‘Green’ hydrogen and international development: a short informational report

What is ‘green’ hydrogen?

Molecular hydrogen (H_2) is a gas at room temperature and pressure. It is colourless and odourless; any ‘colour’ attributed to it refers only to its origins or production. Various colours are used, but current environmental debates mainly concern ‘blue’ and ‘green’ hydrogen. ‘Blue’ hydrogen is produced from methane (CH_4) – the main component of natural gas – and water (H_2O) via ‘steam methane reforming’. The two-step process involved can be summarised and simplified as: $CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$. It also requires a considerable input of energy. ‘Blue’ hydrogen is thus derived from a fossil fuel and has carbon dioxide (CO_2) as a by-product, but its advocates argue that this can be safely sequestered through carbon capture and storage (CCS) mechanisms. (Hydrogen produced in the same way but without CCS is known as ‘grey’ hydrogen.) ‘Green’ hydrogen, by contrast, is produced through electrolysis, with an electric current passed through water to produce hydrogen and oxygen: $2H_2O \rightarrow 2H_2 + O_2$. Such hydrogen is only ‘green’ if a renewable means of electricity generation is used, such as solar or wind. This is deemed more sustainable as, firstly, no fossil feedstock (such as methane) is required – only water; secondly, no carbon dioxide is directly produced; and third, the energy input is renewable.

What are its uses and potential?

Some recent British governments have promoted ‘green’ hydrogen as an energy source for the ‘green transition’ in various sectors. While he was PM, Boris Johnson famously claimed that ‘Britain will become the Qatar of hydrogen’. Subsequent Conservative governments showed less enthusiasm, but in their October 2024 budget, the Labour government allocated new funding for 11 ‘green’ hydrogen projects as part of its manifesto commitment to make the UK ‘a clean energy superpower’. ‘Green’ hydrogen is seen variously as a means to help decarbonise industrial processes (notably the production of steel and some fertilisers) and transport (particularly through synthetic fuel manufacture), and possibly as a partial substitute for natural gas for domestic use (if safety can be assured).

Views differ on whether ‘green’ hydrogen requirements in the UK could be met from domestic sources alone, particularly given the growing demands for electricity for other purposes. Like some other developed economies, the UK may need to rely increasingly on imports of ‘green’ hydrogen, sourced mainly from areas of the Global South which have a comparative advantage in renewable electricity generation to drive industrial-scale electrolysis of water. For example, one recent report estimated that the African continent could generate over 7 terawatts (1 TW = 1 trillion watts) of electricity from solar energy, while its coastlines could generate 1.3 TW from wind. Hydrogen gas is, however, difficult, and dangerous to handle, and hence costly to transport. Long-distance transport options therefore include combining ‘green’ hydrogen with atmospheric nitrogen to make ‘green’ ammonia (NH_3), which can then be used in fertiliser manufacture or converted back to hydrogen; or combining it with low-emission carbon sources to create synthetic fuels.

What are the international development implications?

Various European governments (particularly Germany), the EU, and private investors in Europe and beyond are espousing and supporting ‘green’ hydrogen production, with a particular eye on Europe’s near (and very sunny) neighbours in North Africa, from where hydrogen could potentially flow to Europe through pipelines. Such countries are in turn competing (by offering land and tax incentives) to profit from their northern, developed neighbours, which are seeking to decarbonise their economies for environmental reasons and because of the energy crisis precipitated by the war in Ukraine. Matters are more complicated for some potential producers. Algeria, already a large exporter of natural gas, is interested in diversifying some of this into producing ‘blue’ hydrogen for export, while also developing its renewable energy capacity for ‘green’ hydrogen production. Other countries, in sub-Saharan Africa and elsewhere, are similarly looking to capitalise on this potential market, including South Africa, Namibia, Kenya and the DRC. The Middle East and the Americas are also seen as potentially important regions for producing hydrogen, with some Middle Eastern countries furthermore showing interest in investing in North Africa.

However, the technical, financial, environmental and developmental realities involved both in ‘green’ hydrogen production and in its multiple uses in energy and industrial systems are complex and uncertain at a national and international level. Financial viability is hard to assess given limited infrastructural and market development to date. Some analysts doubt whether it would be economical to ship ‘green’ hydrogen (predominantly as ‘green’ ammonia) from more distant producers, such as those in Southern Africa, when producers in North Africa and the Middle East have the geographical advantage of relative proximity to European (and Asian) markets. Few projects have therefore progressed beyond a Memoranda of Understanding – between companies from wealthier countries and potential producer states – to detailed planning (feasibility study and design) stages at present; even then, the final investment decisions are mostly still pending.

