

NATURAL GAS LIFECYCLE ANALYSIS: THE CLEANEST FOSSIL FUEL

Industry achieving significant reductions in methane emissions

Growing Popularity of Natural Gas Prompts Lifecycle Analysis of Emissions. Although it is well established that natural gas is cleaner than any other fossil fuel when it comes to its combustion at the burner tip — whether it's being burned to make electricity, forge steel or provide heat — the growing popularity of natural gas has brought attention to analyzing the entire lifecycle of natural gas from the wellhead to the burner tip to quantify its overall greenhouse gas (GHG) emission profile, particularly methane emissions.

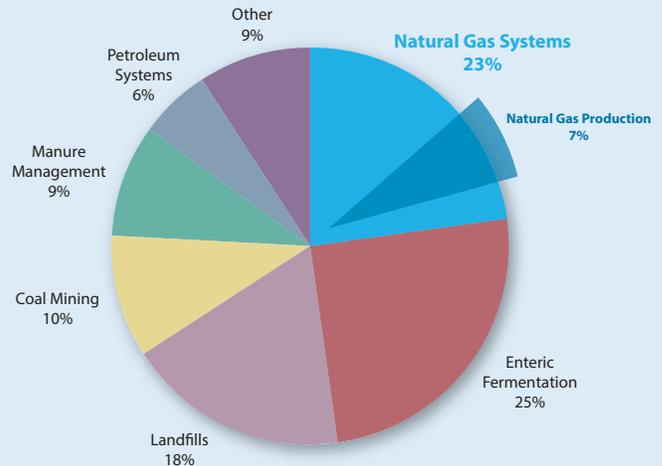
Methane (CH₄) Is the Chief Component of Natural Gas. Methane, the primary component of natural gas, is a GHG that becomes a concern if it is emitted directly to the atmosphere without combustion. Fortunately, when natural gas is combusted to produce energy and heat, its methane emissions are nearly non-existent.

Methane Emissions from Natural Gas Systems. Slightly less than one-fourth of all the methane emitted in the United States is attributed to natural gas systems, including 7 percent that is attributed to natural gas field production activities,¹ for example, when methane escapes capture at the wellhead before the well is completed.

Methane Emissions From Production Have Declined 25 Percent; Industry Dedicated to Further Reductions. The most up-to-date (2012) data available as of late-2014 from the Environmental Protection Agency (EPA) attests to the natural gas industry's dedication to reducing its methane emissions, with the biggest improvements in emissions occurring at the wellhead. According to EPA, methane emissions from production decreased by 25 percent from 1990 to 2012,² which is remarkable considering that natural gas production increased by 35 percent over the same time period.³ Natural gas companies accomplished these emission reductions through improvements in equipment, technology, infrastructure and best practices. For example, the industry pioneered "green" or "reduced emission completion" (REC) techniques that reduce methane emissions at the wellhead by 90 percent by capturing the "backflow" gas.

Trend Will Continue With Industry Efforts. The natural gas industry is highly incentivized to capture methane emissions, not only because captured methane can be used or sold, but because the industry is committed to responsible production. Moreover, in spring 2014 the

Sources of Methane Emissions in the United States



Source: EPA Inventory of Greenhouse Gas Emissions 1990–2012, published 2014.

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There have been a number of recent studies of methane emissions at different points from the wellhead to the burner tip. However findings from the various studies have been difficult to compare because they used different methodologies or relied on different assumptions.

In July 2014, researchers at the National Renewable Energy Laboratory (NREL) performed a comprehensive analysis by taking data from eight major peer-reviewed studies representing hundreds of life-cycle assessments, and harmonized the studies' assumptions in order to make an apples-to-apples comparison. NREL concluded that this, "harmonization reveals that median estimates of GHG emissions from shale-gas generated electricity are similar to those for conventional natural gas-generated electricity, with both approximately half that of the central tendency on coal."

In other words, whether the natural gas was developed from traditional formations or from shale, **over its entire lifecycle natural gas produced half the average life-cycle emissions of other fossil-fueled generation.**

Source: National Renewable Energy Laboratory, "Harmonization of Initial Estimates of Shale Gas Lifecycle Greenhouse Gas Emissions for Electric Power Generation," Proceedings of National Academy of Sciences, July 2014.

administration announced a methane emissions reduction strategy to identify ways to minimize emissions.⁴ Ideally these will complement industry's ongoing efforts. Further methane reductions are likely when EPA's reduced emission completion requirements take effect in 2015.

