



Pump jacks are seen at dawn in an oil field over the Monterey Shale formation in California, where gas and oil extraction using hydraulic fracturing, or fracking.

PHOTOGRAPH BY DAVID MCNEW/GETTY

Fracking boom tied to methane spike in Earth's atmosphere

The chemical signature of methane released from fracking is found in the atmosphere, pointing to shale gas operations as the culprit.

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Scientists have measured big increases in the amount of methane, the powerful global warming gas, entering the atmosphere over the last decade. Cows or wetlands have been fingered as possible sources, but new research points to methane emissions from fossil fuel production—mainly from shale gas operations in the United States and Canada—as the culprit.

The “massive” increase in methane emissions occurred at the same time as the use of fracking for shale gas took off in the U.S., says Robert Howarth, an ecologist at Cornell University and author of the study published Aug 14 in the journal *Biogeosciences*.

“We know the increase is largely due to fossil fuel production and this research suggests over half is from shale gas operations,” Howarth says in an interview.

This big methane increase matters because methane heats up the climate over 80 times more than an equivalent amount of carbon dioxide (CO₂) in the first 20 years after it is released into the atmosphere, according to the Intergovernmental Panel on Climate Change. After 20 years most of the methane becomes CO₂, which can last for hundreds of years.

Methane released from shale gas production has a slightly different chemical fingerprint compared to methane from cow burps (not farts as commonly believed) and wetlands. Previous studies show that shale gas generally has less carbon-13 relative to carbon-12 (denoting the weight of the carbon atom at the center of the methane molecule) than does methane from conventional natural gas and other fossil fuels such as coal, Howarth said.

The study took previous data on the chemical composition of methane in the atmosphere and applied a series of equations to parse out how much of this lighter form of methane could be attributed to shale gas. That lighter form of methane released during fracking is a substantial component of the overall methane rise since 2008.

However, he acknowledges that the chemical fingerprint of shale gas can vary depending on the locale and how the chemical analysis is done. While the study isn't a "smoking gun," it has found a link between recent increases in methane in the atmosphere and shale gas production.

"It's fuzzy, but the fingerprint is there," Howarth says.

Signs point to fracking

Natural gas is mainly methane. Fracking involves drilling an oil or gas well vertically and then horizontally into a shale formation. A mixture of highly pressurized water, chemicals, and sand is injected to create and prop open fissures, or pathways for the gas to flow. Nearly all of the world's fracking operations are in the U.S. and Canada. About two-thirds of all new gas production globally over the last decade has been shale gas produced in the U.S. and Canada using fracking, Howarth's study found.

The amount of methane added to the atmosphere in the past decade also corresponds to studies that show fracking operations leak, vent, or flare between 2 and 6 percent of the gas produced, Howarth said.

A 2015 study estimated that North Texas' Barnett Shale region leaked 544,000 tons of methane a year using a conservative leakage rate of 1.5 percent. That's equivalent to 46 million tons of CO₂, more than some states such as Nevada or Connecticut.

A 2015 study led by John Worden of NASA's Jet Propulsion Laboratory found that methane levels were unchanged for years, but increased sharply after 2006, growing by 25 million tons a year. Using satellites and other measures they concluded that fossil fuels were responsible for between 12

and 19 million tons of this additional methane and the rest was likely biological sources.

The Howarth study adds another piece to the extremely complicated methane puzzle, Worden said in an email, declining to elaborate.

It's unlikely that the sharp rise in global methane levels at the same time as shale oil and gas operations increased dramatically is just coincidence, said Anthony Ingraffea, a Professor of Engineering at Cornell University and a colleague of Howarth's. The paper suggests shale gas's chemical fingerprint offers evidence of a direct link, said Ingraffea, who reviewed an early version of the paper.

"Isotopic analysis of gas samples at wellheads across a number of fracking operations could easily prove or disprove Howarth's hypothesis," he says. "If Howarth is right then we know shale gas operations are making global warming worse, and upending efforts to stay well below 2C."

Under the 2015 Paris Agreement, every country in the world agreed to keep global temperatures well below 2 degrees Celsius (3.6 degrees Fahrenheit), while low-lying island states and others lobbied for 1.5 Celsius.

Although often forgotten in climate discussions, methane increases have added to the current warming and will continue to do so without action to cap them.

"The atmosphere responds quickly to changes in methane emissions. Reducing methane now can provide an instant way to slow global warming," Ingraffea says.

Ingraffea's own research has found that a small percentage of wells are responsible for the bulk of methane emissions either through leaks or deliberate venting. Retrofits and capturing the gas instead of venting could dramatically reduce emissions but would add to costs.

Environment and health

Environmental and health concerns have led France and Germany to ban fracking. New York State, Maryland, and Vermont also have bans. A 2018 study in Pennsylvania found that children born within a mile or two of a fracked well were likely to be smaller and less healthy.

In Arkansas researchers found water levels in 51 percent of its streams dangerously depleted due to water withdrawals for fracking operations. Fracking and the deep-well injection of its waste waters have been widely linked to earthquakes.

In Oklahoma, which has experienced heavy fracking activity, hundreds of small earthquakes have been observed annually in a region that was previously more geologically quiet.