© DSOC / Northern Lights liquid CO2 tanker

CO2 management priorities: Tackling the heart of the greenhouse gas emissions problem

By Stephen B. Harrison on Jan 29, 2025 | 0 FEATURE | FEATURES

Stephen B. Harrison from sbh4 consulting outlines the tangible ways policymakers can make an impact in cutting emissions

European and US debt is at an all-time high. Developing nations are struggling to feed their people and bring them basic healthcare provisions. The costs of war and plans for rising defence expenditure are eating into national budgets. Governments borrowing huge additional sums of money to pay for a Net Zero future is simply an unrealistic proposition.

We must re-think the decarbonisation paradigm and accept that the private sector will lead the way. But only the 'best' projects will be bankable. What does 'best' mean? To the bank it means a clear business case with an acceptably low level of risk.

For example, when ammonia is made from steam methane reforming of natural gas, CO2 leaving the reformer MUST be removed to enable the catalytic Haber Bosch ammonia synthesis reaction to take place.

Every natural gas-fed ammonia plant on this planet already has a CO2 capture facility. The capex is spent and the energy costs for CO2 capture are committed. This CO2 must be sequestered to reduce the CO2 intensity of this ammonia.

Support CCS in ammonia

In this context, my plea to governments and policy makers around the world for 2025 would be to support CCS in the ammonia sector as one of the 'best value for money', material impact and rapidly deployable decarbonisation initiatives.

Coal to chemicals is another example because immediately after coal gasification the raw syngas is fed to an Air Liquide Rectisol™ or Linde RECTISOL® unit where CO2 and sulphurous gases are removed.

At present, this CO2 is blown to atmosphere, just like the CO2 from ammonia production is vented on most ammonia plants today. This captured CO2 must be sequestered.

As with ammonia, the capital and operating costs of the Rectisol plant are absorbed into the overall costs of the coal to chemicals production. To reduce the CO2 intensity of this process, the only incremental costs are CO2 transmission and sequestration.

These do not come for free, but they will be less than the incremental cost of implementing CCS to processes that do not currently have CO2 capture built in, such as power generation or steel making.

So who is this coal-to-chemicals message for? Generally, it is for China where coal is used as a hydrocarbon feedstock to make olefins, diesel and methane. In China, coal is locally abundant and avoids the cost and dollar dependence of crude oil or LNG imports.

What would I wish the Chinese government does? As above, prioritising sequestration of already captured CO2 emissions through regulatory means must be a priority for the Chinese national government and their provinces.

What about production of hydrogen from natural gas on steam methane reformers (SMRs) for oil refineries, where the hydrogen is used to process liquid fuels? CO2 from these SMRs is generally not captured at present.

But 60-70% is available at a very high partial pressure prior to the reformate gas mixture entering the hydrogen separation PSA unit. The unit cost of CO2 capture in this location is low. New equipment and new energy would be required. But the costs of capturing this CO2 are lower than many other industrial sectors.

Why is this not done today? Because the business case is not strong enough. The costs of CO2 emissions are not high enough to justify the investment in the new equipment and suffer the energy penalty.

However, CCS of CO2 from this source would be another ‘good value for money’, material impact and rapidly deployable decarbonisation initiative related to hydrogen production.

What can be done? Policy makers must recognise hydrogen with this CO2 intensity and promote a market for it. The current criteria for blue hydrogen are very tight and this kind of partial decarbonisation does not get the ‘blue’ badge so there is relatively little interest.

Source: Air Products SMR Convent Louisiana

The ‘blue’ hydrogen benchmark is relevant for new-build projects based on ATRs or GHRs with built in CCS, but what about all of the SMR assets out there today?

The cost of capital must be recognised – new investments in greenfield sites are not easy to justify. We must enact regulations that are relevant for 2025, in addition to thinking about how to define the ideal ‘blue hydrogen’.

“Hang on”, I hear you say, “you are prolonging the life of fossil fuels with all of these ideas”. Perhaps. But I am advocating the most cost effective and rapid transition to decarbonisation. I care about velocity more than ideology.

This is 2025 and in many parts of the world there has been significantly less progress towards declared Net Zero targets than has been promised. ‘More of the same’ will not help us achieve 1.5°C, and is unlikely to cap climate change at 2
or 3°C.

We need drastic action now. Ideas that can rapidly and cost-effectively be deployed. The costs and scalability of green hydrogen must be seen in the context of alternatives.

Making rapid impact unquestionably means thinking beyond the ideal 'green' solution and accepting that the next 30 years will be about progressive decarbonisation of existing infrastructure in addition to investment in new ultra-clean technology.

"And what about CCS? It is a failed solution." I hear that often also. I disagree. Yes, I acknowledge that there have been failures, disappointments and poor reporting in some CCS projects. There have also been successes, and the only way to get better is to do more and learn faster.

EOR and EGR should be seen as meaningful ways to store CO2. I do not understand the link between CO2 storage on an EOR site and increased fossil fuel production. There is such an abundance of crude oil and natural gas reserves in the middle east and Russia that these nations will pump whatever the global demand.

