Developing a Marginal Method to Assess Natural Gas System Methane Emissions From Incremental Consumption

OVERVIEW

- Methane emissions from the NG system significantly influence carbon intensity calculations
- A range of diverse causal factors govern emissions sources across the NG life cycle
- Current methods generally predict emissions as proportional to system throughput
- A marginal method is proposed to better estimate incremental emissions per unit of fuel consumed
- Results support alignment of policy and regulation based on causes of emissions

GOAL

The goal of this research is to develop a factor-based model of methane emissions from the NG system that correlates emissions with actual drivers to provide an accurate prediction of changes due to incremental shifts in NG consumption. Results will provide technical insights into the causes of methane emissions and represent a better tool for assessing the potential climate impacts of alternative NG technology deployment scenarios.

RESULTS

At a micro-level, the mechanisms causing methane emissions across NG system sources are highly complex. However, to assess the incremental emissions related to alternative scenarios for natural gas end use, we propose to categorize emissions sources into three primary types: time-based, random-event-based, and throughput-based as shown in Table 1. It should be noted that some sources (likely even the majority of sources) may exhibit a combination of these three factors.

Attributing causes of emissions could have an impact on carbon intensity calculations. Preliminary assessment indicates that over 90% of the 51 discrete NG system sources characterized by the U.S. EPA may show a difference between marginal and average emissions, including those from compressor station sources (Figure 2)

Table 1. General categories of emission drivers across the NG system

Category	Description	NG System Examples
Time	Continuous emissions via leakage or venting. Events occurring at a known frequency.	Continuous pneumatic controllers; Fugitive leaks.
Random Event	Emissions related to discrete events with no systematic or causal dependence on system flow.	System damage; Intermittent pneumatic controllers (IPC).
Throughput	Event or occurrence-based emissions whose frequency and magnitude depends upon cumulative flow over a time period.	Compressor operations; Manual liquid unloadings.

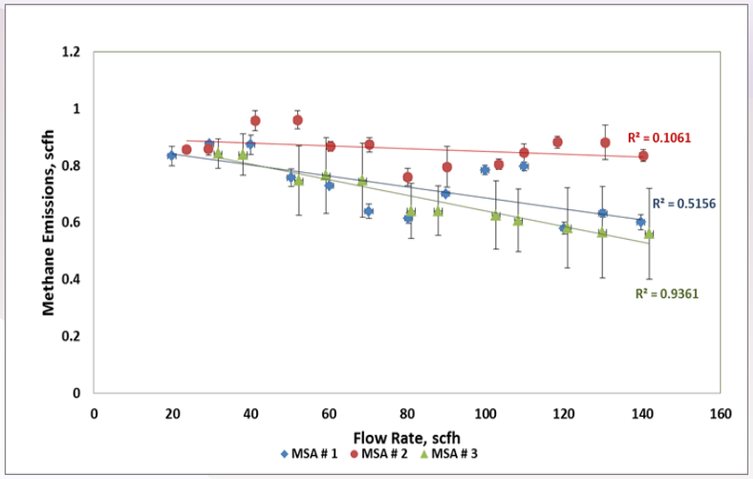

Figure 1. Methane emissions from customer natural gas meters with simulated leaks in response to flow rate variation

RESULTS (continued)

Initial results show methods for assessing carbon intensity of NG pathways treating all upstream emissions as directly proportional to throughput may result in incorrect values. For example, Figure 1 shows that tested customer meters exhibit a decreasing trend of emissions with increasing throughput. Conversely, a positive linear correlation with pressure was measured. The results show emissions as relatively independent of throughput, and no incremental emissions are expected from changes in NG volumetric flow through the meter.

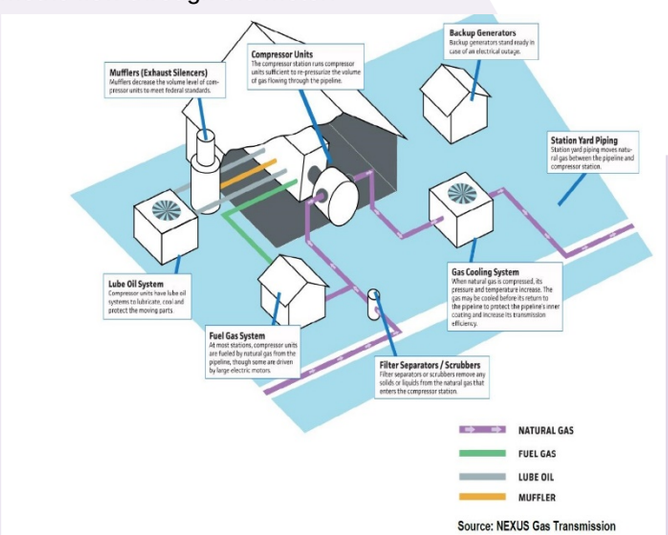

Figure 2. Potential sources of emissions from compressor stations

PERSONNEL

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