

Is South-east Asia storing up trouble with carbon capture and storage hubs?

Governments and big polluters are pinning their hopes on seabed storage for CO2 captured from industry, but some see it as a flawed climate solution.

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By 2030 or even earlier, CO₂, the main greenhouse gas captured from refineries, power stations and cement plants in East Asia could be transported by specialised tanker ships to South-east Asia for storage deep under the seabed.

The hope is that burying millions of tonnes of the gas will curb climate change. To make this happen, tanker ships will be built to carry it to sites offshore in Indonesia and Malaysia and possibly Thailand, Brunei and Australia. The payoff is a fee for every tonne of CO₂ stored in depleted oil and gas wells or saline aquifers.

This is the vision that is rapidly taking shape as South-east Asia forges ahead with a plan to create carbon capture and storage (CCS) hubs to lock away the CO₂ for, hopefully, centuries.

Governments and the fossil fuel industry see this as a viable climate solution for polluting industries that need time to transition. Environmental groups and energy think-tanks say it is a costly and risky strategy, and that other decarbonisation solutions will have a better return on investment and bigger impact on climate change.

CCS has been around for decades for individual projects that captured very little CO₂ and relied heavily on government subsidies. Scaling up to regional hubs taps into the narrative of economies of scale. But it does not negate the risks or costs, experts say.

“This is a new concept and untested,” said Mr Grant Hauber, an energy sector expert for Asia for the IEEFA. “You want to make sure it’s a permanent solution. And the more complexity you add to these situations, the higher the risk,” he said, pointing to the supply chain to capture, transport, process, store and monitor the CO₂ for decades once it is injected 800m or more under the sea.

The challenge for CCS is to make a meaningful dent in the 40 billion tonnes of CO₂ emitted every year from human activity, mainly from burning fossil fuels and deforestation. To date, the amount sequestered is barely a rounding error. CCS hubs, though, are going ahead as climate impacts worsen and urgency to tackle CO₂ emissions grows.

Northern Lights

Later in 2024, Norway is set to start operations on the world’s first CCS hub.

The Northern Lights project expects to start receiving CO₂ from industrial customers in Europe via special tankers being built in China. The CO₂, which has to be chilled and compressed under high pressure, is transported to a receiving port in Norway where it is processed and piped to a saline aquifer 2.6km under the seabed.

The JV between **Equinor**, **Shell** and **TotalEnergies** aims to store 1.5Mtpa of CO₂ in the first phase and 5Mtpa in the second phase. Four CO₂ vessels have been ordered for use in the Northern Lights project, with the first expected to be delivered later in 2024, according to Norway’s DNV, one of the world’s main ship certifiers.

Indonesia has even larger ambitions. It took less than a year for the government to enact three CCS-related regulations, including a presidential regulation on the implementation of carbon capture and storage in January 2024.

The government says hundreds of billions of tonnes of CO₂ can be sequestered in depleted oil and gas wells and saline aquifers, and that the regulations will allow CCS operators to set aside 30% of their storage capacity for imported CO₂.

The government has already identified a number of potential hub sites. One of these is the Asri Basin to the north-west of Jakarta in the Java Sea, where Indonesia’s state energy firm **Pertamina** and US energy giant **ExxonMobil** announced in May 2024 a plan to conduct appraisal drilling for CCS. The companies have signed an initial storage deal with **KNOC**, South Korea’s national oil and gas company.

A preliminary study by Pertamina and Exxon found that the Asri basin could store up to three billion tonnes of CO₂ and would need an investment of US\$2 billion.

Singapore has long considered CCS as a potential climate solution and, in February 2024, was the first country to sign a letter of intent with Indonesia in which both sides agreed to form a working group to craft a legally binding agreement on the cross-border transport and storage of CO₂. The Government is also working with ExxonMobil and Shell to study the feasibility of aggregating CO₂ emissions in Singapore for storage in other countries.

Japanese firms have also been courting regional nations for CCS and that is set to increase after the Japanese Parliament approved its CCS business Bill in May 2024, which covers domestic and export storage projects.

In April 2024, Japanese power producer **Jera** said it reached an agreement with Malaysia's state-owned **Petronas**' subsidiary Petronas CCS Solutions to jointly explore the possibility of capturing CO₂ from Jera's power plants in Japan and shipping it to Malaysia. In 2023, TotalEnergies announced an agreement with Petronas and **Mitsui** of Japan to develop a carbon storage project in Malaysia.

Petronas is also building one of the world's largest CCS projects at its Kasawari gas field off Sarawak. It aims to capture 3.3Mtpa of CO₂ from the gas field once it becomes operational in 2026.

