OpenMinds

Final Presentation: Methane Mitigation

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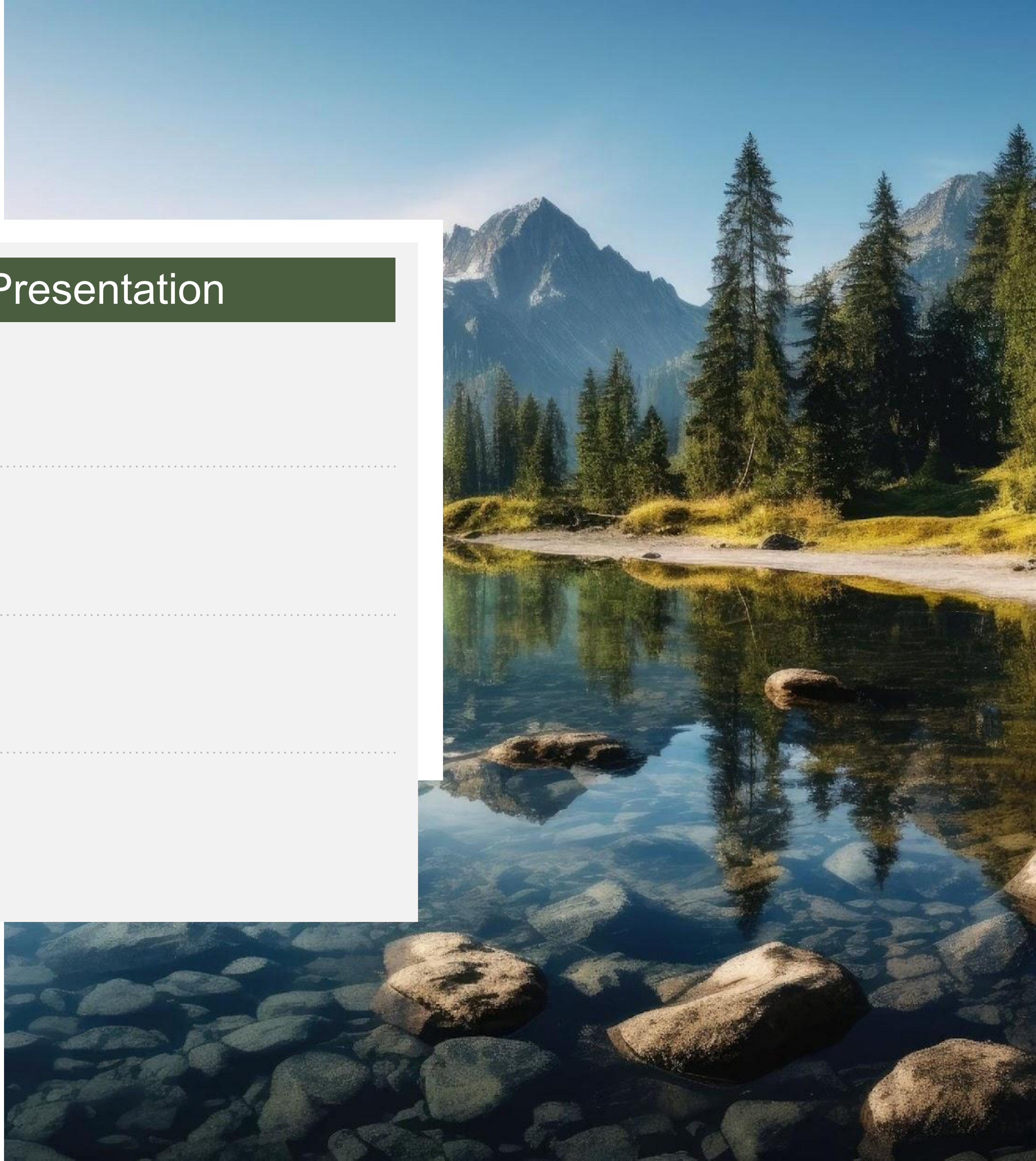
Agenda

