Green is going out of fashion, what now?

By Stephen B. Harrison, sbh4 consulting

Global debt is surging, basic needs are unmet in developing nations, and defence costs are rising. The hope of governments borrowing huge sums of money to pay for a Net Zero future is simply unrealistic.

We must re-think the decarbonisation investment paradigm. The projects that will attract investment are those with a clear business case and low risk – not the 'greenest'. Given that green hydrogen deployment is likely to lag past targets, scarce green hydrogen molecules should be put to their best possible use.

For example, when ammonia is made from hydrogen via steam methane reforming of natural gas, CO_2 leaving the reformer *MUST* be removed to enable the catalytic Haber Bosch ammonia synthesis reaction. Every natural gas-fed ammonia plant on this planet already has a CO_2 capture facility. This CO_2 must be sequestered to reduce the CO_2 intensity of this ammonia. Decarbonising existing ammonia plants should come ahead of using green hydrogen.

My plea to policymakers: support CCS in the ammonia sector as one of the 'best value for money', material impact and rapidly deployable decarbonisation initiatives. We must pursue policies that are relevant for today, in addition to dreaming about what might be ideal for the end game.

What about hydrogen from steam methane reformers (SMRs) in oil refineries? Should green hydrogen be prioritised here? Also, no. The CO_2 from these SMRs is not captured at present. But 60-70% is available at a very high partial pressure before the reformate gas mixture enters the hydrogen separation pressure swing absorption unit. The unit cost of CO_2 capture in this location is low. New equipment and energy would be required, but CO_2 capture costs are lower than in many sectors.

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The reason this is not done today is because the business case is not strong enough. Low carbon prices do not justify the investment in new equipment and increased energy consumption. However, CCS from this source is another 'good value for money', rapidly deployable decarbonisation initiative related to hydrogen that will make a material impact.

We now need policymakers to recognise high carbon-intensity hydrogen and promote a market for it. Current blue hydrogen criteria are very tight and this level of partial decarbonisation does not get the blue badge – eroding interest.

The 'blue' benchmark suits new-build ATR or GHR projects with CCS, but what about all of the SMR assets out there today? We must enact regulations relevant for 2025, while also thinking about how to define the ideal 'blue hydrogen'.

My message here: let's ensure that the costs of greenhouse gas (GHG) emissions, whether they be CO_2, methane, F-Gases or others, must be paid by the polluter. I believe this "polluter pays" principle has served us well through the reduction of NOx and SOx emissions. Then, if green hydrogen is genuinely a large part of the answer, the business case for decarbonisation will reflect that.

Again, I hear the concerns. "But Steve – you can't just let the market decide if green hydrogen is part of the answer or not, a clear direction must be set so that infrastructure projects can be executed." Okay, I partly agree. Pipeline infrastructure to move hydrogen is a useful investment for the future. And since there is no business case for this today, a huge amount of belief and supporting capital is required to get this underway.

To complement the pipeline, there must be high-capacity underground storage to enable seasonal supply and demand balances to be smoothed and allow intermittent hydrogen production from otherwise curtailed power to be produced at exceptionally low cost. I believe the development of common infrastructure is one of the most important roles that any government can play. Just as governments built roads and grids, they must help build hydrogen infrastructure.

I also only partly agree with the above concern, since the hydrogen pipeline I advocate would be agnostic to the CO_2 intensity of the hydrogen that is delivered. Green, grey, blue, turquoise, pink or white – the full rainbow of colours can enter and leave on a mass balance basis.

So, what about e-fuels? Are these the priority for green hydrogen? Some demonstration projects are certainly required to validate electrofuel technology. These will be lighthouse projects for the future. However, considering efficiency losses when converting to synthetic kerosene, I do not see this as a priority use of green hydrogen until it becomes widely available.

Furthermore, fuel is generally the lowest value of a chemical. Why would green hydrogen, such a scarce gas, be treated with such a lowly fate as simply using its energy value? A major issue with the lack of finance for so many green hydrogen projects is that offtakers in the energy sector cannot afford to pay the green premium on an energy commodity – their business models and margins will not entertain such a luxury.

What about high-value circular plastics for branded consumer products? Can these be produced through the combination of CO_2 with green hydrogen? Yes, here I am a major advocate. Why? Because high-value plastics, such as the lenses in your designer sunglasses, require very small amounts of material to produce them. The green premium is marginal in high-value consumer products. The consumer's willingness to pay is high, and the business case stands up.

So where does this leave e-methanol? Well, I am very positive about e-methanol. It can be a precursor to building many high-value plastics with the commensurate benefits as above. It can also be used as a fuel in its own right, for example in maritime applications where the particulate emissions are significantly less than heavy fuel oil, so there are synergistic environmental benefits. Furthermore,

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e-methanol can be aggregated and sent to refineries for conversion to sustainable aviation fuel (SAF).

The case for e-methanol from green hydrogen and circular CO_2 is strong. Technologies are proven or progressing, and projects can be de-risked with multiple offtakes. The business case can be profitable if high-value products in markets with high willingness to pay are targeted.

If e-methanol is so promising, do we need Fischer-Tropsch e-fuels? I am becoming more and more sceptical about that as a viable route. The selectivity towards aviation kerosene (which seems to be the fuel with the best business case) is not as good as methanol to kerosene. Nor is the energy efficiency, and there's no CAPEX benefit. Catalyst disposal and replacement is also expensive and potentially environmentally hazardous.

Have I lost my faith in hydrogen as a key part of a decarbonised future? No. But I do see other priorities for achieving rapid, cost-effective, impactful decarbonisation. Have I lost interest in green hydrogen and become a fossil fuel dinosaur? No. It is simply a matter of phasing one in as we phase the other out. At this point in time, the world is still heavily dependent on fossil fuels whether we like this or not. Working with, not against, this reality is responsible.

What we should do in 2025 is not what we might want to do in 2050. And we must decarbonise rapidly if this planet and its current population are going to survive in some kind of recognisable form until 2050. Let's work with fossil fuels in the best possible way until the alternatives are genuinely scaled. H2V