COP26 – hydrogen, carbon dioxide, methane and more

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The pace of climate change is exponential and many of its effects will be irreversible. An exceptionally warm summer in Greenland caused rain to fall on the huge icefield that covers much of the Island. Rain melts the snow and accelerates the movement of the ice sheet from the land to the ocean, contributing to rising sea levels.

Extreme rainfall in Belgium, Germany, Luxembourg and The Netherlands between the 12th and 15th of July this year also caused freak flooding with loss of life and catastrophic damage to buildings and infrastructure. Flash floods of are common during the monsoon season in Bangladesh and India but are a new phenomenon for Western Europe.

Due to climate change, flooding, drought, and starvation will be inevitable, as will increased levels of poverty in many locations. The finger of blame is clearly pointing at climate change and urgent action is required to reduce CO_2, methane, and F-Gas emissions from many industrial sectors.

There are enough solutions, such as hydrogen and CCUS out there to create hope and enable the positive changes that are required. COP26 must be a platform to raise awareness of the issues, stimulate education about the solutions and propose policy frameworks that stimulate international collaboration for rapid deployment of the right technologies and practices.

The price of prevention is less than the cost of catastrophe

The infrastructure investment costs of 'fixing' the problems caused by climate change, such as building sea defences or irrigation systems will be material for many nations and will largely be recovered through taxation. Furthermore, additional costs will hit balance sheets in the form of higher insurance premiums.

The business case for prevention is clear at a conceptual level and a myriad of technologies exists. Many can readily be implemented if there is enough inspirational corporate action, the right regulatory environment and visionary political leadership. COP26 is the platform where the consequences of climate change must be presented impactfully and effectively. And the outcomes from the meeting must be transformative solutions for immediate implementation. There is a price to be borne, but failure to act will cost the Earth.

Policy leadership ahead of COP26 is coming from several directions. As an example, India could force oil refineries and urea fertiliser plants to use green hydrogen as a portion of their hydrogen production under draft plans sent for cabinet approval by the Indian Government's Power and Renewable Energy minister, RK Singh.

It is speculated that other energy-intensive sectors in India, such as steelmaking and transport, could then be subject to mandatory shares of renewable hydrogen in their hydrogen consumption later. The changes would create a vast market for green hydrogen and stimulate economies of scale in production and distribution to enable cost-effective use of green hydrogen in other sectors.

Methane emissions reduction has also been in focus in the run up to COP26. On behalf of the European Union (EU) and the US, European Commission President Ursula von der Leyen and President Biden announced the 'Global Methane Pledge' on 18th September. It will be launched at COP26 in November, in Glasgow.

François Hollande and Narendra Modi at Paris, 2015

Countries joining the Global Methane Pledge will commit to a collective goal of reducing global methane emissions by at least 30% from 2020 levels by 2030. Delivering on the Pledge would reduce warming by at least 0.2°C by 2050. Major sources of methane emissions include oil and gas, coal, agriculture, and landfills.

Methane is also used extensively by industrial gases companies to make hydrogen on steam methane reformers (SMRs). The liquified natural gas (LNG) value chain also relies on methane. LNG is highly transportable and can connect energy producers and

consumers. Amongst the range of clean energy vectors such as low-carbon hydrogen, ammonia, and methanol the challengers all fall short of LNG when it comes to volumetric energy density, which is a critical factor for distribution and storage.

Read more: The role of LNG in a decarbonised world

Our industry must take responsibility alongside other sectors to ensure 'zero tolerance' of methane leaks to the atmosphere. Initiatives flowing from COP26 may stimulate changes in this direction across all methane processing sectors.

The industrial gases sector can rise to the challenge

Conversion of natural gas to blue hydrogen and low-carbon ammonia is value chain that the industrial gas sector is in pole position to support with oxygen for auto thermal reformers and nitrogen for ammonia production. But methane and CO_2 emissions must ruthlessly be eliminated during processing of the natural gas to low-carbon, low-climate-impact energy vectors.

Blue hydrogen relies on CCS (carbon capture and storage). However, in many countries there are strong concerns about CCS with underground CO_2 storage, but the idea of CCS as 'Carbon Capture and Something' can turn the focus towards capturing the carbon and leaving the next steps open to be utilisation, mineralisation as alternatives to underground storage. To be more precise about 'carbon capture and something', terminology could be developed to cover carbon capture and mineralisation (CCM); carbon capture and synthetic fuels (CCF) and a host of other more specific acronyms.