NextGen | Student Impact Project Final Presentation



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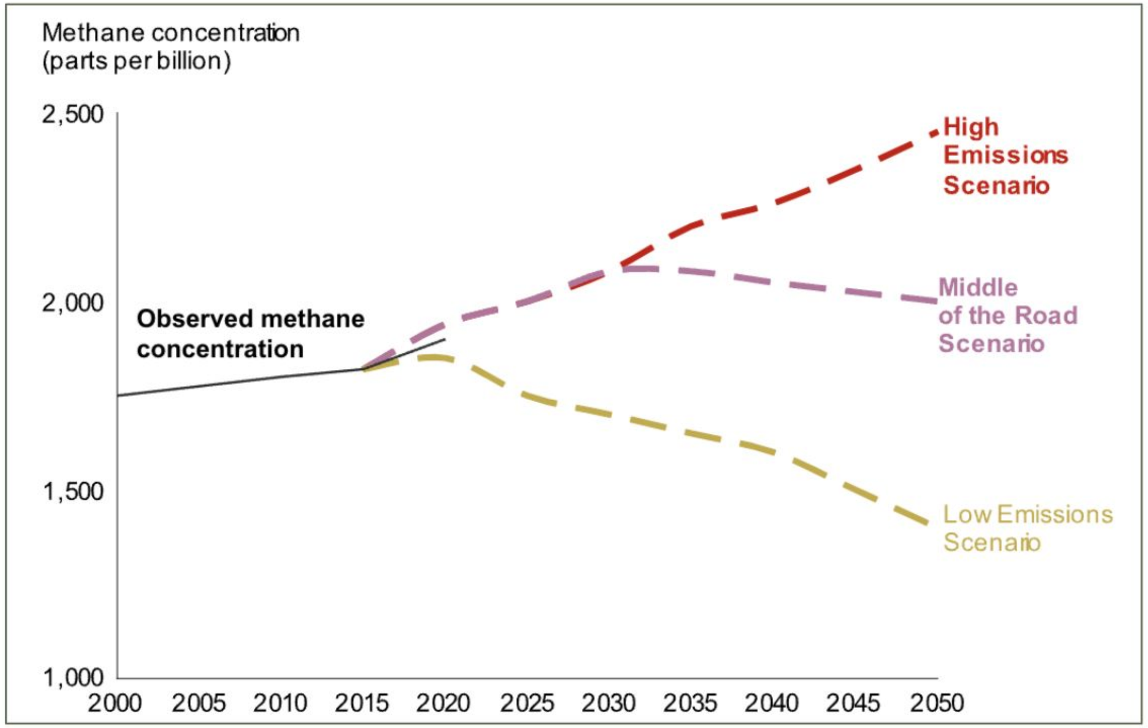
The Dual Challenge: As natural gas consumption grows, so do methane emissions

Drivers: Natural Gas Consumption

- Even as the US electrifies, natural gas use **stabilizes the grid** given the **lack of battery storage capacity** and **growing demand for firm power.**
- Natural gas plays a **key role as a bridge fuel** in reducing energy emissions while supporting growing energy demands in developing economies.
- By the end of 2024, **LNG capacity grew 40%** compared to the last 5 years– and the US is now the world's biggest exporter.

Global Methane Landscape

- Methane is responsible for ⅓ **of global temperature rise**.
- **80x more potent** over its first 20 years (key driver of short-term global warming)
- In 2021, **159 countries** pledged to slash levels by **30% by 2030**. Energy emissions are the easiest place to start.
- Natural gas producers are **leaking product** - creating an organic incentive to tackle the problem.
- As of September 2024, a global stocktake of emissions found that **methane is on a worst-track scenario.**



Note: Solid line shows the average annual concentration of methane in the atmosphere measured by NOAA's Global Monitoring Laboratory; Dotted lines depict project methane concentrations under three different climate scenarios
Source: Global Carbon Project

Our Approach: Landscape research and qualitative interviews

Data Synthesis and Analysis

- Facility and producer emissions inventories such as the ERM Benchmark
- Data and reports from the EPA
- Financial and ESG reports from gas producers
- Cost modeling of technologies from Quantum/EPA Natural Gas STAR Partners
- Scientific studies and literature on methane monitoring, methane impacts, and energy emissions

Interviews

- 14 interviews
- Gas producers
- Standards and policy experts
- Technology providers
- Environmental NGOs
- Academic experts

Key Questions

- Are **different sized producers** influenced by **different incentives** to reduce and monitor methane emissions?
- Where are there **gaps in current research and data** about methane emissions?
- **Where and how do leaks happen?** What **technologies** are available to producers to detect methane emissions? How do these compare to large producers and their methane management systems?
- What are the **key regulatory trends and hurdles** affecting methane monitoring and emissions for O&G?
- How can **players throughout the value chain** of natural gas impact producers in adopting tools to monitor and mitigate methane?