To say that EOR or EGR stimulate demand for fossil fuels is a flawed argument. And, local production avoids the cost and energy of distribution.

So extending the life of wells can increase economic efficiency. I would urge policy makers to take a more supportive, or at least a less negative, view of EOR as a means of CO2 sequestration. Also, when we consider the number of successful EOR schemes to the number of CCS schemes, underground geological storage begins to tilt towards having an overwhelmingly positive history.

Stepping up CDR

I am convinced, now more than ever, that our focus on CO2 reduction (CDR), by whatever means, must be an order of magnitude more than the focus that may be applied to developing green hydrogen.

After all, excessive CO2 in the atmosphere is a problem now and always will be. Hydrogen is only one of many solutions. Let's hit the problem rather than favour one of the many solutions ahead of others that's a very risk guessing game that no policy maker can afford to make.

Policy in many areas is no longer technology agnostic – it should return more closely to that principle.

Let's ensure that the costs of greenhouse gas emissions, whether they be CO2, 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.

Taxation of these category pollutants in northern Europe would confirm this. The cost of CO2 emissions is too cheap, the tax incentives for reduction too weak. The EU ETS, US 45Q and other similar stick and carrot schemes around the world must set a realistic cost to CO2 emissions that drives the business case for decarbonisation investments.

And, even if there is a degree of market fluctuation, there must be a meaningful minimum set to de-risk the business case and ensure higher CO2 emissions costs are an upside, rather than a business case killer.

One of the most impactful decarbonisation common infrastructure projects would be a comprehensive CO2 pipeline network to join emitters to CO2 storage, utilisation and removals projects.

Western Europe would be an ideal place to prove this concept. There is a dense industrial cluster and CO2 storage potential in the North Sea. The Gulf Coast of the US would have similarly high potential. Repurposing oil and gas pipelines may be possible to offset some of the cost.

This will require cross border collaboration, rapid development of international pipeline and CO2 purity standards, good metering and monitoring for mass balancing and

massive investment in common infrastructure. There is ultra-important work to be done!

Top 10 CO2 management policy priorities for the second half of 2020s

1. Incentivise sequestration of CO2 that is currently captured from industrial processes: natural gas processing; ammonia production; ethylene oxide production, VCM production, coal gasification to chemicals or fuels. This will be the most cost-effective use of taxpayers funds to support rapid decarbonisation.
2. Incentivise capture of CO2 from high partial-pressure process streams, and accept the resulting CO2 intensity of the product. This also will be a cost-effective use of taxpayers funds to support rapid decarbonisation.
3. Move away from a go / no-go, digital approach to CO2 intensity, such as the cut off point for 'blue' hydrogen. Use a sliding scale of embedded CO2 and tax or incentivise. This will support CO2 emissions reduction in all forms rather than promote certain technologies above others. The perfect should not be the enemy of the good.
4. Broaden policy acceptance of EOR as a valid mechanism for CO2 sequestration. Our dependence of fossil fuels is a reality and will remain such for many years. Working with them responsibly is the key.
5. Commit to building common CO2 pipeline infrastructure to link CO2 emitters with CO2 storage / utilisation / removals locations. This must have appropriate entry and exit metering, international standards for CO2 purity, pipeline pressure and materials, and cross border agreements in north west Europe and Gulf Coast USA to accelerate CCS.
6. Commit to building a colour agnostic, common hydrogen pipeline infrastructure with underground hydrogen storage in salt caverns or rock caverns. Metering and standards are critical. The pipeline would operate in a similar way to the electricity grid: colour agnostic. HPAs (hydrogen purchase agreements), like PPAs (power purchase agreements) can be used to link green hydrogen producers with green hydrogen offtakers through a mass balance. North west Europe and Gulf Coast USA are priority locations and planning the CO2 and hydrogen pipelines together will create synergies.
7. Return to the polluter pays principle for greenhouse gas emissions with costs (with minimums and some market flexibility) that de-risk meaningful decarbonisation investments. This refers to CO2, methane, F-Gases and nitrous oxide: the four main greenhouse gas contributors. Concerns about unfair international competition due to policies moving at different speed around the world can be met with embedded CO2 border adjustments.
8. Use scarce green hydrogen for small scale use cases in high-value materials, in preference to mass use cases for commodity fuels, whilst it is being produced at a niche scale. Build the technology, bankability of green hydrogen now to allow a progressive ramp up as renewable power ramps up to support it and as fossil fuel dependence progressively subsides.
9. Focus the role of government on effective policy development and common infrastructure enablement rather than technology innovation, project finance or project development. The private sector, not governments, have the expertise and resources to excel in these areas. Governments must use their limited resources and budgets to develop coherent policies and plan common infrastructure.
10. Focus on CO2 and other greenhouse gas emissions reductions as the issues. Allow the solutions, such as hydrogen (of any colour), direct air capture, geological CO2 storage, batteries, electrification, heat pumps etc to evolve. Enable these solutions with permitting, but remain broadly technology agnostic and avoid excessive focus on incentivising one solution ahead of another.