Hydrogen's Role in Scotland's Climate Journey

Executive Summary and Recommendations

Hydrogen is being posited as a low-carbon solution to decarbonising Scotland's economy. Proponents argue that the gas, which can be extracted from fossil fuels or renewables, could help cut greenhouse gases in sectors currently reliant on oil and gas, including transport, heating and industry.

However, the evidence suggests this is far from certain. A number of challenges arise from producing and using hydrogen that fundamentally call into question its role in the just transition.

High carbon emissions

Far from being low-carbon, today's hydrogen production is responsible for huge greenhouse gas emissions – around 830 million tonnes of CO_2 a year. Blue hydrogen – where emissions are captured and stored – is in its commercial infancy in the UK. Research highlights that carbon capture rates at actually operating hydrogen facilities only capture around 60% of emissions – well below industry targets. Even if high capture rates were to be achieved, it is unlikely that blue hydrogen plants would meet UK carbon reduction targets in the next decade.

Huge levels of renewable energy

Though lower carbon than grey (where no emissions are captured) or blue hydrogen, green hydrogen nevertheless has drawbacks. The most significant of these is the vast levels of renewable energy required to create green hydrogen. For example:

- 5 GW of green hydrogen would require 80% of current renewable energy generation in Scotland – solely to meet green hydrogen energy demands
- Using green hydrogen to meet Scotland's heating demand would require 180% more renewable energy than Scotland produces currently
- Adopting green hydrogen in industry would require nearly twice as much new renewable energy capacity compared to electrification technologies.

Low efficiencies

Though its potential end uses are numerous, hydrogen is a fairly inefficient energy vector, with lots of energy lost along the hydrogen conversion chain. This means that electrification technologies – including cars, heat pumps, batteries etc – are often more efficient in terms of energy, generally cost less, and are more advanced commercially.
For example:

- Electric heat pumps may be 168 – 342% more efficient than hydrogen boilers
- Hydrogen boilers may be 53 – 68% more expensive than electric heat pumps
- Electric vehicles are more than twice as energy efficient than hydrogen fuel cell vehicles.

Hard to decarbonise sectors

There are, however, some sectors where hydrogen may have a role to play in decarbonisation strategies. For example, heavy transport like ships and aeroplanes cannot easily be electrified, and so hydrogen could be used as a combustion fuel or in a fuel cell. Even so, challenges remain in terms of storing hydrogen in a cost competitive way.

Industrial applications – for example high temperature heating and as industrial feedstocks to make petrochemical products – could be sectors where hydrogen plays a decisive role alongside other electrification technologies in Scotland. More research is needed to understand how hydrogen and electrification technologies can be used in this way. There is also a need for clear analysis into how the oil, gas and petrochemical industries will transform away from fossil fuels, therefore requiring less hydrogen for refining, as Scotland transitions to a low-carbon economy over the next twenty five years.

A targeted role for hydrogen in Scotland

Given that low carbon blue hydrogen production is far from certain, that unsustainable levels of renewable energy are needed for green hydrogen production, and that electrification technologies are more competitive than hydrogen technologies in heating and transport, we call for a limited, targeted application of hydrogen in Scotland that prioritises green hydrogen production only to be used in sectors where direct electrification is not possible.

Prioritising hydrogen in this way would lessen the risk of locking Scotland into using an inefficient energy resource for decades to come. It would also ensure that renewable energy is not entirely diverted to green hydrogen production and is able to continue decarbonising all sectors of the economy – crucial if Scotland is to meet its legally binding carbon reduction targets.

Recommendations

- The Scottish Government must not support the development of hydrogen derived from fossil fuels (blue or grey), in line with the urgent need for a phase out of fossil fuels to stay within the 1.5°C temperature limit set by the Paris Agreement.
- Any funding for blue or grey hydrogen and associated carbon capture and storage (CCS) should instead be redirected to renewables and energy efficiency, as part of a just transition of the energy system.
- Recognising the greater efficiency, lower costs and lower emissions of electrification when compared to hydrogen, the Scottish Government must prioritise electrification over hydrogen, particularly in heating and transport, and support the use of green hydrogen only in sectors where direct electrification is not possible.
- Any renewable energy intended for green hydrogen production must be sourced from additional or surplus renewable energy capacity. This will ensure renewables are not diverted from decarbonising the electricity grid and prevent the need for fossil fuels to fill the gap.