on both fossil fuels and unproven Carbon Capture Storage (CCS) technology.
- Hydrogen in heating is a distraction from more readily available options such as better home insulation and heat pumps.
- Hydrogen in transport is an inefficient and expensive use of renewable electricity, which should be used to directly power electric vehicles rather than converting electricity to hydrogen power.
- Scotland should be aiming for 100% domestic generation (not just consumption as per the current target) of renewable electricity by 2030. Priority in the first instance should be on increasing generation of renewable electricity, rather than directing renewable electricity to make hydrogen.
- The main focus for renewable electricity must be on directly meeting demand across homes, buildings, transport and heating with only surplus electricity used to make green hydrogen.

Overview

Hydrogen is gaining prominence in climate discussions, with proponents offering hydrogen as a solution for the decarbonisation of heat, transport and industry. However, hydrogen production is expensive, inefficient and, at scale, is far from a low carbon solution. The UK Committee on Climate Change warns that hydrogen "is not a 'silver bullet' solution".

Hydrogen gas can be produced from a diverse range of sources including fossil fuels, biomass, and through the process of electrolysis by splitting water into its component elements oxygen and hydrogen. Globally, hydrogen produced from emissions intensive natural gas - often called Grey Hydrogen - dominates the market/industry, representing three quarters of all hydrogen produced.[1] Green hydrogen, from renewable electricity, accounts for less than 0.1% of total production.[2]

The role of hydrogen in decarbonising sectors such as transport and heat is currently being explored by the Scottish Government, with a number of hydrogen projects outlined as likely recipients of support from the £62 million Energy Fund announced in June 2020.

The publication of Scotland's first Hydrogen Action Plan later this year, along with the projects highlighted in the Energy Fund, indicate that the **key forms of production likely to be pursued in Scotland will be fossil fuel generated hydrogen** with Carbon Capture

[1] https://www.iea.org/reports/the-future-of-hydrogen

[2] https://www.iea.org/reports/the-future-of-hydrogen

Utilisation and Storage (CCUS), also known as **Blue Hydrogen,** and **hydrogen generated from renewables** using the process of electrolysis, also known as **Green Hydrogen.**

Blue Hydrogen relies on unproven technology

Blue hydrogen (made from gas) continues demand for fossil fuels and relies on the rapid upscaling of Carbon Capture and Storage (CCS) to capture emissions. However to date the scale of **CCS necessary to reduce emissions at the level required has not been demonstrated anywhere in the world.**[3] CCS projects have, for decades, received billions in investment with little success and allow fossil fuel companies to claim that a silver bullet solution to reduce emissions is soon to be created, whilst doing very little to address a just and managed phase out of fossil fuels. The best way to reduce emissions is not to create them in the first place rather than relying on this technology which may never work.

Green Hydrogen is an inefficient use of renewable electricity

The creation of green hydrogen relies on there being an abundance of low-cost renewable electricity[4] and widespread deployment of electrolysers, which are used to create green hydrogen with the use of an electric current. At present electrolysis is still an energy intensive process and there is a limited supply of electrolysers with **only 0.1% of global hydrogen** produced by water electrolysis in 2019.[5]

In 2019, **only 51.7% of electricity generated in Scotland came from renewable sources**. Green hydrogen would be made by **diverting that primary renewable electricity and inefficiently converting it into hydrogen,** with significant efficiency loss. As much as 40-60% of energy may be lost during the conversion process[6].

In order to meet our new climate targets Scotland should be aiming to reach 100% domestic generation (not just consumption as per the current target) of renewable electricity by 2030, and reaching 85% of our total energy use from renewables by 2030.

Truly Green Hydrogen is extremely limited and highly expensive

While the top priority for renewables should be to create electricity for direct use, there will be circumstances, for instance in remote areas or to supply hard-to-abate industries, where using renewable power to make green hydrogen might make sense. An example of this can be seen in the Surf N Turf project in Orkney which uses wind and tidal turbines to create locally generated hydrogen to meet electricity grid demands, reducing imports of fossil fuels to the island.[7] However, **the upscaling of green hydrogen nationwide represents a real risk of diverting efforts away from cheaper and more readily available options.**

Although there may be the potential in the future to generate hydrogen from renewables using excess energy at times of low demand, truly **Green Hydrogen power is extremely**

