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INTERVIEW:

Major roadblocks in transitioning from grey to low-carbon ammonia, says advisory firm head, Allied Green Ammonia, ABB tie up to advance green hydrogen, ammonia plant

Quantum Commodity Intelligence – *Independent advisory firm, sbh4 consulting, specialises in decarbonisation and defossilisation through e-fuels, e-fertilisers, biofuels, SAF, CCTUS, GHG emissions reduction, and the emerging hydrogen economy. In an interview with Quantum, founder Stephen B. Harrison spoke about transitioning to low-carbon ammonia, and his views on an economical alternative, called „light-blue" ammonia.*

Q: What are the major impediments to transitioning from grey to blue ammonia?

SBH: Fundamentally there are three impediments to the transition from grey to blue.

Firstly, to build an ammonia facility that would classify as blue ammonia according to the current typical definition of CO_2 intensity, you would be forced to build a new ammonia plant. That's because the CO_2 capture rate for blue ammonia is set to be quite high to achieve the low CO_2 intensity, meaning all the existing facilities running a steam methane reformer with CO_2 emissions from the burner for the heat would not be eligible to produce blue hydrogen, even if they captured and sequestered all of the process CO_2 in the reformate syngas.

Ultimately, if you are forced to build a new facility at a reasonable scale to achieve good process economics, you could easily be spending $2 billion or more. Do we need that additional capacity? Can we afford this ticket?

The second issue is that as soon as I build and operate that new blue mega facility, I would need to incur an energy penalty to capture the additional CO_2 in comparison to my energy costs operating an old grey facility, and that energy penalty gives me an Opex (operating expense) penalty versus my competitors.

But ammonia is an incredibly price-sensitive commodity, and to say it is only (as an example) 15% more expensive might be an easy thing to say, but it could mean that you've lost your customer base.

The third impediment is that we need to do something with all the CO_2 that we've captured.

The whole idea of blue ammonia is to capture the CO_2 on-site and send it somewhere for sequestration, which means we need terminals and storage infrastructure and logistics assets to move that CO_2 around in pipelines, trains or ships. These simply do not exist today.

However, the regional locations where geological storage of CO_2 could be cost-effective are limited. The US, around the North Sea, and the Middle East Gulf region are three hot spots for blue ammonia. Outside of those, you could be struggling due to the costs of CO_2 logistics and geological storage.

Q: Same question, now with green and grey ammonia.

SBH: Green ammonia is massively more expensive than grey – anywhere from four to ten times more expensive.

We are not talking about a better specification. This green ammonia is not going to produce better fertiliser. It's not going to grow more rice. It's the same as grey ammonia in terms of its efficacy.

The only difference is a lower CO_2 intensity, which has some inherent value. But even when we offset the benefit of the reduction in emissions, the economic case for green ammonia does not stack up.

On these government subsidies and incentives to produce green ammonia... Yes, they exist, and there's real money, but when you look at the actual impact that it would have on reducing the cost, it doesn't bring green ammonia anywhere near grey or blue.

When you look at the duration of some of these subsidies, it's too short.

For example, in the US, with the IRA (2022 Inflation Reduction Act) you can get it either until 2033 or until the pot has run out. If you're building a new green ammonia facility today, imagine how long it's going to take to plan it, finance it and construct it.

It could easily be 2030 or 2031 by the time you're up and running, so you get maybe two years of these subsidies. And your asset is going to be depreciated over 25 years.

So, a couple of years of subsidy support really does not make a dent in a business case, even if the subsidy is $3/kg of green hydrogen produced - which is nice money to have (for 2 years or so) - ultimately, when you look at the overall impact on the business case, it's negligible.

Q: And comparing the economics of a green vs a blue ammonia plant?

SBH: The big difference that inflates the cost of green ammonia is the cost of green electrons because you are purchasing renewable electricity from wind, solar, or hydro, or investing in your own renewable power generation facility. The cost of those green electrons is really what kills the business case for green ammonia.

Buying green electrons is significantly more expensive than buying natural gas.

Q: What are your views on decarbonising an existing grey ammonia plant vs setting up a new blue ammonia plant and would you get the necessary low-carbon certifications?

SBH: Let's say, just as an example, that we have 50 fossil fuel-based ammonia plants operating around the world. Every single one of these ammonia plants is removing CO_2 from the syngas today. They must do it because the syngas contains CO_2, which would poison the ammonia synthesis catalyst if that CO_2 went through onto the catalyst.

What happens to that CO_2 - in some cases, it's added back into the ammonia molecule to build urea. But about 60% of that captured CO_2 is not built into urea, it is being blown straight up into the atmosphere as a relatively pure CO_2 stream.

What I would advocate is to do something with this CO_2 that has already been captured - compress it and put it in a pipeline and sequester it or liquefy it and put it on a train or a ship and then sequester it. That will still come at a cost, but it would be a lower cost decarbonisation pathway than for almost every other heavy industry sector since the energy and capital costs of CO_2 capture have already been taken by the process requirements of ammonia synthesis.

The issue with this approach is that, while it's comparatively easy to implement, it would result in about 60% CO_2 emissions reduction. Unfortunately, that is not enough to hit this magic hurdle to get a blue badge.

It's not grey ammonia, but it's not quite blue ammonia. Let's call it „light-blue" or „grey-blue" ammonia.

Q: Lastly, what are your pricing estimations for „light-blue", blue and green ammonia?

SBH: For „light-blue" ammonia we would effectively be adding around €100 or $100 for a mt of CO_2 emissions to the cost. But much of that €100 can be offset in many locations globally. For example, $500/mt (grey ammonia price) might become $600/mt, and once I take CO_2 credits into account, $500/mt could become $520/mt on a rounded basis.

With blue ammonia, fresh capital and additional capacity are going to create downward pressure on ammonia prices. Continuing the example above, $500/mt could go up to $700/mt, then come back down to $620/mt in locations where there is a meaningful cost of CO_2 emissions.

For green, we'll be looking at something around €2,000-2,500/mt if producing in Europe, which might be about €1,500-2,000/mt in Texas or Chile.

Go ahead... pick your colour and pay the price. But if it were supported by CO_2 intensity certification regulation, „light-blue" would come with very little financial penalty, and will have a meaningful beneficial impact on industrial decarbonisation to mitigate climate change.