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**Answering Questions about
Methane Emissions from the
Natural Gas Sector**

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Methane Emissions as a Greenhouse Gas

- On a CO₂ equivalency basis, methane (CH₄) comprises 10% of total GHG emissions from U.S. anthropogenic (human-caused) sources
- Total methane emissions is **636** MMT CO₂ Eq. relative to total GHG emissions of **6673** MMT CO₂ Eq.
- Although methane has a relatively short atmospheric lifetime of 10-12 years, when integrated over 100-years methane it is about 25 times more potent in its effect on global warming than carbon dioxide
- *Comparison with other air pollutants*
 - ✓ Colorless, odorless, naturally-occurring gas
 - ✓ Non-toxic and non-hazardous air pollutant
 - ✓ Leaking gases often co-emit with volatile organic compounds (VOC) to pose ground-level health problems
- *Hard to measure*
 - ✓ Bottom-up versus top-down approach
 - ✓ EPA *GHG Inventory* considered the benchmark but subject to criticisms
 - ✓ Large differences in measurements from studies
 - ✓ More difficult, for various reasons to measure methane emissions than CO₂ emissions
 - ✓ *Consensus: need for more accurate measurements*

Sources of Methane Emissions

- Potential $\text{CH}_4 = f(\text{activity [e.g., miles of pipes]}, \text{emission factor [e.g., emissions per mile]}, \text{drivers [e.g., type of pipe material]})$
- The main sources of human-related methane emissions are enteric fermentation, natural gas systems, landfills, coal mining, petroleum systems and wastewater treatment (*see next slide*)
- Methane, the primary component of natural gas, for example, is a potent greenhouse gas
- Since 1990, methane emissions in the United States have decreased by almost 15 percent, even as many activities that can produce methane have increased
- The Obama Administration projects CH_4 to increase in the future absent additional mitigative actions

Methane Emissions from the Top Seven Sources, 2013*

Source	Amount of Methane Emissions (MMT CO ₂ Eq.)	Percent of Total Methane Emissions
Enteric fermentation	164.5	25.9%
Natural gas systems	157.4	24.7
Landfills	114.6	18.0
Coal mining	64.6	10.2
Manure management	61.4	9.6
Petroleum systems	25.2	4.0
Wastewater treatment	15.0	2.4

* Source: U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013*. April 2015.

Methane Emissions from the Natural Gas Sector

- Nearly 25% of methane emissions comes from the natural gas supply sector
- Three general mechanisms for methane emissions
 - ❖ **Venting** (intentional releasing of excess gas)
 - ❖ **Flaring** (intentional burning of excess natural gas, little methane emissions relative to CO₂ emissions)
 - ❖ **Leaks** (top source; mostly from pipeline and distribution systems)
- Methane leaks in the natural gas industry largely come from drilling wellheads, compressors, meters, regulators, valves and pipelines
- The 2013 leakage rate for the entire natural gas supply chain was 1.5%
- Downward trends since 1990 (12% decline overall) for all functions (except processing) (in MMT CO₂ Eq.)
- Evidence that an extremely small number of leaks accounts for a large portion of the CH₄ emissions (i.e., fat-tailed distribution curve)
- Implications of actual CH₄ levels for public policy
 - ✓ For example, although natural gas is widely regarded as the cleanest fossil fuel, it is debatable for certain uses if methane emissions are on the high side of estimates
- Environmentalists and some other groups contend that the natural gas sector can further reduce CH₄ at relatively low cost and with opportunities for profits

Methane Emissions from Different Natural Gas Functions since 1990 (MMT CO₂ Eq.)*

Function	1990	2005	2009	2010	2011	2012	2013
Field production	59.5	75.5	62.0	56.5	51.3	49.7	47.0
Processing	21.3	16.4	19.2	17.9	21.3	22.3	22.7
Transmission and storage	58.6	49.1	52.7	51.6	53.9	51.8	54.4
Distribution	39.8	35.4	34.1	33.5	32.9	30.7	33.3
Total	179.1	176.3	168.0	159.6	159.3	154.4	157.4

* Source: U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013*. April 2015.

