Note

June 3, 2024 Research update

1 Updates

- Presented 5/15 at CMU Doctoral Student Participatory Workshop on Climate and Energy Decision Making
- Presented 5/29 at AERE Summer Conference
- Working on estimating model
- Still no pipeline maintenance data
- Hiring an RA to work on 1) cleaning VIIRS flaring data, 2) empirical work on NM policy change, and 3) obtaining price futures data
- Working to develop project idea on energy infrastructure

2 Project overlap

Mark Agerton (assistant professor at UCSD) works in the oil and gas economics space. At AERE last week, he presented a project with significant overlap with ours. We spoke with him last year (April 2023) to hear about his work and tell him about our research plans. At that point, he shared a draft of his paper on midstream congestion. That version of the paper (dated April 2022) came to the conclusion that flaring and methane emissions are substitutes, due to increased emissions from gas transmission when gas is sold rather than flared. As such, they assert that increasing transmission congestion would have *decreased* emissions. Since these findings were in direct opposition to ours, we concluded that our project would be distinct enough to stand on its own.

The project that Mark presented last week had very different conclusions, but the same title, coauthors, and methods. Here's how it compares to ours:

- Similarities
  1. Find that midstream congestion is associated with increased flaring and emissions
  2. Use the Waha-Henry price gap as a measure of the pipeline capacity constraints (this is also something Agerton does in his 2020 review paper)
  3. Use pipeline notices and maintenance events data from Wood Mackenzie to instrument for pipeline congestion (we're still trying to get this data)
  4. Use Texas administrative data and VIIRS remote-sensed data to measure flaring activity
- Differences
  1. They look at processing capacity as well as pipeline congestion, linking processing plants with nearby wells
  2. They consider well-level production, but not new well drilling
  3. They do not have a theoretical model
  4. Their work does not disentangle the difference between the emissions impact of gas values vs. transmission costs
  5. They use TROPOMI satellite methane concentration estimates directly. We use a version of these estimates that has been filtered through an atmospheric inversion model to convert from methane concentrations to methane emissions.

One of Mark's coauthors saw me present a version of our paper last November. As per Ryan Kellogg's suggestion, I emailed Mark last week asking to speak. His response was lukewarm, saying that he wouldn't have time to talk but that they are planning to submit their paper soon. He also said that our model would allow us to "say something about the long run production response (which is probably the more relevant question than my short run stuff)."

3 Proposed empirical work on NM policy change

We've been working with a version of VIIRS flaring data cleaned by someone at EDF as part of a separate study on methane emissions estimation. This has limited the time frame and geographic granularity of some of our analyses. We have raw data and EDF's code to clean it, but haven't yet gotten around to cleaning the data ourselves. We are in the process of hiring an RA to do this, and thought that once we had the cleaned VIIRS data, it would be relatively simple to test the impact of New Mexico's recent changes in the regulation of flaring.

3.1 Background

In March 2021, New Mexico announced rules that would eliminate routine natural gas flaring by 2026. The rules called for operators to reduce flaring and venting starting May 2021, with the goal of achieving 98% capture by 2026. Flaring and venting is and will continue to be permitted in emergencies, but must be reported to state regulators.

Some media reports (including an article in The Guardian titled "Texas produces twice as much methane as better regulated neighbor, study finds") claim that these regulations have led to far lower emissions rates in New Mexico vs. Texas. However, differences in average emissions could easily be due to economic and geologic differences rather than regulations: the gas-oil ratio in the Texan Permian is much lower than that of the New Mexican Permian, meaning that Texan producers are less incentivized to capture the gas that they produce. Given the challenges of enforcing flaring regulation (especially with limited state budgets), it is not obvious that rules alone would reduce flaring. Any flaring reductions in recent years could also be atttributed to voluntary corporate commitments (by Exxon, Chevron, etc.) to curtail routine flaring in order to reduce emissions.

We would like to test the impact of New Mexico's rules using standard econometric techniques, comparing flaring in New Mexico to flaring in other states. As policymakers decide how best to reduce emissions from the oil and gas sector, it is important that we better understand how producers respond to regulation.

3.2 Methods

We plan to compare flaring and venting across Texas and New Mexico after these new rules took effect. We will focus in particular on the Delaware Basin, since this basin spans the border between Texas and New Mexico. We will use two types of data on flaring:

- **Producer-reported data:** In both Texas and New Mexico (and perhaps other oil and gas-producing states as well), producers must report flared and vented volumes to state regulators. In Texas, these reported volumes are included in monthly, producer-level disposition data made available by the Texas Railroad Commission. In New Mexico, the Oil Conservation Division collects these data. Since in both states, producers self-report flared and vented volumes, there are obvious concerns about data quality.
- **Satellite data:** As a check on producer-reported totals, we can also analyze data from the Visible Infrared Imaging Radiometer Suite (VIIRS) satellite instrument. VIIRS data can be converted into estimates of the number of flares and volume of gas flared each month. Although this methodology may not capture malfunctioning or unlit flares, due to its reliance on radiant heat and light, we believe that it can effectively capture trends over time.

There is potential to again collaborate with Daniel Varon (a post-doc at Harvard who has given us emissions data) on this project, in order to use his estimates of methane emissions for this period.

For all data sets, we plan to implement a regression discontinuity design. This approach will allow us to assess any changes in trend around the time of New Mexico's policy change. We will need to be careful about when we choose to be the policy start date: although New Mexico's rules weren't finalized until 2021, the state formed a Methane Advisory Panel in 2019 and draft rules circulated in July 2020.

4 Proposed new project on energy infrastructure

Emissions in Space: The Case of Manufacturing

- **Purpose:** Determine the tradeoffs between building new electric transmission lines vs. shifting demand in space. How much would either approach cost? How much emissions reductions can we get from both approaches?
- **Motivation:** Manufacturing consumes huge amounts of electricity, and the carbon intensity of electricity varies tremendously across space. Building long-distance transmission lines is expensive and often politically challenging. Is this our only option for decarbonizing industry?
- **Approach:** Use plant-level data on energy use, energy type, and production (Manufacturing Energy Consumption Survey + Economic Census for U.S., Annual Survey of Industry for India). First, establish patterns in which industries locate in which places, which industries spend the most on energy, and which industries have higher elasticities of substitution between electricity and fossil fuels. Then, build a model of optimal firm location choice, accounting for input costs, trade costs, and agglomeration. Estimate model using variation in transport costs and energy costs. Examine production and emissions under counterfactuals (changes in trade costs, changes in energy costs, place-based subsidies).
- **Contribution:** This project could demonstrate the scale of social welfare gains/losses associated with building adequate transmission, building other transport infrastructure, or using place-based subsidies. This could be particularly important in countries with a still-developing industrial sector, or countries where long-distance electricity transmission capacity will be difficult to build.

It's helpful to think of a motivating example. Suppose production is split across two places:

A	**B**
Established industry hub	Little existing industry
More productive	Less productive
Better market access → lower trade costs	More remote → higher trade costs
Dirtier energy mix	Cleaner energy mix

Should a social planner who wants to reduce emissions from industry invest in

1. Transmission lines to bring cleaner electricity to place A,
2. Roads/rail to increase production in place B, or
3. Subsidies to increase production in place B?

The social welfare impact of either investment depends on

- Elasticity of industry location w.r.t. input and trade costs
- Elasticity of final goods prices w.r.t. input and trade costs
- Elasticity of energy consumption w.r.t. prices
- How much CO_2 is emitted through industry in either place (production + shipping)