Analysis shows greenhouse gas emissions similar for shale, crude oil

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The U.S. Department of Energy's Argonne National Laboratory this week released a pair of studies on the efficiency of shale oil production excavation. The reports show that shale oil production generates greenhouse gas emissions at levels similar to traditional crude oil production.

The research, which was conducted in collaboration with Stanford University and the University of California, Davis, analyzed the Eagle Ford shale formation, also called a play, in Texas and the Bakken play mainly in North Dakota. These plays are shale formations with low permeability and must be hydraulically fractured to produce oil and gas.

Eagle Ford and Bakken are the second and third largest oil producing shale formation regions in the United States, during the last three years. Together, Bakken and Eagle Ford in 2014 accounted for 54 percent of oil production and 19 percent of gas production among the top seven production regions.

Light crude oil trapped in rock, such as shale, is called tight oil. Its production is accompanied by a significant amount of energy product, including natural gas, some of which gets flared or vented off at the well site. Until now, little information has existed about how production methods impact greenhouse gas emissions at these sites.

"These two plays produce a large amount of the shale oil for the U.S.," said Michael Wang, a senior scientist at Argonne who leads the

Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) model, which incorporated the study results. "These two studies have concluded that the net greenhouse gas intensity of production is similar to conventional production."

Both studies showed that after taking into consideration flaring and venting of natural gas, the greenhouse gas emissions associated with shale/tight oil production are similar to those generated at conventional crude oil reserves. This emission intensity stays consistent during the lifespan of extraction at the oil play. This contradicts an earlier estimate that the Bakken play might produce greenhouse gas emissions 20 percent higher more than for crude oil production.

"Drilling and fracturing wells for shale oil is more energy intensive than conventional drilling, but these wells have higher productivity and require less energy to produce and process the crude," said Adam Brandt, a professor at Stanford University, lead author on the Bakken study. "Flaring of gas is a key issue in the Bakken, and if flaring were controlled the Bakken crude would have lower emissions than conventional crude."

The Eagle Ford study looked at crude oil produced from different production zones for 2009-2013. Some zones produced more oil while others produced more gas. The study showed that wells in the gas-rich zone used roughly twice as much energy as wells in the oil-rich zone, which used an average of 1.2 percent of energy produced for production, extraction, and processing. Additionally, the water usage rate was generally higher at the gas-rich wells.

"It was challenging to calculate the net energy use and net greenhouse gas emissions for Eagle Ford because of the wide range of products produced at these places, and there were no publicly available tools for horizontal drilling and hydraulic fracturing," said Sonia Yeh, lead author

on the Eagle Ford study and a researcher with the Institute of Transportation Studies at UC Davis. "The collaboration provided greater transparency and understanding of energy and climate impacts of oil production in these regions."

These studies calculate energy consumption and greenhouse gas emissions associated with the crude oil and natural gas extraction using the Oil Production Greenhouse Gas Emissions Estimator (OPGEE) model with production data collected for shale oil well operations in both plays. This model estimates energy for the lifecycle from the initial exploration to the refinery entrance gate and includes production, processing and transport.

The research team put the OPGEE-produced results into the GREET model developed at Argonne National Laboratory for modeling the life-cycle GHG emissions.

More information: The full reports are available online:

- Energy Intensity and Greenhouse Gas Emissions from Crude Oil Production in the Eagle Ford Region: Input Data and Analysis Methods
- Energy Intensity and Greenhouse Gas Emissions from Crude Oil Production in the Bakken Formation: Input Data and Analysis Methods

Provided by Argonne National Laboratory