

The Singapore International Energy Week, a five-day conference on energy issues, kicks off today. Amid a global fossil fuel crunch and Singapore's drive to decarbonise electricity usage, *The Straits Times* highlights research being done here on how to reduce the nation's carbon footprint.

NTU team looking into storing of CO₂ underground

Studies ongoing to see if rock formations in S'pore are suitable to store the planet-warming gas

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Efforts are under way around the world to reduce the amount of planet-warming carbon dioxide (CO₂) being emitted to reduce the harmful impacts of climate change.

But researchers from the Nanyang Technological University's (NTU) Earth Observatory of Singapore (EOS) are looking to go one step further and study how the CO₂ already in the atmosphere from decades of economic activity can be drawn down.

Their answer could lie underground.

Studies are ongoing to see if Singapore's rock formations will be suitable for storing CO₂. While natural habitats like forests have the natural ability to absorb CO₂ and store it in their soil and in the roots and trunks of trees, Earth's lithosphere – or rocks – are a far larger reservoir of carbon.

There are currently 15 direct air-capture plants operating worldwide, capturing more than 9,000 tonnes of CO₂ per year, the International Energy Agency said in September. Global CO₂ emissions totalled 31.5 billion tonnes.

CO₂ in the atmosphere naturally enter the lithosphere slowly over thousands of years via a series of chemical processes.

This means it will not degas into the atmosphere and trap heat, contributing to the planetary crisis.

EOS researchers are working to develop an underground map of rock formations in Singapore to determine whether technology can be used to take atmospheric CO₂ and pump it deep underground for storage.

With such technology, CO₂ is compressed at such high pressures that it essentially turns into a liquid form.

The weight of overlying rocks help to maintain this pressure, which allows the carbon to remain underground for a long period of time.

This technology essentially speeds up the rate at which carbon can be locked away in rocks, since the natural process takes time that humanity does not have to ward off catastrophic climate change.

But a previous study by five local agencies, including the National Climate Change Secretariat, found that Singapore has various obstacles it has to overcome for carbon capture, utilisation and storage technologies to be used here.

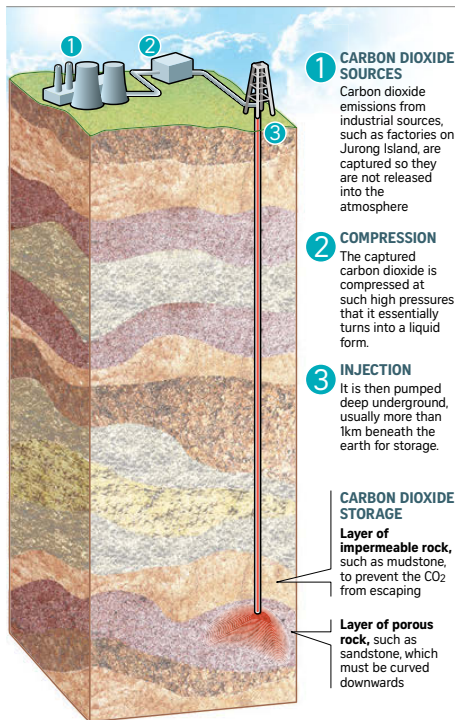
In terms of storage, the study found that Singapore does not have any known suitable geological formations to store CO₂ permanently underground.

But EOS researchers said rock formations in western Singapore could potentially have a carbon storage potential, based on their analysis of rock samples there.

For geological formations to be suitable for carbon storage, they

Locking up carbon dioxide

Carbon dioxide (CO₂) is usually generated when fossil fuels are burnt. Trees have the natural ability to take in this planet-warming gas through photosynthesis, but humans are trying to accelerate the drawdown rate to reduce the harmful impacts of climate change through carbon capture, utilisation and storage technology. This involves taking up CO₂ through technological means and then storing it deep underground



must have layers of porous rock at least 1km underground, either on land or beneath the sea floor.

The porous rock must also be curved downwards – like an upside down bowl, and capped by a layer of impermeable rock, which acts as a seal to prevent the CO₂ from escaping.

These structures are often found in depleted oil and gas fields, where the reservoirs are known to be stable over time as they have held fossil fuels for millions of years.

Dr Karen Lythgoe, a seismologist at the EOS involved in the study, said rock formations in the west-

ern area of Singapore consists of sandstone, which is porous, and finer-grained mudstone that could form an impermeable layer.

But more detailed studies are needed to ensure that the rock is in the correct shape, she added.

Assistant Professor Wei Shengli, who is leading the research team, said: "The overall target of this project is to estimate whether it is possible to do CO₂ sequestration, and to give a quantitative estimation of the sequestration capacity."

Rock samples collected from earlier studies could give the researchers some preliminary insights into whether the rock is effective in holding carbon dioxide and trapping it over time.

But more data is needed on whether these layers of rocks have carbon storage capabilities.

Seismic imaging of the structures and geological analysis can also help the researchers to evaluate the feasibility of carbon sequestration and estimate the carbon storage capacity, he noted.

Assistant Professor Judith Hubbard, a principal investigator at the EOS, said: "If Singapore wants to achieve its carbon emission goals, it is important to try a lot of different things at the same time, as it is quite difficult to find one solution that will be effective at a very large scale."

This means that Singapore should not let up on its carbon mitigation efforts such as renewable energy deployment even as it looks into emerging low-carbon strategies such as carbon sequestration and storage, as there is a possibility that carbon storage may not be suitable here, said Dr Hubbard.

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Global CO₂ emissions totalled 31.5 billion tonnes.

Said Prof Wei: "The team is open to collaborating with other scientists doing research in fields looking into Singapore's carbon sequestration potential, or those who are looking into geothermal potential as we believe that an underground model of Singapore would be highly beneficial in urban and underground planning, as well as resource and risk mapping."

They are looking to apply for available research grants.

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