ASSESSING CLIMATE MITIGATION BENEFITS OF PUBLIC SUPPORT TO CCS-EOR: AN ECONOMIC ANALYSIS

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Overview

By storing carbon dioxide CO_2 captured from the atmosphere or point sources into oil fields, carbon capture and storage with enhanced oil recovery (CCS-EOR) increases the fields' output by raising reservoir pressures. Since CO_2-EOR has been experimented with for decades and the revenues from the additional oil production improve projects' economics, CCS-EOR is the most readily deployable CCS technology. However, public support for CCS-EOR projects is sometimes contested on the grounds that the resulting increase in oil production undermines their environmental benefits. Addressing this concern requires determining the effects of implementing CCS-EOR on global CO_2 emissions. This paper presents a simple approach based on a marginal reasoning consistent with economic decision-making. It produces analytical formulas that account for the effects on the global oil market of incentivizing CCS-EOR. In addition, we quantify the volume of oil that can be decarbonized by storing a ton of captured CO_2 through EOR from different perspectives.

Methods

The International Energy Agency (IEA, 2015) used a large-scale oil model to simulate the impact of new CO2-EOR projects on global emissions. This paper develops analytical formulas as an alternative approach to the numerical, simulation-based approach used by the IEA (2015). Our approach is based on a marginal reasoning consistent with economic decision making. Its simple, partial-equilibrium framework identifies the effects of incentivizing CCS-EOR projects on global emissions. These effects are only implicitly accounted for in the numerical results of previous large-scale, technology-rich models with market-clearing commodity prices. Our approach, instead, allows us to abstract from the complexity of these models and to focus on the elements that are solely relevant to the question under consideration.
For illustrative purposes, we have proposed a first-cut numerical calibration of our results. IEA (2015) reports three different values for EOR-oil-produced per ton of CO2 stored, depending on the CO2-EOR technique used. Using our formulas, we compute the reduction in emissions per ton of CO2 stored for each reported value.

Results

Our analysis shows that CCS-EOR technology has the potential to mitigate global emissions. However, after accounting for the need to decarbonize the EOR oil produced, the reduction in emissions is much less than the stored quantity of CO2. Our illustrative calibration suggests that capturing and storing a ton of CO2 through EOR reduces total global emissions by an amount ranging between 0.05 and 0.60 tons, depending on the EOR technique used. The higher the volume of EOR oil produced per ton of CO2 stored, the bigger the need for decarbonization, with lower resulting reduction in emissions.
The fact that CCS-EOR projects reduce global CO2 emissions by much less than the quantity of CO2 captured (after accounting for the decarbonization of the EOR oil) has policy implications, since fiscal incentives granted by governments to support CCS-EOR as a climate-change mitigation technology should be sized accordingly. However, since CCS-EOR projects benefit from the extra oil revenues generated, limited incentives may be sufficient to render these projects profitable and leverage them to upscale CCS technologies.

Conclusions

This paper has adopted an economic approach that helps to clarify the potential impact on global emissions of capturing CO2 and storing it through EOR. It has produced analytical formulas from different perspectives (economic vs. accounting; well-to-wheel vs. oil upstream). The paper does not discuss questions relating to geological or monitoring conditions. Our calibration should be refined and complemented by sensitivity analyses with respect to elasticity values, since these values are not precisely known. In addition, emissions relating to the manufacturing of equipment used for CCS-EOR may have to be added to perform a full lifecycle assessment. We recommend these considerations for further research.

References

Azzolina, Nicholas A., John A. Hamling, Wesley D. Peck, Charles D. Gorecki, David V. Nakles, and L. Stephen Melzer. 2017. "A Life Cycle Analysis of Incremental Oil Produced via CO2 EOR." Energy Procedia 114 (July): 6588–96.

Caldara, Dario, Michele Cavallo, and Matteo Iacoviello. 2019. "Oil Price Elasticities and Oil Price Fluctuations." Journal of Monetary Economics 103 (May): 1–20.

International Energy Agency (IEA), 2015. Storing CO2 through Enhanced Oil Recovery, Combining-EOR with CO2 Storage (EOR+) for Profit. IEA. https://iea.blob.core.windows.net/assets/bf99f0f1-f4e2-43d8-b123-309c1af66555/Storing_CO2_through_Enhanced_Oil_Recovery.pdf.