What is the **impact** and **feasibility** of **methane mitigation** for **small-to-mid sized producers?**

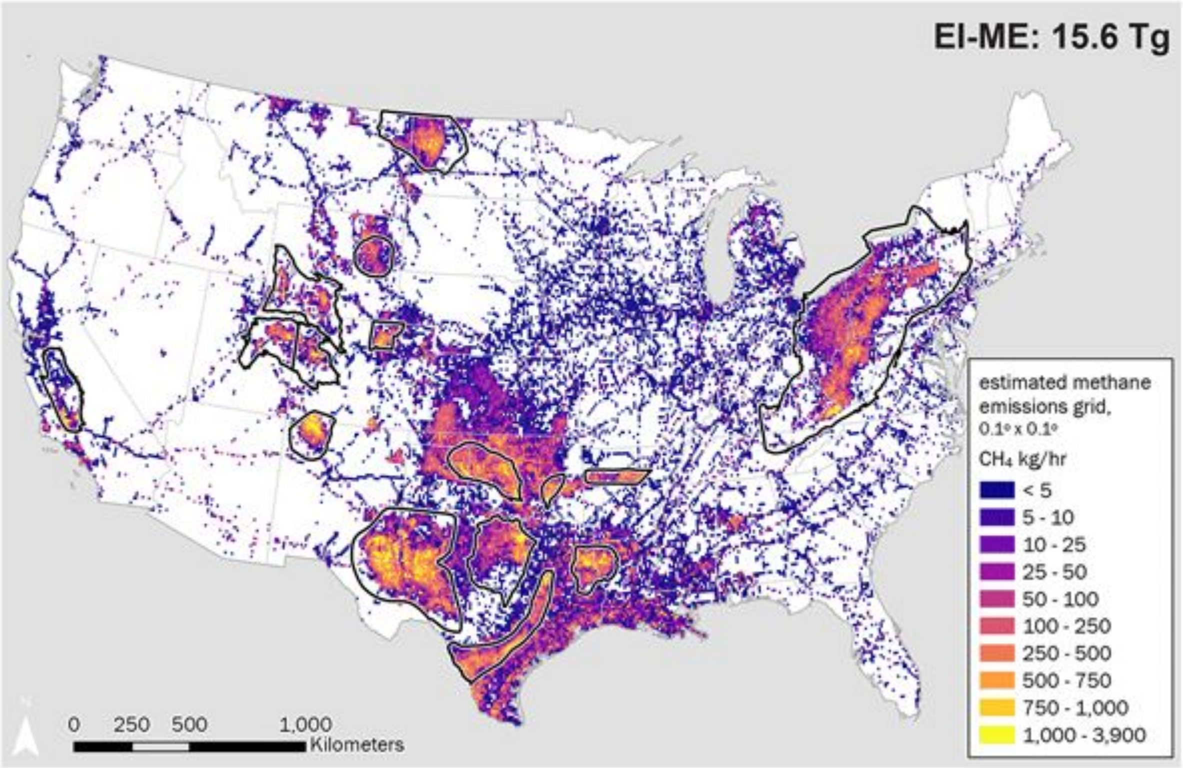
Our Perspective: the impact of mitigation methane from low-producing wells is massive but feasibility is challenging with small producers

Low-production wells are owned by operators of all sizes

- **Methane intensity** is a key metric since emissions are not absolutely correlated to production volumes
- **~565,000 low-producing wells** may constitute up to **50% of methane pollution** despite producing only 6% of the country's natural gas output
- Monitoring and mitigation is **implemented unevenly** even across similar sized producers

Small producers lack incentives across technology, policy, and cost

- **Assets trade hands regularly** and data on well ownership is not maintained continuously
- **Limited compliance pressure, cost-sensitivity, and lack of technical capacity** gives smaller operators limited reason to voluntarily monitor emissions
- Smaller operators are still an important segment to target **representing the last mile of decarbonization**



