Congressional Research Service
Informing the legislative debate since 1914

IN FOCUS

August 23, 2018

Methane Emissions: A Primer

Methane is the world's simplest hydrocarbon, with a chemical formula CH_4 (one atom of carbon and four atoms of hydrogen). It is gaseous under normal atmospheric conditions and is commonly produced through the decomposition of organic materials in the absence of oxygen. It is released into the atmosphere by natural sources such as wetlands, oceans, sediments, termites, volcanoes, and wildfires as well as human activities such as oil and natural gas systems, coal mines, landfills, wastewater treatment facilities, and the raising of livestock.

Methane: Fuel and Chemical Feedstock

Methane is the primary component of natural gas. When extracted from geologic formations or captured by other means, it can be used as either a fuel or a chemical feedstock.

When used as a fuel, methane has many advantages over other hydrocarbons (e.g., coal and oil). Methane is more versatile: It can heat homes, fuel stoves, run vehicles, fire power plants, and be exported to support the energy needs of U.S. trading partners. Methane is cleaner-burning: It emits, on average, about half as much carbon dioxide (CO_2) as coal and one-quarter less than oil, per unit of energy, when consumed in a typical electric utility plant. Further, its combustion emits no mercury (a persistent, bio-accumulative neurotoxin), virtually no particulate matter or sulfur dioxide, and less nitrogen oxides, per unit of energy, than either coal or oil. Recent expansion of natural gas production—primarily as a result of improved technologies (e.g., hydraulic fracturing and directional drilling) used on unconventional resources (e.g., shale, tight sands, and coalbed methane)—has made methane an increasingly significant component in the energy supply and security of the United States.

When used as a chemical feedstock, methane is a manufacturing component for a variety of household and industrial products including plastic, fertilizer, antifreeze, and fabrics. Abundant and economical supplies of methane may arguably serve to reinvigorate the U.S. petrochemical sector, bringing manufacturing industries back on shore and aiding in the creation of domestic jobs and economic development.

For these reasons, many have advocated for the increased production and use of methane (via natural gas extraction or other capture technologies) and have hailed it as a potential "cost-effective bridge" to a less polluting and lower greenhouse-gas-intensive economy. This position has been supported by many Members of Congress as well as recent Administrations.

Methane: Pollutant

Methane, however, when released or allowed to escape into the atmosphere (commonly referred to as "vented" and "fugitive" emissions, respectively), can affect human health and safety and the environment. The U.S. Occupational Safety and Health Administration lists methane as both an asphyxiant and an explosive, as increased concentrations in local settings can jeopardize worker safety. Further, the U.S. Environmental Protection Agency (EPA) classifies methane as both a precursor to ground-level ozone formation (commonly referred to as "smog") and a potent greenhouse gas (GHG), albeit with a shorter atmospheric life than CO_2. Methane's effect on climate change is up to 34 times greater than that of CO_2 when averaged over a 100-year time period and even greater when considered over the first 20 years after it is emitted. Arguably, any increase in methane emissions may counteract some of the environmental benefits that the U.S. economy has to gain by switching from coal or oil to natural gas. For these reasons, the Obama Administration proposed and promulgated several regulations to control for emissions. Under the Trump Administration, federal agencies are in the process of reconsidering these rulemakings.

Generally, air pollution regulations compete against the economic considerations of affected industries. In methane's case, however, its dual nature as both a commodity and a pollutant provides a unique set of incentives. Under certain conditions, the value of fugitive methane and other byproducts that can be recovered and sold at market may be able to offset the cost of their capture. Further, the value of these recovered products during oil and gas extraction can contribute to increased royalty payments to state and federal governments.

The difficulty, however, is that methane emissions are not always easy to capture. Methane, unlike some other pollutants (e.g., sulfur dioxide or CO_2), is not commonly emitted in a concentrated stream from industrial processes. Rather, it is released into the atmosphere through dispersion, leaks, vents, accidents, and ruptures. In this way, methane emissions are most similar to those of other volatile organic compounds (VOCs), both in manner and control. Efforts to monitor, capture, or abate these emissions are generally more difficult and costly than for other pollutants. Whether recovery of methane is profitable for producers may depend upon a number of factors, including the nature and extent of the release, the technology available for capture, and the market price for the recovered products. In this way, the cost-benefit consideration of methane capture becomes similar to that of energy efficiency efforts wherein high up-front investments and other market barriers have the potential to be offset over time.