What do activists say?

Contestations already abound over the environmental costs and benefits, sustainability and, in international development terms, the equity of 'green' hydrogen. Critics point to the inequity of large-scale renewable energy development in Africa to produce hydrogen for export, when large proportions of their domestic populations have no (or only limited or unreliable) access to electricity. While over six hundred million people (about 43% of the continent's population) are lacking good access to electricity, Africa has received just 2% of global clean energy investment and accounts for less than 2% of global renewable energy capacity.

A further concern is that 'green' hydrogen production could exacerbate existing problems in the context of water scarcity (given the high water demands of the process) and/or land conflicts (with the risk of 'land grabbing' by large corporate/state interests from local users with traditional land rights). Such problems are generally worsening amid climate change and, in Africa particularly, population growth is increasing pressures on land. As an idea of the potential scale involved in 'green' hydrogen ambitions, Morocco recently stated that it would make one million hectares of land available to such investors. Tunisia, meanwhile, has earmarked 0.5 million hectares for production in its south, an area already suffering from water scarcity and land conflicts, and also plans to source large volumes of water from desalinisation – an energy-intensive process in itself, producing environmentally harmful concentrated saline effluent.

Unsurprisingly, there has been pushback from civil society in some countries. In Tunisia, for example, environmental groups and various bodies concerned with political and civil rights have issued public statements and engaged in small-scale physical protests, despite the politically repressive context. In Namibia, too, concerns have been expressed about local environmental impacts, with one of the world's largest touted 'green' hydrogen projects located in a national park. Namibian activists argue that this plan risks, first, loss of biodiversity undermining livelihoods based on eco-tourism; and second, reputational damage caused by local environmental damage scaring off hydrogen-importing countries in Europe, leaving 'green' hydrogen production facilities as a stranded asset. Long experience with extractive industries suggests that it is very unlikely that foreign companies or their backers would clear up the environmental and social mess left by such failures; they would just walk away.

Indeed, a deeper historical argument is that 'green' hydrogen exports would simply reproduce the sort of extractive economies that most African countries have endured for centuries, with limited developmental benefits (and often some negative impacts) for their own people. The risk with hydrogen is that (again) these countries end up exporting resources in a raw or semi-processed state with little 'added value', while mostly still having to import high-tech manufactured goods, including the plant needed to produce 'green' hydrogen. These arguments parallel those in other current (and perhaps better-known) debates about Africa as a source of the 'green minerals' (such as copper, nickel, cobalt, lithium, manganese and rare earth metals) needed to decarbonise electricity generation and for battery manufacture. Claims that domestic access to electricity in producing countries would improve amid 'green' hydrogen investment also look shaky in the light of experience with fossil fuel extraction, where energy benefits for the masses are often patchy; Nigeria is the prime example of such problems. The ability for a 'green' hydrogen economy to create large numbers of local jobs has similarly been questioned.

Conclusion

'Green' hydrogen has become another arena for debates about 'climate justice' and 'energy imperialism'. It is fair to ask why countries in the Global South, where access to electricity and safe water are already often inadequate for so many, should again be exploiting their natural resources to support energy profligacy, further industrial development and high consumption in the Global North (having done so for many decades with oil and gas exports). To return to the British context, while 'green' hydrogen could well play a useful part in decarbonising energy use in some sectors going forward, careful thought must therefore be given to what that part is and, crucially, where and how this commodity is sourced. The possible risk with national 'blue' or 'green' hydrogen projects is that, without such careful consideration, they could be the thin end of an unpleasant wedge. Over time, through infrastructural investment and technological development, increasing domestic dependence on hydrogen risks locking the UK into a potentially inequitable (and not so 'green') global hydrogen production and trading system.

Dr Martin Evans **21 November 2024**

Further reading

Ammar, S. (2024, 14 August). Green hydrogen: Africa is not Europe's battery. *African Arguments*. https://africanarguments.org/2024/08/green-hydrogen-africa-is-not-europes-battery/

Scott-Quinn, B. (2021, 21 October). Sorry Boris Johnson, the UK will not become the Qatar of hydrogen. *The Conversation*. https://theconversation.com/sorry-boris-johnson-the-uk-will-not-become-the-qatar-of-hydrogen-170307