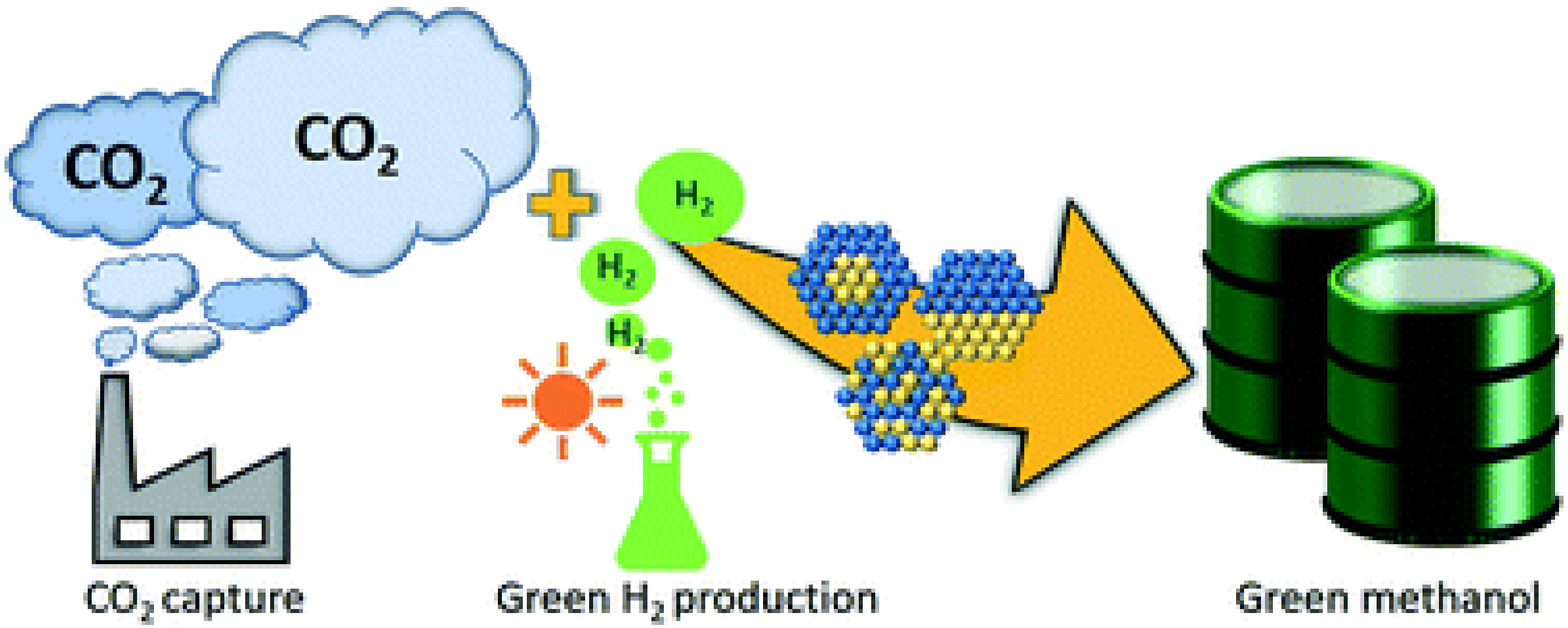
THE MISSING LINK

Why the debate about Green Methanol needs to be more strategic

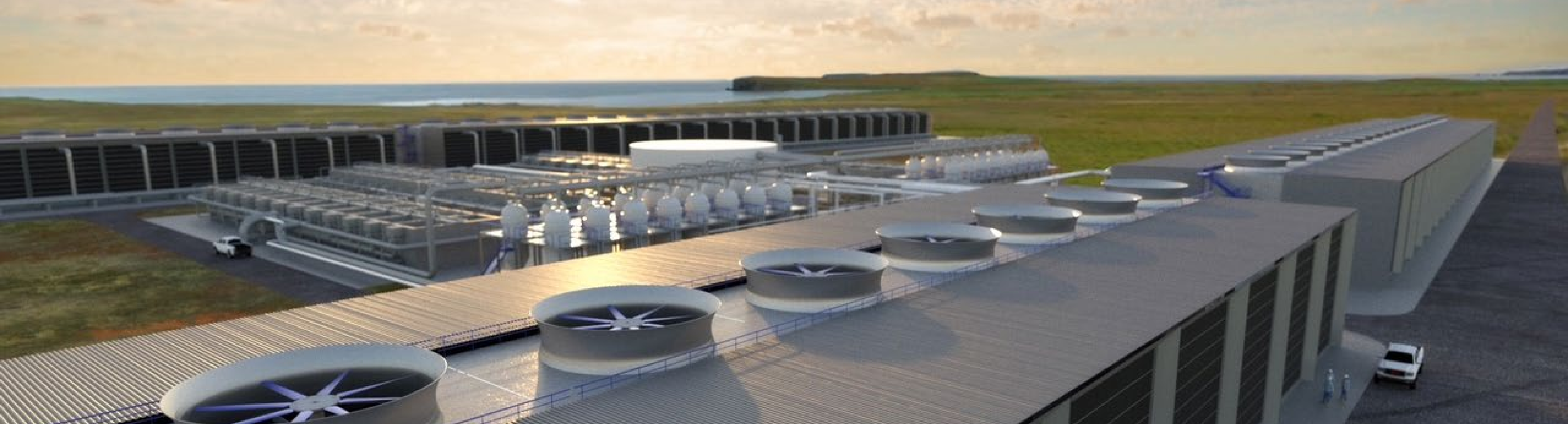


PMW TECHNOLOGY

There is no doubt that Methanol is a strong contender in the future fuels race and if it can be delivered as truly Green Methanol then it has the potential to be more than a short-term transition fuel. Indeed, if bunker supply chains are going to have any chance of reaching scale there needs to be something more than a "temporary" mindset for any new fuel.

So, what is Green Methanol? Many of you will be saying that it's e-Methanol produced from Green Hydrogen, and you are correct.....well partially correct. The missing link is the source of the CO_2 needed to combine with that Green Hydrogen to produce e-Methanol. It is ironic that CO_2 is the thing that is being largely ignored in the Green Methanol debate.

