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How Indonesia Can Reduce Its Carbon Footprint through Enhanced Oil Recovery

Carbon capture, utilization, and storage technologies can support efforts of countries to curb carbon dioxide emissions from using fossil fuels. Photo exclusively licensed to ADB until 2022.

Injecting carbon dioxide into mature oil fields can boost production and store this climate-warming gas underground permanently.

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Introduction

Enhanced oil recovery through the injection of carbon dioxide (CO_2) can be a win–win solution for Indonesia. This technology can help slow or halt the decline in oil production while addressing the urgent need to curb rapidly rising greenhouse gas (GHG) emissions.

Indonesia is one of the world's oldest producers of crude oil. However, its production has fallen steadily for more than 20 years. There may be extensive opportunities for enhanced oil recovery in the country, given the maturity of many of its oil fields. While there are other recovery methods, using CO_2 to boost oil production can provide the added benefit of permanent CO_2 storage underground.

This article is adapted from a report from the Asian Development Bank (ADB), which evaluates the technology as a climate mitigation strategy and provides insights on how to implement it.

What is carbon dioxide-enhanced oil recovery for climate mitigation?

Carbon dioxide-enhanced oil recovery or CO_2?EOR has been used on a commercial scale since 1972 in the United States and it is also used in other countries. However, the use of the technology to mitigate climate change is relatively new.

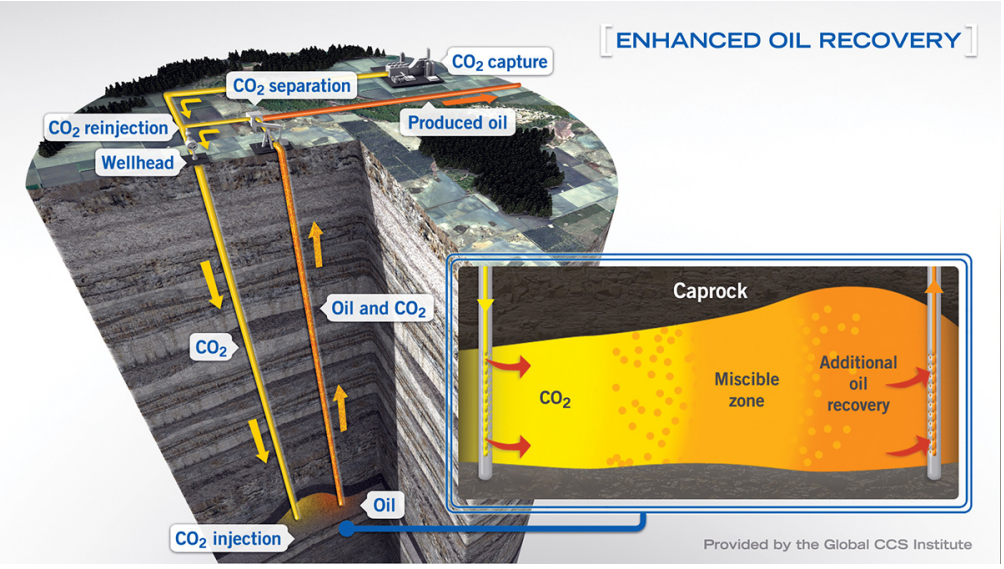
During normal CO_2-EOR operations, some of the CO_2 injected is incidentally trapped in the oil field. Ways to ensure CO_2 storage as well as oil extraction are attracting interest around the world as a type of carbon capture, utilization, and storage (CCUS) technology called CO_2-EOR+.

As a climate mitigation measure, CO_2?EOR+ requires the CO_2 to come from an anthropogenic source (resulting from human activities), such as a power station or a natural gas processing plant (natural gas extracted from reservoirs can contain significant amounts of CO_2). Additional steps also need to be undertaken before, during, and following CO_2 injection, including additional measurement, reporting, and verification.

Regulatory requirements and fiscal incentives, such as a carbon tax or price for the CO_2 stored, can incentivize oil field operators to adopt the additional measures to serve as a climate mitigation project. Projects that take off are usually in response to financial incentives.

There are currently 14 large-scale CO_2?EOR+ projects with the dual goal of boosting oil production and storing CO_2. Ten are in North America, of which eight are in the US; the largest is in Brazil. Their total injection capacity is around 35 million metric tons (MMT) per year.

