COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
HEARING CHARTER

Detecting and Quantifying Methane Emissions from the Oil and Gas Sector

Wednesday, June 8, 2022
10:00 AM EDT
Zoom

PURPOSE

The purpose of this hearing is to assess the challenge of oil and gas sector methane leaks from a scientific, technological, and policymaking perspective. The hearing will discuss the current scientific consensus regarding the role of methane leaks as a driver of oil and gas sector methane emissions. The hearing will highlight recent advances in innovative leak detection and repair technologies, as well as the importance of deploying such technologies broadly throughout oil and gas sector operations to achieve large-scale reductions in methane emissions. Finally, the hearing will examine research gaps related to oil and gas sector methane emissions and opportunities for the Federal government to support scientific research activities pertaining to oil and gas sector methane leaks.

WITNESSES

- **Dr. David Lyon**, Senior Scientist, Environmental Defense Fund
- **Mr. Riley Duren**, Chief Executive Officer, Carbon Mapper, Inc.
- **Dr. Brian J. Anderson**, Director, National Energy Technology Laboratory
- **Dr. Greg Rieker (REEK-uhr)**, Co-Founder and CTO, LongPath Technologies, Inc.

Key Questions

- Why are oil and gas sector methane leaks a unique contributor to climate change?
- Are oil and gas companies confronting methane leaks in accordance with the latest scientific knowledge?
- How can innovative leak detection and repair technologies help reduce methane emissions from oil and gas sector operations?
- What opportunities exist for Federal research activities and investments to improve the characterization of oil and gas sector methane emissions, support leak detection and repair capabilities, and monitor large methane leaks more effectively?

Impact of Methane on Climate Change

Methane (CH_4) is a potent greenhouse gas (GHG) that makes up 11% of U.S. anthropogenic GHG emissions by volume. It is 84-86 times more heat-trapping than carbon dioxide (CO_2) on a twenty-year timeframe and 25 times more potent on a100-year timeframe. Thus, methane accounts for about a third of global warming since the Industrial Revolution[1] despite there being approximately seven times more metric tons of CO_2 emissions in the atmosphere.[2] 2021 witnessed the highest annual growth rate for methane on record, according to an analysis by the National Oceanic and Atmospheric Administration (NOAA).[3] This is the second record-breaking year in a row.

Due to methane's relatively short atmospheric lifetime relative to CO_2 – about a decade versus potentially hundreds of years – methane mitigation efforts can lead to rapid, significant reductions in the rate of atmospheric warming. The Intergovernmental Panel on Climate Change estimates that reducing methane emissions by one third by 2030 is a necessary step to limit global warming to 1.5℃.[4] At the 26th meeting of the United Nations Climate Change Conference of the Parties in Glasgow, Scotland in November 2021, a new global effort was announced to confront the threat of methane emissions. Led jointly by the United States and the European Union, the Global Methane Pledge commits over 100 countries to reducing global methane emissions 30% below 2020 levels by 2030, which can prevent 0.2℃ of warming by 2050.[5]

Oil and Gas Sector Methane Emissions

Methane is the primary component of natural gas, which currently accounts for about a quarter of global electricity generation and about 32 percent of U.S. energy consumption.[6] Methane can be released during extraction, processing, transportation, and storage activities throughout the oil and gas sector supply chain. The oil and gas sector is responsible for over 60 percent of fossil fuel-related methane emissions, and the energy sector represents the second largest source of anthropogenic methane globally.[7]

As methane makes up 70-90% of natural gas, it is both a pollutant and a product with substantial economic value. Therefore, methane emissions from the oil and gas sector are considered a promising area for short-term climate action, since the captured gas derived from methane mitigation efforts represents a valuable commodity. The International Energy Agency (IEA) estimated that in 2021, global methane emissions from fossil fuel operations were equivalent to the amount of gas used across Europe.[8] The compelling business case for reducing methane emissions has spurred an industry of methane emissions reduction technologies for oil and gas operations. A 2021 report published by the UN Environment Programme estimated that nearly half of all readily available methane emission reduction technologies apply to the production and