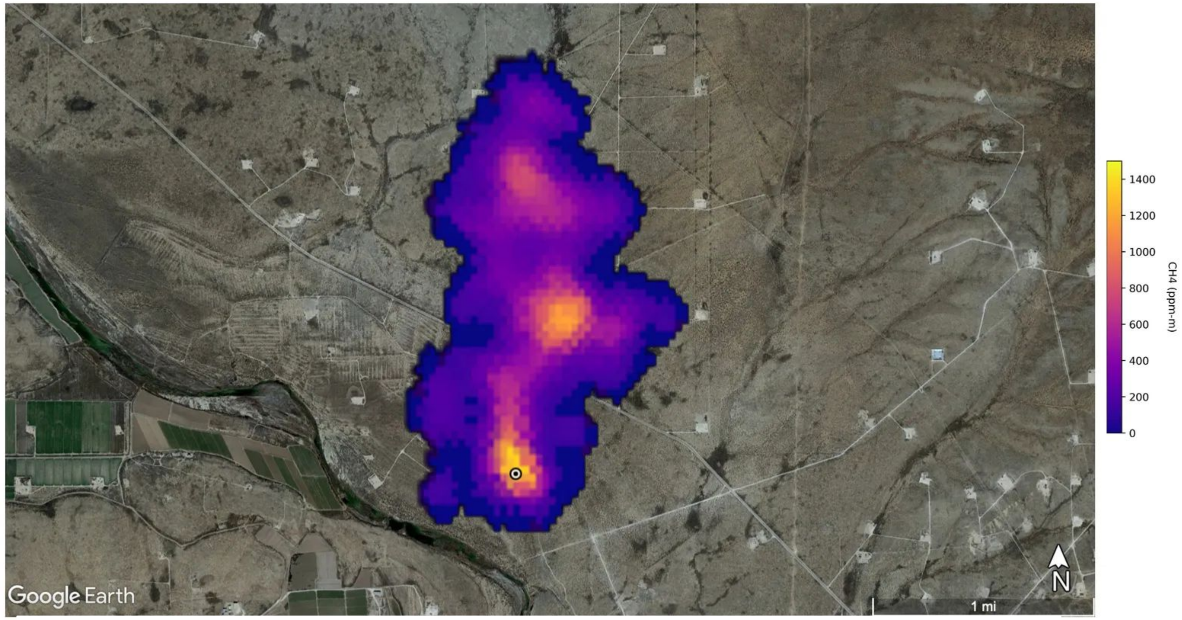
A study done by the EDF in 2022 shows that over $700M worth of product is lost from low-producing annually. **Source**: Earth System Science Data

Potential for mitigation: ~110 million CO2e annually

Key Findings: There are many systemic challenges facing small producers…

Inconsistent and nascent regulations

- **Rules can vary by state:** e.g. venting and flaring, emissions monitoring
- **Policies can be stop and start:** Waste Emissions Charge from the IRA subject to criticism and dispute, now will be rolled back
- **Methane focus is recent:** The US NDC target for methane was set as of 2024, aims for a 35% reduction in overall methane by 2035. Action yet to be coordinated across industry.



A 2 mi methane plume in New Mexico captured by a NASA satellite.
Source: NASA New Earth Space Mission

Limited tech capacity and cost incentives

- **Limited staff capacity**: the average independent operator has just 12 employees. This leaves little bandwidth for evaluating solutions. With over 200 technology providers in the US, for producers of all sizes it can be hard to start.
- **Partnerships with large producers:** When technology providers want to partner for field projects, they typically go with with large operators.
- **Tight margins:** Small operators must make a profit on a well within 2-3 years, giving them limited margins and little reason to voluntarily implement mitigation and repair.