Methane Emissions

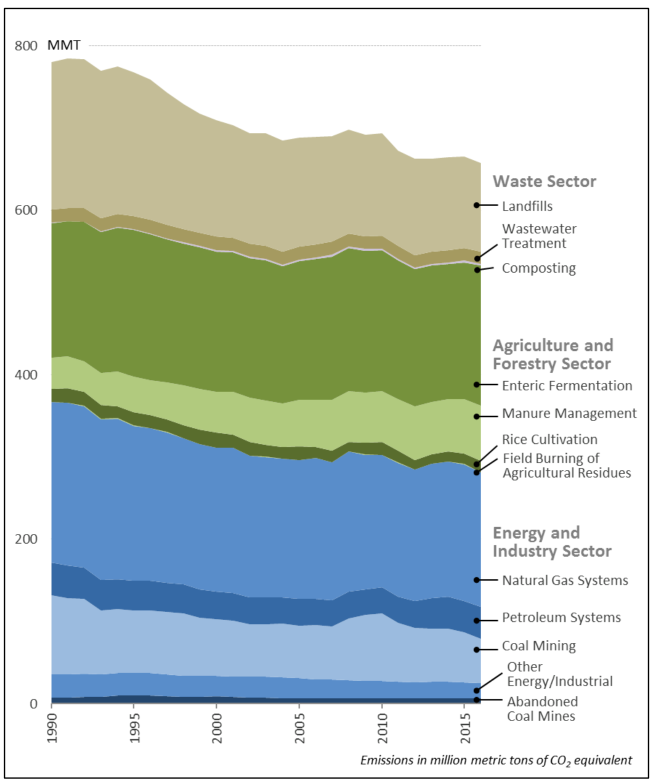
According to EPA, methane is the second-most prevalent GHG emitted in the United States (behind CO_2), and in 2016—the latest year of available data—it accounted for

657 million metric tons of CO_2 equivalent, or about 10% of all domestically produced GHG emissions from human activities. Some studies have put these emissions higher. Of the total, 43% was emitted from sources in the energy and industrial sector, 38% from sources in the agricultural sector, and 19% from sources in the waste sector.

Between 1990 and 2016, U.S. methane emissions decreased by a little over 16%. Still, trends have fluctuated over the past decade, with increases reported in some years. Since 1990, emissions from sources associated with agriculture have increased, while emissions from sources associated with waste management, energy, and industrial processes have decreased (see **Figure 1**).

Economic and technical difficulties have made a comprehensive national inventory of methane emissions difficult to attain. Unlike CO_2, whose emissions are reported using well-tracked energy statistics, methane is emitted to the atmosphere primarily through fugitive releases. By definition, fugitive emissions are diffuse, transitory, and elusive. Thus, one of the greater difficulties in understanding the impacts of methane emissions is acquiring comprehensive and consistent observational data. For this reason, methodologies for measuring methane emissions are under near-constant revision.

Figure 1. U.S. Methane Emissions: Historical Trends



Source: CRS, with data from the U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016*, EPA 430-R-18-003, April 12, 2018.

Issues for Congress

Through the years, the federal government has sought policies (both legislative and regulatory) to control methane emissions for a variety of economic, environmental, public health, and safety reasons, including:

- Promoting domestic energy production and security,
- Protecting the property rights of mineral owners (including federal resources and associated royalties to the American taxpayer),
- Assuring the operational safety of employees who work with or near significant emission sources, and
- Safeguarding the general population from air pollution.

Under President Obama, federal activities in support of methane emission reductions became one of the cornerstones of his "Climate Action Plan." In the Administration's 2014 "Strategy to Reduce Methane Emissions," a number of federal agencies proposed and promulgated a suite of voluntary and regulatory programs to address methane emissions, including:

- A joint Department of Agriculture, Department of Energy, and EPA "Biogas Roadmap" outlining voluntary strategies in the agricultural sector (released on August 1, 2014).
- EPA standards to reduce methane emissions from new and modified activities and equipment in the oil and natural gas sector (promulgated on June 3, 2016).
- EPA standards to reduce methane emissions from new and existing municipal solid waste landfills (promulgated on August 29, 2016).
- Bureau of Land Management (BLM) standards to reduce venting and flaring from oil and gas production on public lands (promulgated on November 18, 2016).

Some stakeholders raise concerns over federal controls. They argue that more stringent standards on methane emissions would not provide cost-effective health and environmental benefits. Some industries contend that they are already doing everything feasible to capture and reuse methane emissions (for economic and safety reasons). Others note that state and local authorities—who may share a closer understanding of the industries' specific circumstances—are better equipped to oversee and enforce emission reduction efforts. Some states (e.g., Colorado, California, Ohio, Wyoming, and Pennsylvania) have emissions standards for their energy industries.

President Trump—in a direct response to the Obama-era standards and in line with his campaign promises—signed Executive Order 13783 on March 28, 2017. The order requires agencies to review existing regulations and "appropriately suspend, revise, or rescind those that unduly burden" domestic energy production and use. As a result, EPA's landfill, oil, and natural gas sector standards and BLM's venting and flaring rule are under reconsideration. The federal court system is currently reviewing several provisions in the Obama-era standards as well as the suspension actions taken during the Trump Administration.

Richard K. Lattanzio, rlattanzio@crs.loc.gov, 7-1754

IF10752