Producing Methanol is not a new challenge but until now it has been derived from hydrocarbon-based processes. There are several alternatives being tabled including the synthesis of Methanol using CO_2 captured from a municipal waste combustion or from biogas production but, again ironically, there will soon be a major shortage of CO_2 suitable for use in the synthesis of methanol. That's before you even start to debate whether CO_2 derived from incineration of municipal waste is in fact any shade of green.



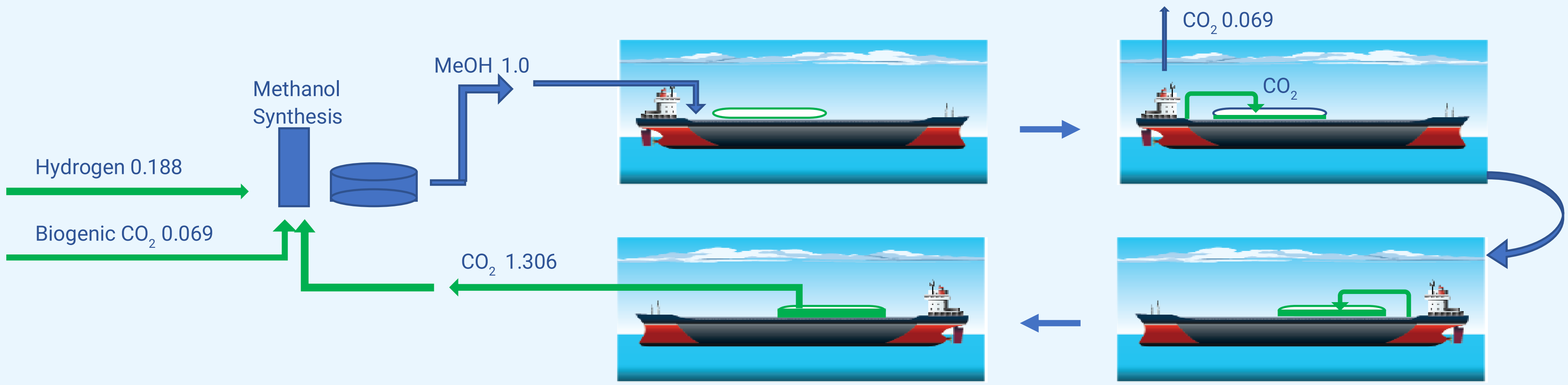
The fallback in this debate seems to be an expectation that carbon dioxide captured directly from the air will be capable of filling that gap. Direct Air Capture (DAC) is an attractive story but, unfortunately, the science is not that easy. You will have already guessed that if it was, we would have solved the climate change impact of CO_2 emissions some time ago.

