METHANE, MARKETS, AND PUBLIC POLICY: INCENTIVES TO REDUCE EMISSIONS

Introduction

Methane is a potent greenhouse gas. Though policymakers around the world have made efforts in recent years to reduce methane emissions, we still have much to learn about what drives these emissions and what kinds of regulation are most effective, particularly in the case of methane emissions from the oil and gas industry. Natural gas is composed of more than 70% methane, so natural gas that escapes to the atmosphere from oil and gas infrastructure represents a *private* cost to oil and gas producers, in addition to the public costs it creates in the form of climate damages. Because oil and gas companies can sell any extra gas that they capture, the International Energy Agency and others calculate that the industry's methane emissions can be abated at negative or very low cost.

However, private incentives to abate vary with the value of natural gas and the cost of transporting that gas to customers. In ongoing work, Harvard Economics PhD students Coly Elhai and Toren Fronsdal explore how variation in natural gas prices influences emissions from the Permian Basin, the most important oil- and gas-producing region in the United States. The project investigates what drives emissions abatement decisions, and how these decisions influence total methane emissions from the Basin. The stakes for this research are large: the oil and gas industry accounts for around a quarter of global methane emissions and 30% of U.S. methane emissions.

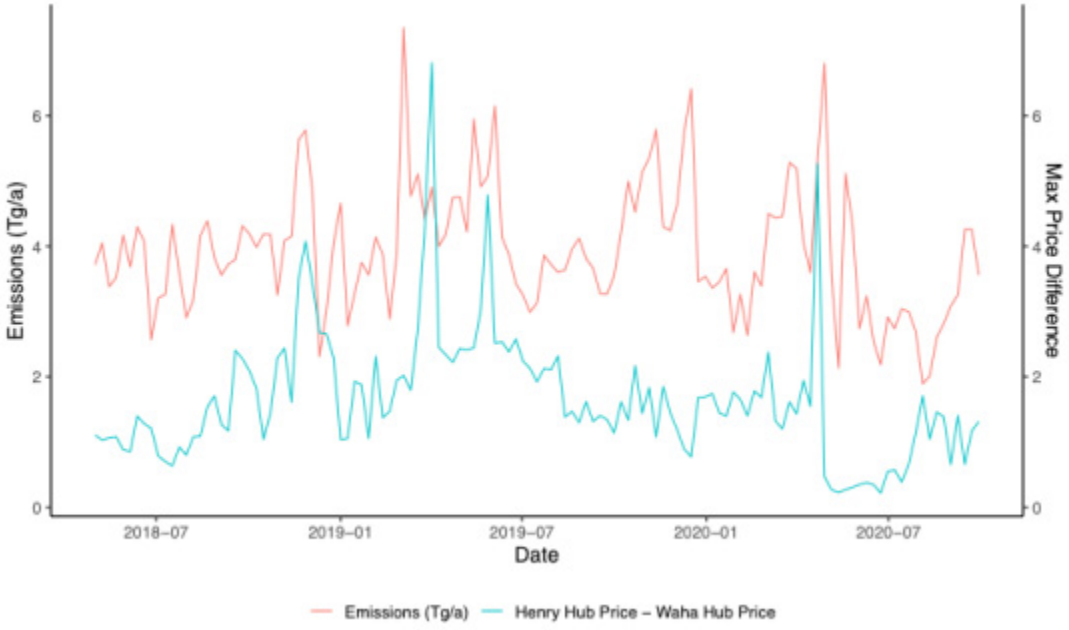
Overview

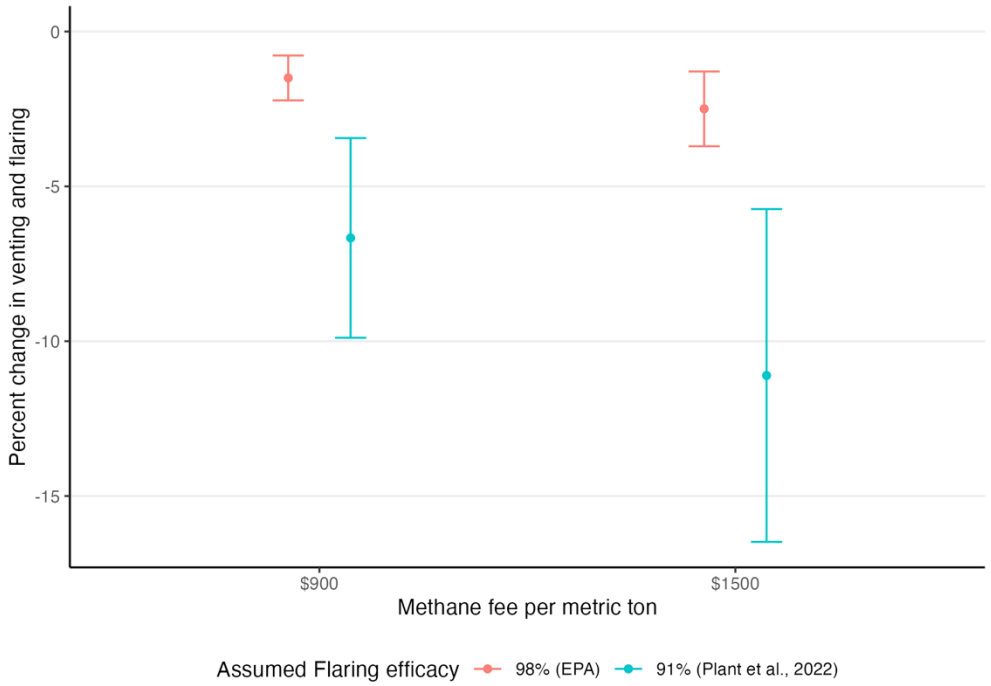
Elhai and Fronsdal leverage methane emissions data produced by another team of Harvard researchers, led by Daniel Jacob and Daniel Varon (Varon *et al.*, 2022). Using Jacob and Varon's dataset of weekly methane emissions from the Permian Basin, Elhai and Fronsdal examine the relationship between prices and emissions at high frequency. They predict that emissions should respond to prices for two reasons:

