CO2CRC is Australia's leading carbon capture, utilisation and storage (CCS) research organisation

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HIGHLIGHT: One of the world's biggest CCS operations commences in WA

In early August, Chevron made the announcement that the CCS community had been waiting for: safe startup and operation of the carbon dioxide injection system at the Chevron -led Gorgon LNG facility on Barrow Island, off the north-west coast of Western Australia.

The Gorgon CO_2 Injection and Storage Project is the largest of its kind in the world and will reduce carbon emissions from Chevron's Gorgon LNG project by around 40 per cent.

Over the next few months the injection of CO_2 into a deep reservoir unit known as the Dupuy Formation more than 2km beneath Barrow Island will steadily ramp up to full operational capacity.

Chevron plans to store around 100 million tonnes of carbon dioxide underground over the life of the project, making Gorgon the least greenhouse gas intensive LNG plant in Australia. The project will reduce Gorgon's emissions by 3.4-4 million tonnes a year, the equivalent of taking 680,000 cars off the road.

"It's exciting to have one of the world's largest greenhouse gas mitigation projects ever undertaken by industry here in Australia. The project is a major milestone in efforts to develop commercial scale carbon capture projects," said CO2CRC's CEO David Byers.

POLICY: US CCS research bills in Congress

US lawmakers are taking further steps to accelerate the uptake of CCS in the United States. There is bipartisan support in both the US Senate and House for Bills seeking to extend tax-exempt financing to CCS projects.

The identical Bills – the Carbon Capture Improvement Acts -- seek to adopt US tax-exempt financing bonds (which have been in place since the 1960s) to include CCS projects across all sectors. The Bills are seeking to provide a 100 per cent tax exemption for projects that capture 65 per cent or more of emissions, with a pro rata exemption for projects with a lower exemption.

Both Bills are seeking implementation at the beginning of 2020, and are currently working their way through the relevant committees.

At the same time, a group of House Republicans have introduced the Launching Energy Advancement and Development through Innovations for Natural Gas (LEADING) Act. The Bill seeks to push greater funding from the US Department of Energy towards funding CCS developments, to the tune of USD50 million. A Senate companion bill is already at the Committee stage.

Texas Representative Crenshaw, the key sponsor of the bill, has championed the Net Power Plant in La Porte, Texas, which launched in May this year. It produces enough energy to power the town's 5,000 homes but has zero carbon emissions thanks to CCS.

Okalahoma's Representative Lucas stated that: "Modernizing energy production and reducing greenhouse gas emissions requires realistic solutions that don't prohibit effective fuel sources and inhibit economic growth. This bill will expand early-stage research and development of carbon capture technologies to make natural gas an even cleaner energy source."

TECHNOLOGY: ExxonMobil inks Agreement with Mosaic

ExxonMobil has announced an agreement with California start-up, Mosaic Materials, a chemical and engineering company.

According to Mosaic, the company has developed a process to separate carbon dioxide from air or flue gas using porous solids.

The technology is based on metal-organic frameworks (MOFs). MOFs generally comprise two components: a grouping of metal ions and an organic molecule linking the metal ions.

Occasionally referred to as a class of nanoparticles, they are unique in that a single gram can have a surface area of 10,000m ^{2}.

They are particularly promising for CCS in industrial applications because of their low heat capacities.

The US Department of Energy has undertaken a number of projects on MOFs in relation to carbon capture. According to one study, using MOFs would be around 15 per cent cheaper than other systems.

Mosaic Materials was spun out of the University of California Berkley (UCB) as a commercial venture. Earlier demonstrations of its MOF technology for CCS were seeking to develop the MOFs into a pelletised form.

Moasic CEO Thomas McDonald said that the company's "proprietary technology allows us to separate carbon dioxide from nearly any gas mixture using moderate temperature and pressure changes, substantially increasing energy efficiency and decreasing costs."

The company has also received funding from the Office of Naval Research to scrub CO_2 from air in submarines, and similar defence applications.

FUNDING: Mtisubishi and Stripe commit to CO_2 recycling and negative emissions

Mitsubishi Chemical is leading a group of 16 companies to form a fund dedicated to carbon capture, with a specific emphasis on using the CO_2. According to the Nikkei Review, the group has formed the Carbon Recycle Fund, with an initial USD1 million in seed funding. Rather than sequestration, the fund's focus appears to be oriented towards CO_2 recycling, using the gas to make synthetic fibres or to fortify concrete.

Other companies that form part of the group include power plant operator J-Power, Mitsubishi Hitachi Power Systems and industrial groups IHI and Kawasaki Heavy Industries

US tech darling Stripe has put up USD1 million for CCS startups to assist it reduce its emissions. Stripe provides technical infrastructure for payment systems, such as Visa and Mastercard. The company currently has a valuation of around USD22 billion.

Stripe has launched the funding as part of its broader " Negative Emissions Commitment". The company is seeking to go beyond purchasing offsets for its own relatively small emissions, but also fund projects that will capture carbon from emissions sources or from the atmosphere more broadly.

This is a significant step for a private sector company not directly involved in either energy or industry. It's a signal that a growing number of private sector operators are beginning to appreciate that CCS has a clear place in the emissions reduction mix.

CCS BASICS: Storage

To effectively tackle climate change risks, we need to keep anthropogenic carbon dioxide (CO_2) emissions out of the atmosphere. For CO_2 emissions from a wide variety of industries, this can be achieved very effectively by permanently storing CO_2 deep below ground in secure geological storage formations. CO_2 storage isn't a new or emerging technology – there are many geological systems that naturally contain CO_2 and have stored it for millennia.

A CO_2 storage formation must meet four main criteria:

1. The formation must be both porous (have pore spaces where CO_2 can reside) and permeable (have links between pore spaces allowing CO_2 to permeate through the rock).
2. The formation must offer a stable geological environment
3. Geological trapping system should exist over the formation to trap the CO_2 in place. Thick shale seals consisting mainly of clay, make an excellent trapping system.
4. The formation should be at or below 800m depth. CO_2 at these depths is in a dense liquid-like state, making storage very efficient. Storage reservoirs have typical depths of 1-3kms.

Common geological formations meeting these criteria are either depleted oil and gas reservoirs or deep saline formations.

When CO_2 is injected into a storage formation it displaces fluids as the CO_2 plume moves into the pores of the rock. The same geological forces that kept the original fluid in place will also secure the CO_2. Once injected, the CO_2 will be trapped by impermeable layers of overlying rock (structural trapping) and in tiny pores within the storage rocks (residual trapping) .

Over time, the CO_2 will dissolve in fluid already in the rock formation (dissolution trapping) and then may combine chemically with the rocks so that eventually carbonate minerals are formed. Having multiple mechanisms at work creates storage security, ensuring the CO_2 is permanently and securely trapped.

Studies have shown that around the world there is enough geological storage capacity for hundreds of years of global CO_2 emissions.