What will it take to get sustained benefits from natural gas?

Understanding the climate impacts of methane leakage from natural gas

There has been much debate about the climate implications of increased natural gas usage. While it is true natural gas burns cleaner than other fossil fuels, methane leaking during the production, delivery and use of natural gas has the potential to undo much of the greenhouse gas benefits we think we're getting when natural gas is substituted for other fuels.

Methane, the primary component of natural gas, is a powerful, short-lived greenhouse gas. It is more than 100 times more potent at trapping energy than carbon dioxide (CO_2), the principal contributor to man-made climate change. When considering its conversion to carbon dioxide over time its impact on an integrated weight basis is 84 times more potent after 20 years and 28 times more potent after 100 years.

The problem starts when unburned gas gets into the atmosphere. Leaks and releases occur throughout the natural gas supply chain, but no one is sure exactly where the leaks and releases are or how much escapes. If not better mitigated, methane leaks and releases could undermine the greenhouse gas advantage natural gas offers and spell major trouble for the climate.

The good news is that leaks can be detected, measured and reduced. But we need better science to minimize leaks and releases.

Methane leakage study

EDF and its partners have launched an ambitious scientific research effort in order to find and measure the leaks and releases across the natural gas supply chain. The project currently involves more than 100 academic researchers and natural gas industry companies. Roughly 16 studies have been undertaken and we expect the results to be submitted in peer-reviewed science journals by mid 2015.

This work is organized into five research modules:

- **Production** – University of Texas in collaboration with EDF and nine natural gas producers is leading a research team in measuring methane leaked or released at natural gas well pad. UT study results are complemented by other studies supported by EDF to accurately characterize methane emissions for the production sector.

- **Gathering & Processing** – *coming soon*
- **Long Distance Transmission & Storage**–Colorado State University in collaboration with EDF and seven industry participants is measuring emissions from the nation's interstate pipeline systems and storage facilities that deliver natural gas around the country for a diversity of end-users including electricity, as a feedstock for industrial development and domestic heating.
- **Local Distribution** – A Washington State University led study, involving EDF and several natural gas utilities, will help determine methane leaked when gas moves through local distribution systems to consumers. Additional EDF studies led by scientists from Harvard, Duke and Boston Universities and others will supplement work in this module.
- **Transportation** – West Virginia University, in collaboration with EDF and leading engine manufacturers, fleet operators and fueling station equipment owners within the natural gas industry is focused on making some of the first measurements of methane leakage from medium and heavy duty trucks and CNG and LNG fueling stations.

Findings from this effort will help inform policymakers, researchers and industry, providing new insights and data about the sources of methane emissions from across the natural gas supply chain and illuminating ways to reduce those emissions.

Methane leakage paper

An enhanced method for assessing climate impacts from natural gas development and use is offered in Greater focus needed on methane leakage from natural gas infrastructure, a scientific paper in *Proceedings of the National Academy of Sciences* co-authored, with others, by EDF scientists Ramon Alvarez and Steve Hamburg.

The paper illustrates the importance of accounting for methane leakage across the value chain of natural gas (i.e. production, processing and delivery) when considering fuel-switching scenarios from gasoline, diesel fuel and coal to natural gas.

Key findings of the *PNAS* paper, based on the best available estimates on methane emissions from the EPA, include:

- Assuming the Environmental Protection Agency's (EPA) 2009 leakage rate of 2.4% (from well to city), new natural gas combined cycle power plants reduce climate impacts compared to new coal plants; this case is true as long as leakage remains under 3.2%.*
- Assuming EPA's estimates for leak rates, compressed natural gas (CNG)-fueled vehicles are not a viable mitigation strategy for climate change because of methane leakage from natural gas production, delivery infrastructure and from the vehicles themselves. For light-duty CNG cars to become a viable short-term climate strategy, methane leakage would need to be kept below 1.6% of total natural gas produced (approximately half the current amount for well to wheels – note difference from well to city).
- Methane emissions would need to be cut by more than two-thirds to immediately produce climate benefits in heavy duty natural gas-powered trucks.

- At current leakage rate estimates, converting a fleet of heavy duty diesel vehicles to natural gas would result in nearly 300 years of climate damage before any benefits were achieved.

Related resources

- Air pollution issues associated with natural gas [PDF]
- *TIME* article on the paper and methane leakage
- Methane leakage fact sheet [PDF]
- Natural gas coverage on our energy blog

Methane leakage model

Our economics team has created a methane leakage model based on the science in the *PNAS* paper. The model explores the climate implications of reducing emissions from natural gas systems in the context of a switch towards natural gas-fueled technologies.

To use the model, enter a policy case of desired values for natural gas leak rates and sector fuel mixes. Power plant efficiencies can also be modified. The model outputs a graph and summary table of the impact of that policy case on the climate. Results are represented as a percentage change in net radiative forcing relative to 2010 U.S. emissions.

Our economics experts

Susanne Brooks
Program Director, Office of Economic Policy & Analysis
Contact

Jonathan Camuzeaux
Senior Economic Analyst
Contact

See our full list of energy experts »

Media contact

Lauren Whittenberg
(512) 691-3437 (office)
Contact

Sources

*Source: EDF calculation based on IPCC AR4 values for radiative efficiency and atmospheric lifetimes of CH4 and CO2

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257 Park Avenue South, New York, NY 10010
Donations/General Information (800) 684-3322 or email us