Thailand and Japan are also looking at the possibility of a CCS hub in the Gulf of Thailand.

With the surge in interest, what is the potential for the region?

Rystad Energy estimates CO₂ capture demand for the Asia-Pacific region at nearly 200Mt by 2035, from less than 10 Mtpa now.

Globally, several dozen CCS projects currently capture about 50 Mt of CO₂ – about 0.1% of humanity's carbon emissions, according to the **International Energy Agency**. To achieve the agency's Net Zero Emissions by 2050 Scenario, one billion tonnes of CO₂ needs to be captured and stored every year.

No price signal

Cost remains one of the greatest challenges, experts say. What is missing is a powerful price signal.

Other concerns include ensuring the permanence of long-term geological storage, robust laws covering liability for any leaks or mishaps and accusations that wealthier nations are simply dumping their CO₂ waste in poorer nations in a trade that is prolonging the life of the fossil fuel industry.

Northern Lights is likely to succeed because of Europe's high price on carbon emissions and lessons learnt from two high-profile but problematic Norwegian CCS projects, Sleipner and Snovit.

In Asia, a carbon price of about US\$100 a tonne is needed to make the investments work, said Mr Tim Buckley, director of the Climate Energy Finance think-tank in Sydney.

Every step of the CCS supply chain was costly, he said, from capturing the CO₂ from the smokestacks of power plants and heavy industry, chilling and liquefying the gas, building the ships, transporting the CO₂ and then storing and monitoring it for decades. "It's a pretty straightforward equation. If you don't have a price on carbon, or the equivalent tax, why would it work?" he said.

Japan, which is struggling to wean itself off coal and gas, is offering subsidies. But for how long? "For now, businesses will rely on subsidies to conduct CCS projects but since there is no strong carbon pricing in Japan, and no clear plans to reduce costs, it is likely that CCS cannot be conducted without subsidies in the future as well," said Ms Ayumi Fukakusa, director of **Friends of the Earth Japan**.

Another problem: Scaling up CCS is unlikely to mean costs will plunge. Mr Hauber pointed out that it was not like wind or solar technology, where mass production and innovation pushed down costs. "CCS doesn't have that advantage. The equipment is

bespoke for every single application,” he told The Straits Times’ Green Pulse podcast. Each site was unique with different conditions and geology. And the costs could mount if something goes wrong with the storage site.

CO2 is a long-lived gas in the atmosphere, between 300 and 1,000 years, according to Nasa. So it has to stay in the ground for centuries. “I reckon CCS could work. I am worried about the multi-decades of monitoring,” Mr Buckley told ST.

Mr Hauber has another concern: “Depleted oil and gas fields, in reality, are probably the worst place to put CO2. Anything that has multiple perforations, wells, is not where you want to permanently store a climate-changing waste product. You have to make sure that each of those wells is fully plugged.”

Liability

National regulations and bilateral agreements will help to define responsibility for the stored CO2.

The Singapore office of law firm Bird & Bird sketched out what this might look like for Singapore in a March 2024 note. Among other things, regulations should define ownership rights and obligations throughout the value chain and over the course of a project. There also needs to be a robust monitoring and reporting system as well as some form of security or performance bond to ensure compliance.

Still, concerns remain about the viability of mandating decades-long monitoring by CCS operators, especially if they go out of business or government regulations change.

‘Sisyphean task’

Mr Putra Adhiguna, of **Energy Shift Institute**, said his greatest concern with CCS is that it diverts attention from more ambitious decarbonisation targets in polluting industries.

It is a view shared by Ms Lili Fuhr, fossil economy programme director at the **Centre for International Environmental Law**. Governments, she suggests, should prioritise solutions such as replacing fossil fuels with renewable energy, increasing energy efficiency, and reducing energy and resource use. “CCS is a dangerous distraction.”

The IEA says the most effective way to decarbonise for the least money is through renewables, energy efficiency, electrification and stopping methane leaks. “So if you did those four things, that’s about 85% of the decarbonisation challenge,” said Mr Hauber.

Halting deforestation and restoring forests, mangroves and other habitats can also capture and prevent billions of tonnes of CO2 from being emitted while also having major economic benefits for people and nature.

In the end, CCS is unlikely to prove cost-effective to be scaled up fast enough. Cheaper alternatives are the ones that need the most attention for the world to reach net-zero emissions by mid-century, experts say. “CCS is like a Sisyphean task. You’re pushing this rock uphill, and it’s not getting any lighter or easier to do,” said Mr Hauber.

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