That shift in mindset may help get some traction behind carbon capture as the first stages of constructive action for decarbonisation.

If a minimum international CO_2 emissions tax is given serious consideration at COP26, it will trigger a chain of events that see a surge in interest in carbon capture. The resultant CO_2 supply chain to move the captured gas to a location where it can be utilised or permanently stored is a business model that the industrial gases companies are perfectly placed to implement.

1/3 SHOW CAPTION

Carbon capture – the root of all CCS or CCUS technologies

During with the production of glass, lime, cement and refractory products, CO_2 generation is unavoidable. This is because the sands and minerals used contain CO_2, which is released during the melting and calcination processes. These mineral processing industries must live with the fact that this geogenic CO_2 is generated, even if heating from renewable electrical power or hydrogen is used to replace fossil fuel-fired burners.

Due to the geogenic CO_2 emissions, part of the decarbonisation solution in glass making and other mineral processing industries must therefore include 'carbon capture'. The CO_2 shortage that the UK is experiencing at present may prompt industrial gases companies to look favourably on geogenic CO_2 as a reliable source to complement the existing CO_2 sources. In the UK, the majority of food-grade CO_2 comes from SMRs in the ammonia and urea fertiliser value chain. These units are started up and shut down as the prices of urea and natural gas fluctuate around the world. The CO_2 is a relatively low value by-producy that is at the mercy of greater profit motives.

Read more: CO2 crisis averted…for now?

In the industrial gases sector, similar SMRs consume natural gas to make hydrogen. The vast majority make grey hydrogen and emit CO_2. In the long-term, this can be mitigated with 'green' hydrogen production, using electrolysers fed with renewable electricity or reformers fed with biogas.

In the short-term, retrofitting carbon capture to SMRs to make so-called 'blue hydrogen' will reduce CO_2 emissions and take a big step towards carbon neutrality. It is also an investment that will pay for itself if CO_2 emissions taxes are implemented in more countries because of discussions at the COP26 meeting. That CO_2 could also be purified to food-grade specifications and traded as a valuable industrial gas product, further adding value to the investment in carbon capture.

Direct air capture of CO_2 and methane

Whilst several commercial direct air capture (DAC) technologies for atmospheric CO_2 removal exist, there is not yet one that has been implemented for methane capture from the atmosphere.

It would be a good idea to capture these gases in parallel, since a major energy consumer in the system is the power requirement to drive the fan that moves air through the equipment. Using this power once to remove both gases would perhaps be the most efficient way to reverse the historical damage that has been done from CO_2 and methane emissions.

Methane adsorption may be the answer and the race to innovate a super-sorbent for methane is on. Gas purification and separation technologies live in the heart of industrial gases R&D and it would be a wonderful contribution to planetary health if one of the industrial gases companies were to pioneer integrated direct air capture of methane and CO_2 with an innovative adsorption technology.

Funding mechanisms to support transformative innovations of this kind will be discussed at COP26, for sure. Industry must provide the brain power, but governments are likely to bankroll the speculative stages of the innovation cycle with research grants and funds for demonstration projects.

HVAC refrigeration F-Gas system maintenance

F-Gases – low temperature, high impact

The Paris Agreement on climate change sets a framework for the control of greenhouse gas emissions including CO_2, N_2O and fluorinated hydrocarbons, known as F-Gases.

In recognition of the very harmful impact, legislation has been implemented around the world to focus on the processing and use of F-Gases, such as Regulation (EU) No 517/2014.

Refrigerant gases are used in industrial gases air separation plants and nitrogen liquefiers. A transition to low GWP F-Gases or so-called 'natural' refrigerant gases such as CO_2 or ammonia in mechanical refrigeration cycles will be essential to ensure sustainable industrial gas processing operations.

COP26 is likely to shine the spotlight on all greenhouse gas emissions and move the debate from decarbonisation to climate change prevention. As such, F-Gases, methane and N_2O emissions will come under as much scrutiny in the coming years as CO_2 emissions have come into the limelight this decade.

About the author

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