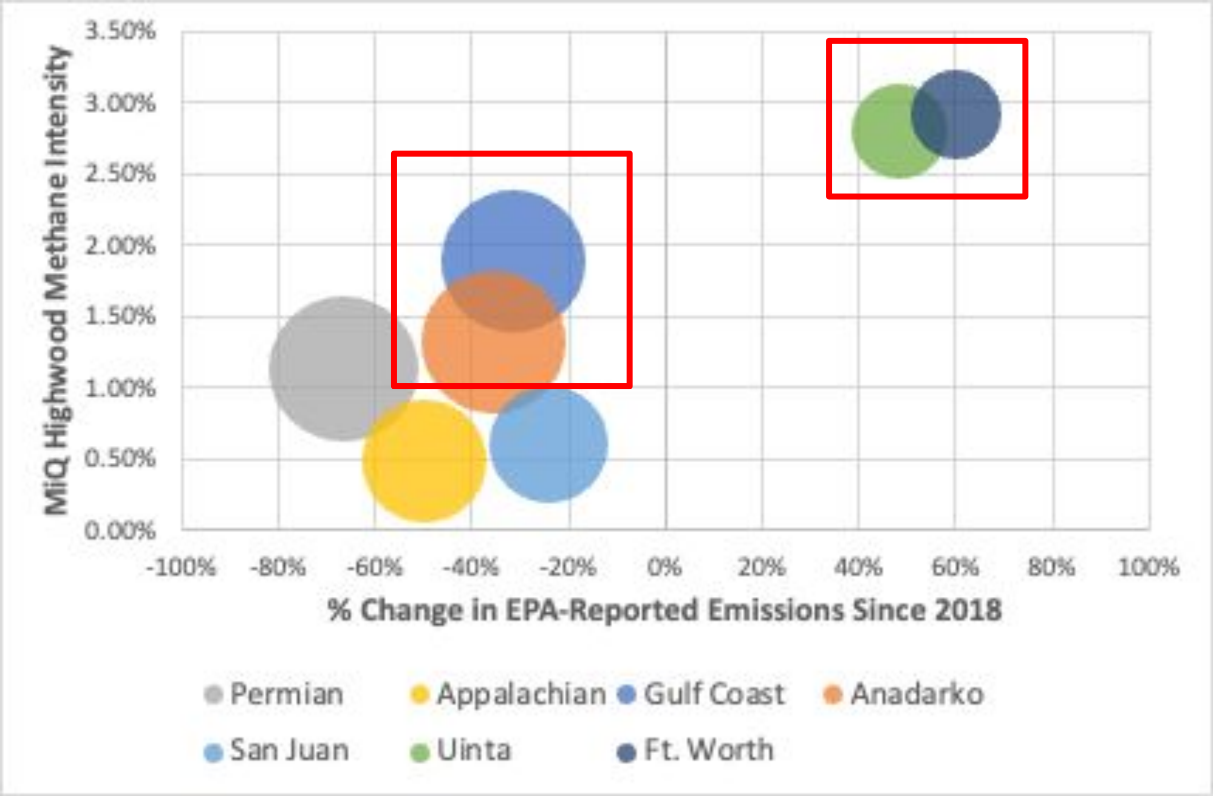
Gaps in emissions data collection

- **Missing data:** wellsites emitting <25 MCO2e annually are exempt from reporting into the EPA's greenhouse gas inventories.
- **Different methodologies**: EPA inventories are based on amount of equipment and emissions factors, **not** verified emissions of wells. Repeated studies find them to underestimate real emissions.
- **Snapshot vs continuous:** Aerial measurements are increasing but point-in-time monitoring can miss outlier incidents like superemitter events.

Recommendation 1: Focus on highest emissions basins

Methods:

- Analysed highest-emitting basins in terms of absolute methane emissions and methane intensity.
- Utilized the MiQ-Highwood Methane Intensity Index, a measurement-informed estimate for each US basin.
- Included each basin's change in reported emissions over recent years.



In terms of absolute emissions reduction potential, the Gulf Coast and Anadarko basins should be prioritized.

While smaller total emitters, the Uinta and Ft. Worth basins have large and increasing methane intensities and may require support to reduce emissions.

The best solutions will vary by region, depending on variables such as basin properties, gas infrastructure, and geographic dispersion of wellsites.

Local universities and associations can be strong partners in removing the burden from these small operators by identifying solutions tailored to local geography and controlling deployment from a local location (cutting down on logistics costs).