[1] https://www.iea.org/reports/global-methane-tracker-2022
[2] https://www.epa.gov/ghgemissions/overview-greenhouse-gases#methane
[3] https://www.noaa.gov/news-release/increase-in-atmospheric-methane-set-another-record-during-2021
[4] https://www.ipcc.ch/2022/04/04/ipcc-ar6-wgiii-pressrelease/
[5] https://www.globalmethanepledge.org/
[6] https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php
[7] https://www.iea.org/reports/global-methane-tracker-2022
[8] https://www.iea.org/reports/global-methane-tracker-2022

transmission lines of the fossil fuel sector.[9] The IEA asserts that three-quarters of global methane emissions arising from oil and gas operations could be mitigated by the deployment of such technologies.[10]

While these estimates demonstrate the potential that exists for methane emissions reductions from the oil and gas sector, serious knowledge gaps exist regarding the true scale of methane emissions from oil and gas operations. The Environmental Protection Agency's (EPA) Greenhouse Gas Inventory (GHGI) has served as America's authoritative accounting of anthropogenic GHG emissions since the early 1990s.[11] In recent years, the scientific community has concluded that the inventory's "emission factor" methane estimates – based on expected methane releases from oil and gas infrastructure under normal operating conditions – underestimate methane emissions from the U.S. oil and gas sector by a significant amount. For example, one landmark study in 2018 concluded that the GHGI underestimated methane emissions from the U.S. oil and gas supply chain by more than 60%.[12] In order to understand the extent of the problem of oil and gas sector methane emissions, new technologies have emerged with the ability to quantify methane emissions, and scientists have increasingly worked to develop more accurate measurement-based methodologies that can account for methane releases occurring outside normal operating conditions.

Leak Detection and Repair Technologies

During the Committee staff's assessment of oil and gas sector methane emissions in preparation for this hearing, certain definitions were adopted for key terms:

- Methane Leak: Any release of methane that results from a malfunction or an abnormal operating condition, including both unintentional [i.e., fugitive] emissions and emissions resulting from malfunctions or abnormal operating conditions among vented sources and combustion sources.

- Leak Detection and Repair (LDAR) Program: Any program or activity that is intended to monitor, detect, or repair methane leaks, or monitor, detect, quantify, or mitigate methane emissions resulting in methane leaks, including through the implementation of operational changes.

Scientific measurement data indicates that the largest sources of methane emissions in the oil and gas sector result from malfunctions and abnormal operating conditions, which are referred to as methane leaks. These methane leaks appear to be a significant contributor to the systematic underestimation of methane emissions by GHG inventories such as the GHGI.

A traditional LDAR program utilizes either optical gas imaging (OGI) cameras or a method known as Method 21 to detect the presence of methane at oil and gas facilities.[13] Presently, these

[9] https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions
[10] https://www.iea.org/reports/methane-tracker-2021
[11] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
[12] https://www.science.org/doi/10.1126/science.aar7204?siteid=sci&keytype=ref&ijkey=42lcrJ%2FvdyyZA
[13] https://www.epa.gov/sites/default/files/2017-08/documents/method_21.pdf

processes represent the only EPA-approved technologies for methane leak detection.[14] The EPA issued a proposed rulemaking in November 2021 to regulate methane emissions in the oil and gas sector and strengthen emission reduction requirements, and the agency is considering the regulatory authorization of additional methane detection technologies as a part of that rulemaking.[15] However, that rulemaking remains ongoing and may extend into 2023. The technologies that are commercially available for oil and gas operators to improve their LDAR programs possess capabilities far beyond EPA-approved methods. Any instrument-based LDAR technique that is not currently approved for the purposes of regulatory compliance can be defined as an innovative LDAR technology.

Innovative LDAR technologies are extremely diverse.[16] Some mount methane detection sensors on drones and aircrafts, allowing for broader surveys of multiple oil and gas facilities. Others place fixed sensors on the ground across facilities to detect emissions on a continuous basis, which is referred to as continuous monitoring. Some technologies utilize satellites and imaging technology to visualize plumes of methane as it leaks. Many of these innovative LDAR systems also employ data analytics platforms that use the information collected by detection sensors to quantify emission rates. Over the past few years, a large number of innovative LDAR technologies have emerged with the capacity to provide data that goes beyond EPA regulatory requirements.