There are significant issues for DAC, largely driven by the low concentration of carbon dioxide in air, only 0.04%, compared with 20% for life-giving oxygen. The two biggest challenges are the energy required to capture the CO_2 and the size of the capture plants.

The strong chemicals necessary to absorb CO_2 from air need a sophisticated and energy intensive chemical plant to recover the CO_2. Carbon Engineering, a leading DAC developer, report that capture from the air requires over 3.5 times the energy needed to recover CO_2 from combustion exhaust gases using conventional processes. That is over 8 times the energy required using our advanced cryogenic process. It's these numbers that drive the high cost of CO_2 from DAC, which in turn contribute to the high forecast cost of Green Methanol.

Secondly to obtain useful amounts of carbon dioxide very large volumes of air must be processed. For example, to produce 1 tonne per hour of methanol a DAC plant must process at least 1.7 million cubic metres of air, and that's at 100% efficiency. In practice technical limitations mean that up to twice this amount needs to be used. In case you are scratching your head, 1.7 million cubic meters is two thirds of the volume of the O2 arena in London.

The plant needed to handle these air flows is unavoidably large. With typical air velocities of 1-3 m/s the process equipment to produce 1 tonne/h of methanol needs to have a face area of 250 - 1, 000 m^2. This is comparable to one to four times the area of the Centre Court at Wimbledon. To meet the immediate fuel needs of the 12 new vessels that Maersk plan to run on Green Methanol, declared to be 730,000 t/y by 2025, a wall of DAC air handling units with inlets 5m high and up to 18 km long would be necessary.



Figures are relative weight of fuels and gases compared with methanol fuel input

So, what is the answer? Well for shipping at least, we see it as being the Methanol Cycle™ where ships powered by methanol are also fitted with on board carbon capture equipment. The high performance of our process enables around 95% of the CO2 to be captured to provide feedstock for e-Methanol synthesis with only a modest top up of CO_2 from other net neutral sources.

This creates a closed loop and shifts the debate relating to Carbon Capture from the equivalent of sending household waste to landfill into the world of recycling. Picture that Methanol powered vessel owned by Maersk arriving in Southampton, discharging its secondary cargo of captured CO_2 to the local e-Methanol plant and into the supply chain which fuels the ship for its next voyage.

There are no silver bullet solutions for any of our climate change challenges and this solution doesn't pretend to be one. Our studies have however shown that there is a significant proportion of shipping to which this solution could be applied.

Aside from the obvious environmental benefits, this solution also helps with the economic debate. In the world of landfill then the "value" of captured CO_2 is entirely driven by the penalties which nation states and global regulators decide to apply to CO_2 emissions. With this model the captured CO_2 has its own economic value as part of the feedstock for a future fuel. It makes e-Methanol a zero-impact fuel which then, importantly, moves it from being a transition fuel to a truly future fuel. If we can deliver that then there is a reason for the investment needed to create that long term supply chain for e-Methanol. If on the other hand, we continue to ignore the elephant in the room about the availability and cost of CO_2 from other sources and we place our bets on DAC, then is e-Methanol even going to be a meaningful transition fuel?