1. When captured natural gas is less valuable to oil and gas producers, they may choose to flare more of it rather than selling it. Although flaring is intended to combust all methane and convert it to carbon dioxide (a relatively less potent greenhouse gas), in practice, flaring releases some methane directly to the atmosphere. Captured gas has less value when natural gas prices are lower and when it is more expensive to move gas to consumers via long-distance transmission pipelines. So, both lower gas prices and higher gas transmission costs should be associated with more flaring and more emissions.

2. When producers expect higher profits from future oil and gas sales, they may choose to drill more wells today. The well drilling process emits methane, as does the addition of more oil and gas infrastructure: On average, more equipment means more leaks and more venting. As a result, higher oil and gas prices should be associated with more emissions.

Elhai and Fronsdal formalize these predictions into an economic model, and then use data on emissions, prices, and flaring to validate and estimate the model. Using the gap between natural gas prices at the Waha Hub and Henry Hub as a proxy for gas transmission costs, they find that — as predicted — gas transmission costs are positively correlated with both methane emissions and flaring. In other words, producers flare more gas when profits from selling that gas would be lower. Higher gas prices are associated with less flaring, but not lower emissions, which may be due to the countervailing effect of expanded investments in production (as described in the second bullet above).





Using their estimates, Elhai and Fronsdal predict the emissions impact of various methane regulations. First, they consider the Waste Emissions Charge (WEC) mandated by the Inflation Reduction Act and implemented by the U.S. Environmental Protection Agency (EPA). The WEC applies to oil and gas facilities and starts at $900 per metric ton of methane emitted in 2024, increasing to $1,500 per ton in 2026 and thereafter. According to Elhai and Fronsdal's analysis, this policy should reduce flaring from oil wells in the Permian Basin by 1%–3%. Associated methane reductions should be even larger if regulators assume a flaring efficacy closer to what has been measured in the scientific literature: The EPA assumes that flaring is 98% effective at destroying methane, whereas Plant *et al.* (2022) find that flaring is closer to 91% effective.

Elhai and Fronsdal also investigate the potential effects of equalizing the tax treatment of flared gas. In Texas, gas flared at oil wells is exempted from the 7.5% excise tax that applies to all other gas produced by these wells. They estimate that subjecting flared gas to the same tax would reduce flaring at Permian oil wells by 1%–2%.

Endnotes

Plant, Genevieve, Eric A. Kort, Adam R. Brandt, Yuanlei Chen, Graham Fordice, Alan M. Gorchov Negron, Stefan Schwietzke, Mackenzie Smith, and Daniel Zavala-Araiza. "Inefficient and unlit natural gas flares both emit large quantities of methane." *Science* 377, no. 6614 (2022): 1566–1571. https://www.science.org/doi/abs/10.1126/science.abq0385

Varon, Daniel J., Daniel J. Jacob, Benjamin Hmiel, Ritesh Gautam, David R. Lyon, Mark Omara, Melissa Sulprizio *et al.* "Continuous weekly monitoring of methane emissions from the Permian Basin by inversion of TROPOMI satellite observations." *Atmospheric Chemistry and Physics Discussions* (2022): 1–26. https://doi.org/10.5194/acp-23-7503-2023

About the Program

The Harvard Methane Initiative seeks meaningful and sustained progress in reducing global emissions of this very important greenhouse gas — through research and effective engagement with policymakers and key stakeholders. This Initiative is supported by the Salata Institute for Climate and Sustainability at Harvard University. The Harvard Methane Initiative and other Research Clusters supported by the Salata Institute comprise interdisciplinary teams of researchers from across Harvard's schools, whose varied expertise is required to address the complexity of the climate-related problems that they seek to solve. Robert N. Stavins, A.J. Meyer Professor of Energy and Economic Development at Harvard Kennedy School, directs the Harvard Methane Initiative. The findings, views, and conclusions in this publication are those of the authors alone.