Simple Solutions to a Complex Problem: Reducing Methane Emissions from Natural Gas Transmission

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Debate over the use of natural gas intensified last week with the release of a new study, led by researchers at Colorado State University (CSU), quantifying methane emissions associated with gas transportation. The debate will be familiar to readers of this blog. It centers on the climate benefits of substituting natural gas for coal in electricity generation and other applications. On one side is industry, which argues that natural gas is a "clean" fossil fuel, emphasizing that its combustion produces 50 percent less carbon dioxide than coal. Despite this, however, environmentalists claim that switching to natural gas may deliver few climate benefits. Those benefits depend critically on emissions of methane – the primary component of natural gas and a potent greenhouse gas – during natural gas production.

Methane is emitted throughout the production process as a result of intentional venting and accidental leaks. The precise amount of these emissions is unknown. The U.S. Environmental Protection Agency (EPA) estimates that, in 2013, natural gas systems emitted over 6.2 million metric tons of methane (representing 25 percent of national emissions). However, as previously reported, other studies have questioned the accuracy of this estimate. Some studies have found actual emissions to be lower than those reported by the EPA, while others have reached the opposite conclusion.

According to the EPA, roughly one-third of methane emissions occur during the transmission of natural gas. Briefly, by way of background, the transmission sector consists of large diameter, high pressure pipelines that transport natural gas from field production and processing areas to local utilities (i.e., retailers that on-sell gas to residential customers) and large volume customers (e.g., power plants and chemical factories). Compressor stations located along the pipelines are used to move natural gas through the transmission system. While these stations have long been suspected of emitting methane, until recently, little was known about the extent of those emissions.

The CSU study provides valuable data on methane emissions from compressor stations used in natural gas transmission. The study was conducted in partnership with 7 transmissions companies which provided researchers with access to their facilities. The researchers collected nearly 3000 measurements at 45 facilities and used the results to build a computer model to estimate overall emissions. Based on the model, the researchers estimate that the transmission sector emits over 1.5 million metric tons of methane annually. That's equivalent to roughly $240 million worth of wasted natural gas or enough to meet the annual needs of over 1 million households.

Interestingly, the CSU study suggests that the bulk of transmission sector emissions originate from a small number of facilities, known as "super-emitters." According to the study, 1 in every 25 facilities may be a super-emitter, releasing 300 cubic feet or more of natural gas per minute. These facilities account for a quarter of total emissions from the transmission sector.

This idea – that a small number of facilities may contribute disproportionately to emissions – is not new. Back in March, Washington State University published a study assessing methane emissions from 230 underground pipeline leaks. The 3 largest leaks were found to account for over half of total emissions. Similar results were also observed in another study, led by researchers at Carnegie Mellon University, measuring emissions from 45 compressor stations. According to the study, 10 percent of compressor stations may account for 50 percent of emissions, while 50 percent of stations account for 10 percent of emissions. (Further information about these studies can be found in my previous blog here).

These findings suggest that methane emissions could be dramatically reduced by targeting super-emitters. Various measures have been proposed for dealing with emissions from the transmission sector, including:

- installing equipment to capture methane leaking from compressor stations and re-route it to a collection tank, fuel system, or combustion device;
- replacing old reciprocating compressor stations with newer devices that emit less methane;
- re-fitting centrifugal compressors with dry-seal systems, which use high pressure gas as a barrier to prevent leakage, in place of wet-seal systems;
- substituting high-bleed pneumatic controllers, which are designed to vent large amounts of gas while regulating flow and pressure, with low-bleed devices;
- adopting monitoring systems and installing leak detection equipment to identify and control fugitive emissions; and
- improving maintenance systems to ensure timely replacement or repair of damaged facilities.

Many transmission companies have voluntarily implemented these and/or other measures to reduce emissions. The EPA estimates that, as a result of these voluntary efforts, methane emissions from the transmission sector declined by 7 percent between 1990 and 2013. While this is encouraging, there remains further room for improvement.

The CSU study suggests that, while some companies have worked hard to reduce emissions, others have been less diligent. Perhaps unsurprisingly, the 7 companies participating in the CSU study were found to have emissions roughly 30 percent lower than other companies, which did not participate. For some categories of equipment, the difference in emissions was almost eight-fold. The study's authors attribute this to variations "in equipment, operational methods, or maintenance practices between partner and nonpartner facilities."

So, what does all this mean for the use of natural gas? Clearly, natural gas will play an important role in the transition to a clean energy economy. Natural gas can act as a bridge fuel, providing a lower emission alternative to coal, while cleaner renewable energy technologies develop. However, in order to realize the full benefits of switching to natural gas, methane emissions must be reduced. The good news is that, with simple changes in the gas transmission system, substantial reductions are possible. Hopefully, all transmission companies will step up.

climate change | coal | energy | greenhouse gas emissions | methane | natural gas | pipeline | super-emitter | Transmission

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