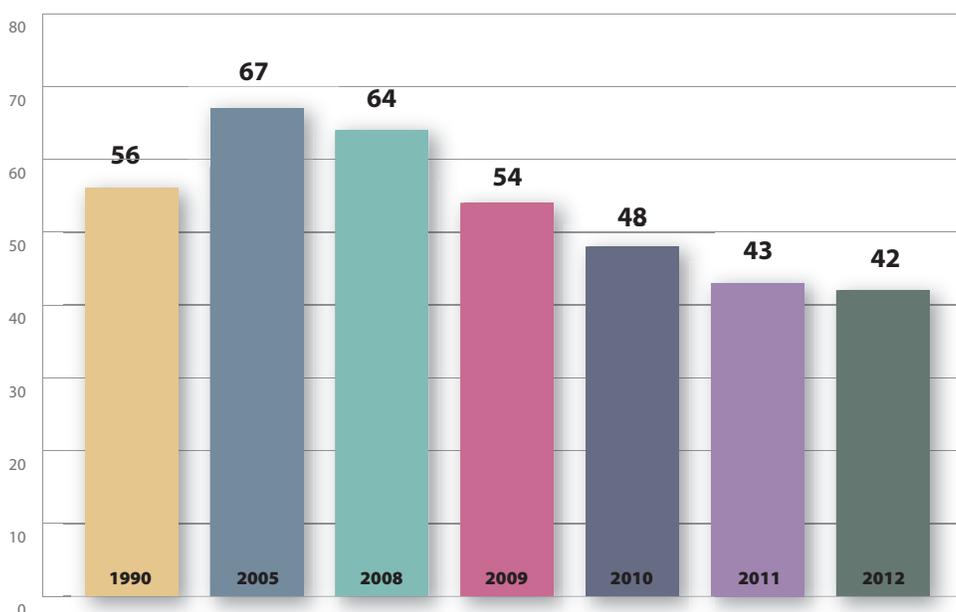
Comparing Methane and Carbon Dioxide. Although methane is a strong GHG, it is unlike carbon dioxide (CO₂) and other leading GHG pollutants because it remains in the atmosphere for a shorter period of time — an estimated 12 years before dissipating.⁵ In contrast, CO₂ can remain in the atmosphere for thousands of years.⁶ According to the Environmental Protection Agency, methane accounts for about 9 percent of all U.S. GHG emissions from human activities.⁷ In comparison, carbon dioxide emissions dwarf those of methane, with CO₂ accounting for 82 percent of emissions.⁸

Increased Use of Natural Gas Lowered Carbon to 20-Year Low. Along with its other attributes, natural gas emits about half the CO₂ of other fossil fuels. Because

of that low carbon profile, natural gas has become the preferred fuel of power generators and electric utilities seeking to meet higher environmental standards and the majority of new power plants are natural gas-fired, which has resulted in significant benefits to air quality. In fact, greater use of natural gas-fired power plants in 2012 resulted in the lowest carbon emissions since 1992.⁹

Natural Gas Provides Significant Environmental Contribution. Methane emissions from natural gas systems are trending down because of updates in equipment, best practices, infrastructure and technology. Notably, the decrease in emissions has coincided with an unprecedented increase in natural gas production. The industry is committed to further reductions. Meanwhile the increased use of natural gas for electricity in 2012 helped reduce carbon dioxide levels to the lowest level since 1992. Because of its environmental advantages and other attributes, demand for natural gas in the United States is projected to increase for at least the next 25 years.¹⁰

DECLINING METHANE EMISSIONS FROM NATURAL GAS PRODUCTION 1990–2012 (in million metric tons of CO₂ equivalent)



Source: EPA Inventory of Greenhouse Gas Emissions 1990–2012, published 2014.

Sources:

- 1 EPA, "Properties of Methane," Overview of Greenhouse Gases: Methane Emissions, 2014.
- 2 EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2012, 2014.
- 3 EIA, "Natural Gas Annual U.S. Gross Withdrawals and Production," 2014.
- 4 The White House, "Climate Action Plan: Strategy to Reduce Methane Emissions," March 2014.
- 5 U.S. Environmental Protection Agency ("EPA"), "Properties of Methane," Overview of Greenhouse Gases: Methane Emissions, 2014.
- 6 EPA, "Properties of Carbon Dioxide," Overview of Greenhouse Gases: Carbon Dioxide Emissions, 2014.
- 7 EPA, "Properties of Methane," Overview of Greenhouse Gases: Methane Emissions, 2014.
- 8 EPA, "Properties of Carbon Dioxide," Overview of Greenhouse Gases: Carbon Dioxide Emissions, 2014.
- 9 U.S. Energy Information Administration ("EIA"), "Today in Energy," August 1, 2012.
- 10 EIA, Annual Energy Outlook 2014, May 7, 2014.