Unlocking the potential for CCUS in Vietnam

There is excellent potential for CCUS in Vietnam and the government could play a key role through subsidies for demonstration projects and regulatory changes to incentivise the industry.
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Vietnam is a highly populated country, of close to 100 million inhabitants, located in Southeast Asia. Its economic growth rate has remained consistently high during recent decades, with an average annual GDP growth of around 7%.

This pace of development is likely to continue in the coming years, which means that investment in heavy industry will increase, leading to higher annual carbon dioxide emissions. There are also significant plans to increase natural gas and coal-fired power generation to support the expected industrial development, further increasing CO2 emissions.

Furthermore, Vietnam's proximity to highly industrialised countries in North Asia, such as Japan and South Korea, makes it an attractive location as a regional CCUS hub. Japan and South Korea are targeting CO2 emission reductions based on The Paris Agreement and are considering exporting CO2 on tankers for permanent underground storage in Indonesia and Australia.

These countries are much further away than Vietnam, potentially making Vietnam a more cost-effective and attractive option for a regional North Asian CCS hub.

CO2 emissions sources in Vietnam

Currently, the main source of CO2 emissions in Vietnam are thermal power stations, including coal, gas, and fuel oil fired plants. Refineries, steelworks, and cement plants also contribute to a strong industrial base. Annual CO2 emissions in Vietnam have increased from 13 million tonnes in 1990, to 253 million tonnes in 2018. It is expected that this could increase to 830 million tonnes in 2030.

This is mainly due to high number of coal-fired power stations that have been installed in recent years, as well as a coal fired power generation ramp up to 37 GW of power generation in 2030 to meet the growing national demand [1].

To meet the worldwide need to mitigate climate change in the coming years, it is likely that CCS technology will be used in many countries to capture CO2 from main emissions sources and inject it into underground reservoirs, instead of releasing it into the atmosphere.

CCS is a viable option that could play an important role in the future CO2-neutral energy system. Beyond that, CCUS can be more economically attractive than CCS when the CO2 is used for Enhanced Oil Recovery (EOR) for depleted oil fields, or CO2 Enhanced Coal Bed Methane Recovery (CO2-ECBM) for Coal Bed Methane (CBM) resources.

CCS must become integrated into future energy sector infrastructure plans to ensure cost-effective decarbonisation. The combination of natural gas reforming with CCS to make blue hydrogen is one possible example. Gasification of coal with integrated CCS to make purple hydrogen is an alternative.

The ideal geological structures for CCUS

Saline aquifer and depleted oil and gas fields are two main options for CO2 storage. Depleted oil and gas fields often have legacy surface and subsurface facilities from previous hydrocarbon production and the possibility of EOR may also exist. Therefore, they can be less expensive to use for CCS than aquifers.

However, aquifers have much larger storage volume and are more ubiquitous worldwide. They are also plentiful in and around Vietnam and could therefore play a significant role in CO2 emissions reduction for the nation and broader region.

One of largest CCS projects in development globally is the Gorgon project in Western Australia. It has faced several issues regarding equipment specifications and the challenges of saline aquifer water removal from the sandstone rocks that cap the carbon dioxide storage field. The problems are not related to fundamental issues of using saline aquifers for CCS but are specific to the way the project has been engineered and executed.

To demonstrate that aquifers can successfully be used for CCS; the Utsira saline aquifer in the North Sea has been used for permanent underground CO2 storage by Equinor (previously Statoil) for over 20 years. Sleipner West, Gorgon and more than 20 other CCUS projects can offer many lessons for subsequent projects in Vietnam and other high-potential regions of the world.

The third underground CO2 utilisation and storage option is CO2-ECBM. Although CO2-ECBM has not been developed in Vietnam, there may be a significant opportunity to use this technology with several coal reserves, located in the northern part of the. CBM is an unconventional natural gas resource in which gas is generated in coal deposits and is recovered by conventional well drilling methods.

CCUS operation for CO2-ECBM in CBM deposits is an appropriate solution not only for CO2 storage, but also for enhanced natural gas recovery from these sources. It can be a complimentary mix to the range of CCUS technologies in locations where saline aquifer and depleted fields are not available.

From a technical point of view, Vietnam has an attractive geological structure for underground CO2 storage and injection. Most of these geological structures are offshore sedimentary basins.

Based on conservative initial estimates, 12.2 billion tonnes of CO2 could be injected into the subsurface, including 10.4 in saline aquifers, 0.6 in depleted oil fields, 0.7 in depleted gas fields and 0.5 in CBM [2].

More than thirty hydrocarbon fields are producing oil and gas in the offshore regions around Vietnam. It is estimated that the top 14 oil and gas fields could have the capacity of 900 million tonnes for CO2 Storage.

During every underground CCS project, there is a risk of leakage for CO2 storage that should be considered during the design and pilot phase of the project. No CCS pilot has yet taken place in Vietnam, but a recent feasibility study by the Asian Development Bank (ADB) [3] showed that Cuu Long Basin in the southern part of the country could be the best location for CCS due to availability of high numbers of oil and gas fields, as well as its proximity to CO2 resources particularly coal power plants.

The CO2 could be transported from emissions sources via onshore pipeline followed by offshore pipeline or ship to the offshore CCS location.

In the White Tiger oil field of the Cuu Long Basin, the ADB feasibility study estimated an annual CO2 storage capacity of 4.6 million tonnes could be achieved and the oil recovery rate could be enhanced by 45,000 bbl/day.

Industrialisation and power generation investments are set to continue in Vietnam

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The estimated CCS costs in Vietnam are 43-52 €/tonnes CO2 (85% capture, 4% transportation and 11% storage). High carbon prices would encourage private sector investment in CCS and lead to a CO2 emissions reduction.

Although technical evaluations point to the high potential of CCS in Vietnam, regulatory changes would support deployment of this technology. Whilst energy policy is developing and the use of renewables is increasing, currently, there is no clear plan to reduce CO2 emissions from the installed base of fossil fuel power plants and new coal and LNG fired capacity is being planned.

The government could play a catalytic role in unlocking the potential for CCS with carbon taxes, subsidies for demonstration projects and R&D support to enable change and to motivate industry in Vietnam to decarbonise. A holistic review of energy policy, to focus on low carbon solutions, for example turquoise or blue hydrogen production, could also unlock the potential for CCS.

In the power sector, Vietnam Electricity of (EVN) could be a highly influential stakeholder for CCS. EVN controls power generation and the power grid in Vietnam and its ambition and vision impact CO2 emissions and the potential for post-combustion CCS deployment.

Another key to unlock the potential could be for companies such as Petro Vietnam, the national Oil and Gas group, to cooperate with operators in countries that have experience of CCS such as China, Kazakhstan, Australia, Canada, US, and Norway, to develop economical and safe CCS schemes and system designs.

References

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