Methane Quantification

The data that is generated from many innovative LDAR technologies allow for increasingly accurate quantification of actual methane emissions. While the EPA GHGI calculates methane levels based primarily on emission factor estimates of what we know about oil and gas equipment under normal operating conditions, methane quantification is based on real-world observations.

Quantifying methane emissions is statistically complex, and there is still research to be done to make the technology and methodologies more precise. However, as it stands, the ability to quantify methane emissions does exist and is offered by reputable vendors of innovative LDAR technologies. Using these technologies – which include ground-based continuous monitoring, aerial surveys, and satellites – can allow operators to gain insight into their operational emissions profile as well as finer-grained information on what parts of their infrastructure are leakiest and in need of an upgrade. Generally, vendors who offer quantification information collect the on-the-ground data via their particular technology, conduct a statistical analysis to extrapolate from the observed data and account for environmental conditions, and deliver real-world data-based estimates of total emissions to the oil and gas operators. Operators can then use this information to inform their LDAR programs and strategies.

Quantification can also assist oil and gas companies in achieving Environmental, Social, and Governance (ESG) metrics that are increasingly important to investors at the institutional and

[14] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-60/subpart-OOOOa
[15] https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/epa-proposes-new-source-performance
[16] https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/epa-methane-detection-technology-workshop

retail level.[17] Third-party ratings providers evaluate companies using available data on environmental stewardship, and the value of funds consisting of ESG-rated companies is growing massively, with an estimated $330 billion in assets under management at the end of 2021.[18] Quantification data represents a tangible way for operators to demonstrate the progress they are making on reducing methane emissions, boosting their ESG rankings.

Super-Emitting Methane Leaks

In recent years, researchers have improved the characterization of methane leaks from the oil and gas sector. An increasing body of scientific evidence supports the idea that a small number of massive, "super-emitting" leaks are disproportionately responsible for overall methane emissions from oil and gas operations. For example:

- A 2021 study conducted in part by NASA Jet Propulsion Laboratory scientists found that 20% of emissions sources in the Permian Basin – an area that accounted for 16.7% of U.S. natural gas production in December 2021[19] and is likely the largest methane-emitting basin in the country[20] – were responsible for 60% of detected methane emissions during the survey.[21]
- Another study focused on the New Mexico Permian Basin found that just 12% of emission sources contributed 50% of overall methane emissions.[22]
- A 2022 study narrowed the focus further to what it deemed "ultra-emitters" and found them to be responsible for as much as 8-12% of global oil and gas sector methane emissions.[23]

Super- and ultra-emitting leaks make up a small percentage of the total number of methane leaks that occur across the oil and gas supply chain. Therefore, their mitigation presents a significant opportunity to achieve large-scale emissions reductions on a rapid basis. Oil and gas operators can make a substantial impact on their overall methane emissions if they can reduce emissions from very large leaks by detecting and repairing them quickly.

Committee Findings: Innovative LDAR Technologies

In December 2021, Chairwoman Johnson sent letters to 10 oil and gas operators in the Permian Basin to inquire about their LDAR programs and use of innovative LDAR technologies. The Committee found that all ten operators had implemented some level of innovative LDAR technology deployment that goes beyond EPA regulatory requirements, and that all ten operators had piloted or deployed at least one technology that possesses the ability to quantify methane emissions. The Committee found that opportunities exist for Federal research investments to bolster the quantification abilities of innovative LDAR technologies and develop technical

[17] https://corporatefinanceinstitute.com/resources/knowledge/other/esg-environmental-social-governance/
[18] https://corpgov.law.harvard.edu/2022/02/25/esg-2021-trends-and-expectations-for-2022/#:~:text=Inflows%20into%20ESG%20funds%20continued,ESG%20funds%20expected%20in%202022
[19] https://www.dallasfed.org/research/energy11/permian.aspx#Region
[20] https://www.science.org/doi/10.1126/sciadv.aaz5120
[21] https://pubs.acs.org/doi/10.1021/acs.estlett.1c00173
[22] https://pubs.acs.org/doi/10.1021/acs.est.1c06458
[23] https://www.science.org/doi/10.1126/science.abj4351

standards for estimating methane emissions. There is also an opportunity for better coordination among oil and gas operators and across Federal, private, and nonprofit stakeholders to share information and best practices for methane detection and mitigation.