Figure 1: Illustration of Carbon Dioxide-Enhanced Oil Recovery



CO_2 = Carbon Dioxide
Source: Global CCS Institute. CCS Image Library - Carbon Capture and Storage Images. https://www.globalccsinstitute.com/resources/ccs-image-library/ (accessed 14 October 2019).

Why should Indonesia consider this technology?

CO_2?EOR+ could make an important contribution to efforts in Indonesia and elsewhere to curb CO_2 emissions from fossil-fuel power plants or industrial processes over the long term. It is seen as a stepping-stone to pure carbon capture and storage, which is widely regarded as a potentially important means of reducing emissions, alongside a shift in energy use to less carbon-intensive sources, improvements in CO_2 efficiency, and energy conservation.

The large amount of oil remaining in most of Indonesia's mature oil fields suggests that there is significant technical potential for CO_2?EOR, though the economic potential is likely to be far smaller, especially at low oil prices. The cost of procuring the CO_2 is particularly important to the economic viability of deploying the technology. The most promising candidates for projects are mature fields with declining production that are located close to low-cost sources of CO_2, such as natural gas processing plants.

What are the potential anthropogenic sources of CO2?

Potential sources of CO_2 in Indonesia are oil and gas processing plants, and industrial processes that involve the conversion of hydrocarbons. Power plants and petrochemical plants, including fertilizer factories, could also capture and supply CO_2.

The processing of natural gas is likely to be the cheapest source of high-purity CO_2 now and in the future. Before the natural gas can be distributed and consumed, the CO_2 has to be removed along with other impurities. This removes a great deal of the CO_2 capture cost that would be incurred at a power plant or other source before transporting it to the oil field for injection. The availability of CO_2 from gas processing is likely to grow in Indonesia as several of the gas fields that are expected to come on stream in the coming years have particularly high CO_2 content.

What needs to be done to deploy this technology?

The critical first step is to launch an initial pilot project. Commercial projects will only follow if at least one pilot and demonstration project has been operating successfully for several years. The learning and experiences from pilot and demonstration projects will be of enormous value in helping operators design commercial projects and helping policy makers draw up an effective legal and regulatory framework.

Pertamina, the state oil and gas company, is exploring a pilot project at the Sukowati oil field located in East Java, and ADB provided technical assistance to analyze the potential for delivering on dual goals of CO_2 storage and oil extraction. The pilot project consists of four production wells and a CO_2 injection well. If the pilot proves to be successful, a commercial-scale project is envisaged, involving the use of all 35 existing production wells and drilling new CO_2 and water injection wells. The CO_2 needed for the pilot

project would be sourced from the Sukowati field itself; the gas associated with the oil currently produced from the field contains about 40% CO_2.

Using CO_2?EOR in climate mitigation is a new activity in Indonesia. It requires a comprehensive legal and regulatory framework.

A draft presidential decree setting out a general framework for carbon capture and storage was completed in March 2019, building on existing regulations governing the upstream sector and industrial activities. The primary objective of the decree is to establish a performance-based system of permitting for the storage of CO_2. It sets out the standards by which projects shall be permitted with the objective of mitigating associated risks, covering both pilot and full commercial projects. The decree exempts pilot projects involving the injection of less than 150,000 tons of CO_2 from certain requirements and allows the regulator to waive other requirements on a case-by-case basis.

The development of a more comprehensive framework at a later stage is expected to benefit from the lessons learned from the pilot projects.

There is also a need to review and recommend specific policies and tax incentives for CO_2?EOR+ projects with climate mitigation objectives. For large-scale commercial projects to take off, a significant financial incentive in the form of a carbon price or tax credit will probably be necessary, especially if oil prices fall. The development of human capital will also be an important element in achieving the successful demonstration and subsequent large-scale deployment of this technology in Indonesia.

Resources

Asian Development Bank. Indonesia: Pilot Carbon Capture and Storage Activity in the Natural Gas Processing Sector (TA 9189-INO).

ADB. 2019. *Dioxide-Enhanced Oil Recovery in Indonesia: An Assessment of its Role in a Carbon Capture and Storage Pathway*. Manila.

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Asian Development Bank (ADB)

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