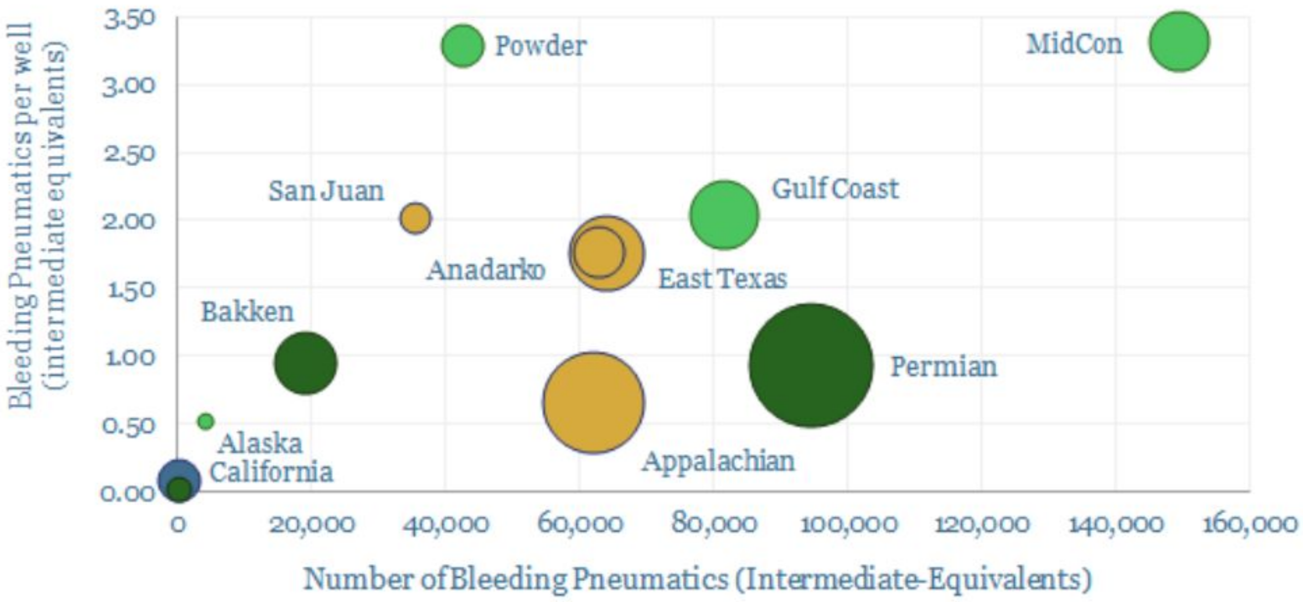
For example, CSU recently received funding to work with an estimated 250 small operators on identifying and deploying cost-effective solutions for their wells.

Based on the geographical analysis above, **universities and associations in the Gulf Coast and Oklahoma could be great partners for future work.**

Recommendation 2: Target critical pieces of equipment and upgrades

Methods:

- Interviewed operators to understand the status of methane detection and quantification technologies.
- Identified the common ways methane leaks occur and what mitigation measures are in place for operators.
- Evaluated responses and compared the success stories from larger operators to produce recommendations.



Operation of pneumatic devices and storage tank venting represent over half of methane leaks in regular operations.

Upgrading pneumatic valves, replacing components like spark plugs to prevent leaks from lean-burn engines and deploying continuous monitoring are among the highest impact solutions.

A fit-for-purpose technology guide and financial assistance fund from larger companies could showcase success stories and help producers choose the best technologies for their needs.

We recommend the following:

1. Develop a plan for leak detection and repair. Potential steps may include training for audio-visual leak detection and/or sensor installation ~11% of methane emissions
2. Replace high-bleed pneumatic controllers with mechanical pneumatic controllers ~23% methane emissions
3. Address reciprocating compressor fugitives by installing vapor recovery units ~14% of methane emissions

Focusing on these three pieces of equipment can reduce nearly half of methane leaks.

Recommendation 3: Organize demand-side pressure for mitigation

Demand-side pressure can create powerful incentives for producers. Gas operators, especially small ones, do not sell directly to end-users. But as demand increases for natural gas in the next ~10 years, customers can shape market standards.

Hyperscalers like Google and Microsoft are shaping energy markets through a combination of sustainability goals and purchasing power. These buyers only report the CO_2 footprint of their operations and energy purchases. If they tried to trace the methane footprint of their operations, they would find gaps in data collection and many simplifying assumptions.