Emissions Levels by Natural Gas Function (MMT CO₂ Eq.)

• Field production	47.0 (30%)
• Processing	22.7 (14%)
• Transmission and storage	54.4 (35%)
• Distribution	33.3 (21%)

(Note: Gas distribution contributes about 0.5% of U.S. GHG emissions, while the entire natural gas supply chain contributes about 2.4%)

* Source: U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013*. April 2015.

Relative Level of Methane Emissions from Gas Distribution (2013)*

Source	Amount of Methane Emissions (MMT CO ₂ Eq.)	Percent of Total
Total U.S. GHG emissions	6,673	-
From fossil fuel combustion	5,158	77%
• From electricity generation	2,040	31
• From vehicles	1,718	26
From natural gas system (CH₄)	157	2
From gas distribution (CH₄)	33	0.5

* Source: U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013*. April 2015.

Methane Emissions from Gas Distribution

- About 20% of CH₄ emissions from the natural gas sector originates from the distribution sector
- Distribution system methane emissions in 2013 were over 16% lower than in 1990 (largely because of plastic pipes replacing cast iron and bare steel pipes and upgrades of metering and regulating stations)
- Sources of CH₄ emissions
 - ✓ Pipe leaks (~50%)
 - ✓ Meter/regulator at the city gate (~40%)
 - ✓ Others (customer meter leaks, “blowdowns”, maintenance)
- Examples of mitigative actions
 - ✓ Replace old pipes
 - ✓ Replace high-bleed pneumatic devices
 - ✓ Reducing venting during “blowdowns”
 - ✓ Inspect and maintain pipes and other equipment
- Because methane emissions are just one subcomponent of lost and unaccounted-for (LAUF) gas, a utility with a higher LAUF doesn't necessarily have higher CH₄ emissions

Obama Administration Initiatives

- The Administration's Climate Action Plan (June 2013) includes EPA working with other federal agencies to develop a comprehensive interagency methane strategy; this strategy, issued in March 2014, calls for:
 - ✓ Acceleration of best practices
 - ✓ Better common understanding of CH₄ levels
 - ✓ Development of cost-effective strategies to reduce CH₄
 - ✓ Use of voluntary programs to stimulate action (e.g., an enhanced Natural Gas STAR Program)
 - ✓ Overall, the Obama Administration believes that further nudging and mandates on the natural gas industry would help reach the GHG targets it set out
- On January 14, 2015, the Obama Administration established a goal to reduce methane emissions from the oil and gas sector by 40–45 percent from 2012 levels by 2025
 - ✓ The Administration announced a series of regulatory and voluntary steps to achieve this goal
 - ✓ In the summer of 2015, EPA will propose a 111(b) rule to set standards for methane and VOC emissions from new and modified oil and gas production sources and natural gas processing and transmission sources
 - ✓ It is likely that proposed new regulations will apply only to new sources
 - ✓ BLM will propose standards reducing methane leaks and flaring from oil and gas wells on Federal lands

Obama Administration

Activities – *continued*

- Some points of interest from DOE's Quadrennial Energy Review
 - Importance of evaluating “mid- and downstream” CH₄ reduction opportunities
 - Distribution inspection and maintenance (DI&M) programs potentially have large benefits (e.g., trigger profitable leak repair, target most serious stations and components problems)
 - For example, ICF estimated quarterly leak detection and repair could reduce CH₄ from city gate stations by 60%
 - ICF also estimated that some CH₄ controls pay for themselves
 - New technologies and approaches to using methane sensing equipment can help prioritize investment, leading to improved safety and greater emission reductions
- DOE Natural Gas Modernization Initiative
 - Energy efficiency standards for compressors
 - Accommodation of regulatory practices for cost recovery of new infrastructure
 - Investments in new technologies for leak detection and measurement
 - Technical partnership
 - Pipeline efficiency R&D program
 - Loan guarantees to support new CH₄-reducing technologies
- Series of white papers on major sources of CH₄ (e.g., liquids unloading, leaks, pneumatic devices and compressors)
- FERC 's proposed policy statement on *Cost Recovery Mechanisms for Modernization of Natural Gas Facilities* (PL15-1-000)