---

[3] https://foe.scot/resource/bioenergy-carbon-capture-storage-briefing/
[4] https://www.iea.org/commentaries/the-clean-hydrogen-future-has-already-begun
[5] https://www.iea.org/reports/the-future-of-hydrogen
[6] https://www.sciencedirect.com/science/article/abs/pii/S1364032116305366?via%3Dihub
[7] https://www.communityenergyscotland.org.uk/surf-n-turf.asp

limited. The UK Committee on Climate Change (2018) highlights that the quantity of hydrogen is likely to be low in comparison to the potential scale of hydrogen demand and that ***"producing hydrogen in bulk from electrolysis would be much more expensive and would entail the extremely challenging build rates for zero-carbon electricity generation capacity".***[8]

Reliance on hydrogen could lock us into high carbon pathways

The technical and financial barriers to Green Hydrogen mean that if it were to become feasible we would not be able to implement it at the scale required until at least 2030. If we are to meet our climate target of 75% emissions reduction by 2030 we fundamentally do not have the time to waste waiting for Green Hydrogen to be ready. Blue and grey hydrogen projects that rely on fossil fuels are considered by industry to be more viable alternatives in the short to medium term due to their comparative cheapness from a potentially steady supply of gas[9]. This indicates **worrying potential for any reliance on fossil hydrogen to not only lock us into high carbon emission pathways from continued fossil fuel production, but actually increase demand for natural gas in Scotland[10].**

Hydrogen is not the solution for heating

To date, no country in the world has managed to decarbonise their heat supply with pure hydrogen. A grid that uses 100% hydrogen would require large scale CCS to capture the emissions generated from the conversion process which, as previously outlined, has yet to be evidenced at the scale required. **Green hydrogen is not a viable alternative as it relies on an excess of renewables and electrolysis, and is considerably more expensive than fossil hydrogen.**

There is another role that's been suggested for hydrogen in heating called blending, a process where some hydrogen can be mixed with natural gas. A safe level of hydrogen to blend with is considered to be approximately 20% due to hydrogen's propensity to corrode steel pipes and is currently being explored in a small project in North East England. Nonetheless, should the project prove feasible to scale up **a 20% hydrogen blend** has been estimated to **only reduce the UK's carbon emissions by 6 million tonnes[11]** which is **less than 2% of total emissions emitted in 2019.[12]** To meet our targets, we must aim for total decarbonisation of heat systems. Further, the incompatibility of hydrogen with existing pipeline infrastructure indicates that a like for like replacement of gas with hydrogen would require a complete replacement of existing pipelines. **The Committee on Climate Change (2018)[13] also highlight that *"the costs of having an extensive gas grid do not automatically mean that it will be lower cost to switch it over to hydrogen and use it in boilers as we do with natural gas".***

---

[8] https://www.theccc.org.uk/publication/hydrogen-in-a-low-carbon-economy/
[9] https://www.iea.org/commentaries/the-clean-hydrogen-future-has-already-begun
[10] https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/pages/4/
[11] https://hydeploy.co.uk/faqs/much-difference-20-hydrogen-make-uk-carbon-emissions/
[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875485/2019_UK_greenhouse_gas_emissions_provisional_figures_statistical_release.pdf
[13] https://www.theccc.org.uk/publication/hydrogen-in-a-low-carbon-economy/

Rather than backing inefficient and fossil fuel reliant hydrogen in heating, priority should instead be on investing into the electrification of heat, widespread adoption of heat pumps, heat networks and ensuring that homes are built or retrofitted to the highest efficiency standards, making them easier to heat and supporting the eradication of fuel poverty.

Hydrogen vehicles are inefficient and unnecessary to decarbonise transport

The Scottish Government has increasingly been providing support for renewable electricity dependent hydrogen buses (e.g in Aberdeen) as a way to decarbonise transport which is Scotland's largest emitting sector accounting for approximately 37% of total emissions. However, **using electricity to create hydrogen rather than to directly power vehicles is extremely inefficient.** Electric bus fleets have been shown to produce lower levels of cumulative emissions compared to hydrogen,[14] and along with cars and small trucks are cheaper to run than hydrogen fuel cell vehicles.[15] Our priority should be expanding our electric bus fleets and with manufacturing companies like Alexander Dennis already in Scotland, protecting and expanding these jobs should be the focus.[16]

For more information contact:
Jessica Cowell
Climate Campaigner
jcowell@foe.scot | 0131 243 2711

[14] https://www.sciencedirect.com/science/article/pii/S136192092030537X0
[15] https://data.bloomberglp.com/professional/sites/24/BNEF-
[16] Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf
https://foe.scot/good-green-jobs-at-alexander-dennis-under-threat/