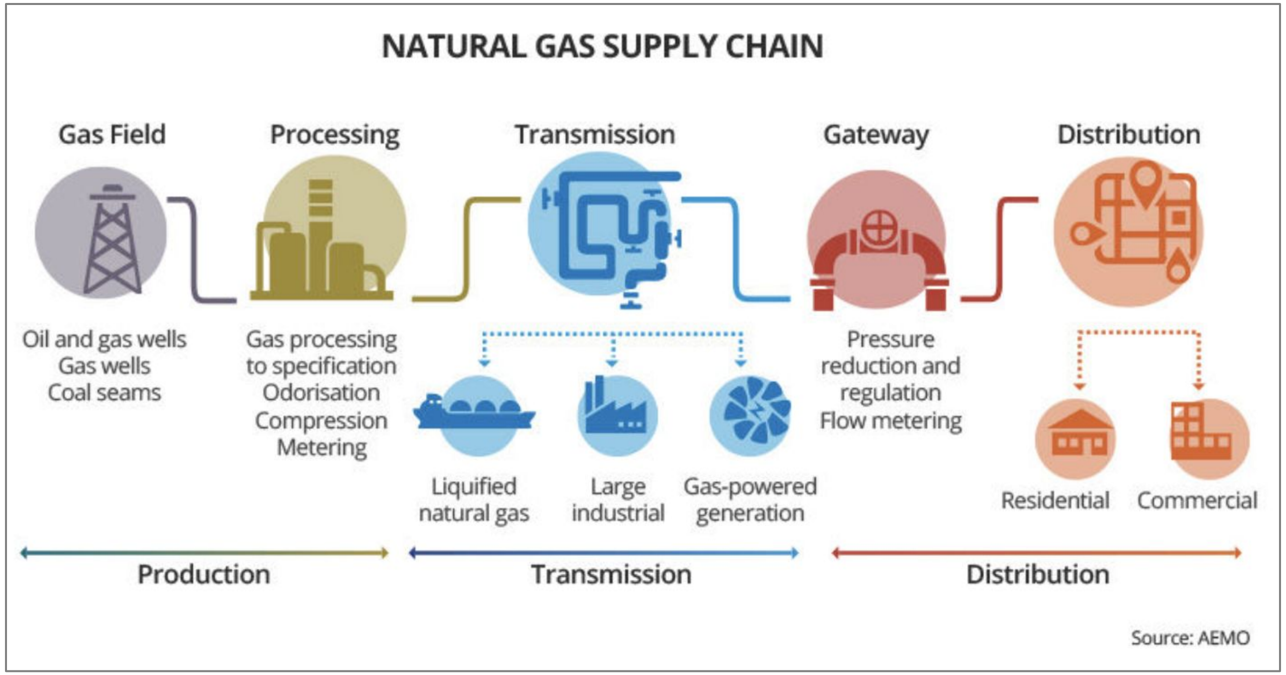
Industry partnerships and pressure could lead to **better data collection on methane emissions** as a starting point.

Ultimately, these large consumers could influence markets by **paying premiums for natural gas** produced and transported with best-in-class methane mitigation practices. These types of demand-side activities could ensure more consistent adoption of monitoring and repair technologies.

Over time, pressure from consumers can transform natural gas markets.

Examples:

- Increase the adoption of voluntary certification standards such as MiQ or Project Canary's TrustWell
- Work with third party satellite monitoring companies to understand emissions footprint of energy consumed
- Jumpstart emissions data collections of natural gas through buyers' coalitions such as the Clean Energy Buyers Association



Recommendation 4: Build industry partnerships to inform state and global policies

Regulations are the single most important driver for operators to reduce emissions. Given uncertainty in O&G regulation, we suggest building on existing policies while looking to inform policies at the state-level and in nations importing natural gas.

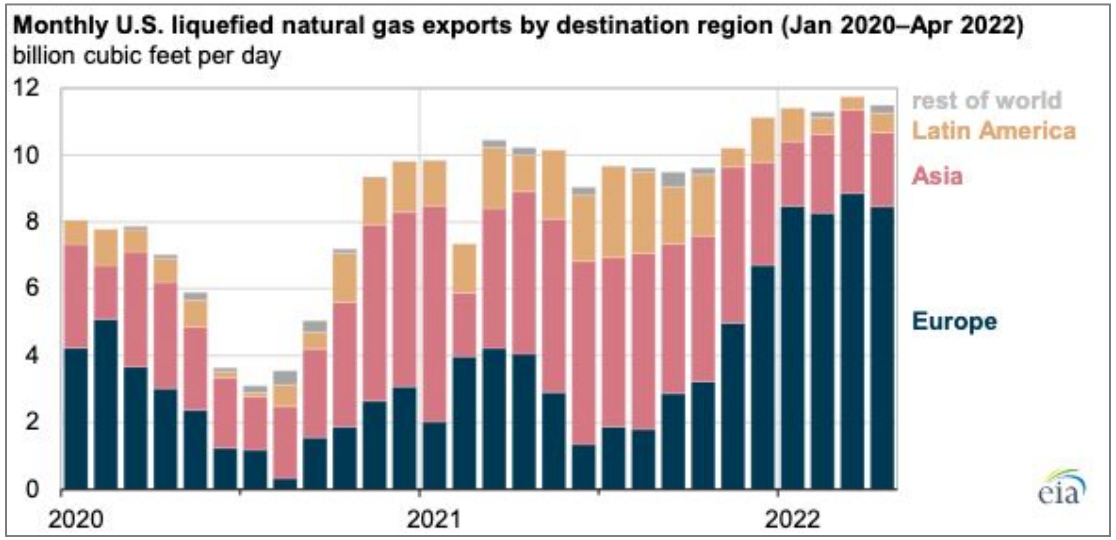
Funding opportunities to reduce methane emissions are likely to endure, including the Regrow Act and MERP.