Gas Utilities' Actions

- Pipe replacement
 - ✓ Safety is the primary motivator but reduced CH₄, improved operational efficiency and reliability are side benefits
- PHMSA has required gas utilities to implement a Distribution Integrity Management Program (DIMP) since 2011
 - ✓ The program's main intent is to find and repair pipe leaks
- Participation in the voluntary EPA's Natural Gas STAR Program
- Joint EDF/AGA studies (e.g., more accurate measurements of CH₄ from gas distribution; Washington State University field study measuring equipment-specific leaks; Boston study)
- Contention by some observers that gas utilities lack the incentive to fix leaks that are not hazardous but emit CH₄
- *Downstream Natural Gas Initiative* by MJ Bradley and 5 gas utilities (addresses key technical, regulatory and workforce challenges affecting CH₄ emissions mitigative opportunities)
- Efforts by GTI to develop new technologies (e.g., methane sensors) and approaches for detecting, quantifying and reducing methane emissions from the entire supply chain of the gas industry
- Gas utilities' position generally is that:
 - ✓ Technological advances, industry best practices and infrastructure investments have reduced recent methane emissions with
 - ✓ The most fitting actions being utility-specific

Major Findings of WSU Study

- The amount of estimated methane emissions from gas distribution is 36-70 percent less than estimates for 2011 reported by the EPA *Inventory*
- Reductions of methane emissions over time is largely a result of pipe replacement and the upgrading and rebuilding of metering and regulating (M&R) stations, as well as improved measurement techniques
- Lower methane emissions are somewhat surprising, given that gas-distribution pipeline mileage has increased by about 44 percent since the prior study of the 1990s
- The study generally found that emissions compatible with the 1992 GRI/EPA numbers were found at M&R stations with *no* infrastructure updates
- Although cast iron and bare steel mains represent less than 10 percent of U.S. distribution system pipeline miles, emissions from them are almost 50 percent of the total emissions from pipeline mains
- Just a few large leaks account for a high percentage of methane emissions; for example, three leaks produced half of the total methane emissions from pipes
- Emission factors for underground pipeline leaks were about two times lower than those reported in the GRI/EPA study
- Leakage rates for methane emissions from gas distribution systems ranged from 0.1 percent to 0.2 percent

The “Big Questions” for Policymakers

- Prioritizing actions
- Incentives for mitigation
- Appropriate actions under high uncertainty
- Special feature of methane emissions as a pollutant
- Merits of more stringent regulations
- Limits of voluntary actions

Questions for State Public Utility Commissions

- Should gas utilities do more to mitigate CH₄ emissions?
- What are the costs of reducing CH₄?
- What incentives do gas utilities have to reduce CH₄ emissions?
- What steps should state utility commissions take in considering the reduction of CH₄ emissions by gas utilities?

Questions for PUCs – *continued*

- What positions have gas utilities taken on how, and how much, to control CH₄ emissions?
- What priority or attention should gas utilities and state utility regulators place on CH₄ emissions?
- What should be the objective of a CH₄-emissions reduction strategy
- What metric or benchmark should regulators apply to assess a utility's performance in controlling CH₄ emissions?

Questions for PUCs – *continued*

- Given that CH₄ emissions from the gas distribution system comprise an extremely small portion (0.5%) of the total GHG in the U.S., ***would additional efforts to reduce CH₄ be defensible from a cost-benefit perspective?***