Beyond the hype: How to shape the green hydrogen economy

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1. There is a renewed, significant interest – bordering even to hype – about hydrogen worldwide. Some of that interest is triggered by the realisation, that **decarbonisation of „hard to abate sectors“** like certain industries and long distance sea and air transport **needs to begin already now** in order to reach the Paris temperature goals. **Other players rather use hydrogen as a convenient smoke screen** to continue fossil gas investments. This makes it sometimes ambiguous and difficult to form an opinion.
2. Hydrogen can be generated with various technologies (Box 1). **Only green hydrogen** made of renewable electricity can be truly sustainable. As there is currently very little green hydrogen available on the market, there is a challenge to scale up simultaneously production and a market for green hydrogen.

Box 1: Different types of hydrogen (colours of hydrogen)

- Green hydrogen: Via electrolysis from electricity produced by renewable energies
- Brown hydrogen: Via steam reforming process from coal
- Grey hydrogen: Via steam reforming from fossil gas, or via electrolysis with non-green electricity
- Blue hydrogen: Via steam reforming from fossil gas, with CCS.
- Turquoise hydrogen: Via pyrolysis from fossil gas
- Pink/yellow hydrogen: via electrolysis from nuclear energy.

3. There is a need to **distinguish between production and end uses** of green hydrogen. Each comes with a different set of challenges. Beyond the “greenwashing” issue mentioned above, the main problem exist in an excessive promotion of end uses where more efficient direct uses of electricity are possible.
4. **Production:** If done in a environmentally and socially sustainable manner (see Box 2), scaling up of hydrogen production is generally beneficial and **should be supported**, promoting best practices, making sure green electricity and hydrogen are produced under good environmental and social standards, and that economic benefits accrue to the host countries.

Box 2: Core criteria for sustainable production of green hydrogen

- Ensure good siting of renewable energies, avoiding areas of high biodiversity and conservation value, areas of high agricultural or grazing value, or areas of high cultural and spiritual value of indigenous people
- Respect traditional land use and water rights (even informal ones), and the right to free prior informed consent of traditional landowners.
- Ensure economic participation of local communities via payments for resources used, provision of energy and clean water, jobs etc.
- Consider dual use of land e.g. for pastoralists wherever possible (agro-photovoltaic installations).
- Carefully consider water use for cleaning of solar panels, and electrolysis. Avoid displacing traditional water uses or overusing groundwater.
- Ensure economic benefits for the host country via local industrialization of green

5. **End use:** There is a significant number of industries that promote the use of hydrogen to enable the continuation or even expansion of outdated, wasteful modes of transport and

production. This needs to be opposed. To replace fossil fuels, the **direct use of electricity** or the efficient storage of green electricity in batteries (wherever possible) instead of the highly inefficient route via electrolysis to hydrogen and then back to electricity via fuel cells (e.g. for passenger cars, trucks). Hydrogen is very versatile, but its production is inefficient (losses of 15-40% of energy). It is precious and for a long time it is going to remain scarce. Therefore, it should be the **fuel of last resort**. Its use should be very targeted, and be used to **replace existing dirty fuels**. Its cleanness should **never be used as an excuse for the expansion of wasteful energy uses, satisfying expansive desires** (e.g. flying taxis, space flight, hypersonic flight etc.).

Summary: The prospect of a green hydrogen economy comes with significant opportunities and risks. There is a need to both promote and carefully shape the much needed expansion of production, while limiting the end use of green hydrogen.

There are a number of risks: The biggest risk is that the green hydrogen revolution gets called off or is delayed, and the fossil energy use prolonged. The second biggest risk is the use of hydrogen to greenwash dirty fossil fuels or nuclear energy via the hydrogen route (brown, grey, pink and blue hydrogen). A third risk lies in a wasteful expansion of hydrogen end uses (rebound effects), leading to a further delay of reaching a 100% green energy system, due to the inefficiencies inherent in production and use.

Avoiding these risks, a path forward for a rapid and significant, but sustainable scaling up of sustainable green hydrogen production must be forged, while keeping the end uses very focused on some priority areas and avoiding rebound effects.