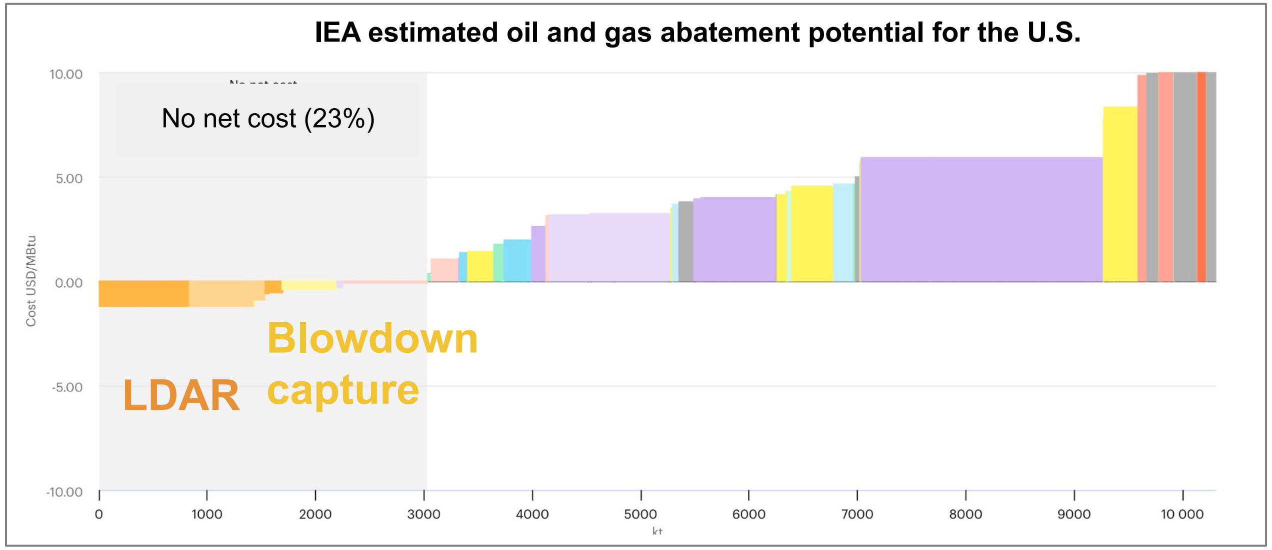
- Funding and technical assistance for methane reduction
- Funding to plug orphan wells

Meanwhile, **collaborating with regulators in states** like Colorado, New Mexico, or Pennsylvania can advance data collection on emissions, better tracking of low-production and orphaned wells, and financial assistance for small operators.

Lastly, **industry can collaborate with regulators in international markets** like Europe and Asia to help set standards for emissions traceability in natural gas and LNG supply chains. Currently, key regulations like CBAM do not include provisions for natural gas.

Now is not the time to give up on policy change.





References: U.S. Energy Information Administration (EIA), *Natural Gas Monthly* and EIA estimates for April 2022
International Energy Agency Global Methane Tracker, 2023. https://www.iea.org/data-and-statistics/data-tools/methane-tracker

Wrap Up: Takeaways for OpenMinds Community

Collaborative

Solutions must cut across industry and producers of all sizes. It takes government, large companies, tech providers, and customers coming together to make the value chain work.

OM must focus on effective solutions will allow operators to access pooled knowledge and resources.

Local

Operating conditions can be different by producer and basin across methane intensity, infrastructure access, state policy, and geographical considerations.

Solutions tailored to a basin and operationalized through regional hubs can be an effective way for OM to build momentum.

Government Backed

Policy is still the single biggest incentive to emissions reductions. While the domestic climate agenda is unclear, states and energy importers can be engaged to shape effective regulations.

OM must continue to advocate for better policies whether at the state, federal, or global level to shape market incentives for emissions reductions.

OpenMinds

Solving for the

Dual Challenge.