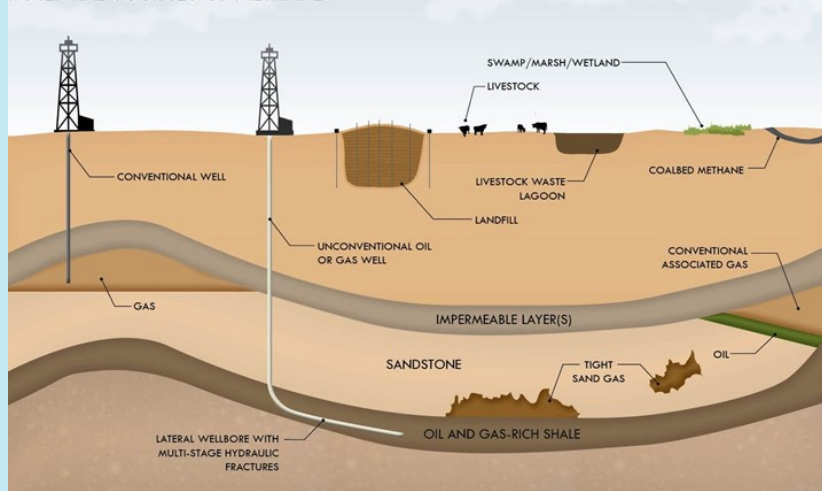


Methane

What is Methane?

Methane (CH₄) is a colorless, odorless, tasteless and combustible gas that typically makes up 70 - 98 percent of the mixture known as natural gas. It is a naturally-occurring hydrocarbon that can be found underground in rock formations, such as shale formations and coal beds, areas of decomposition of organic material, and is also commonly found in groundwater. **Methane is not known to be a toxic health hazard.**

POTENTIAL SOURCES OF METHANE



Like other gases, if concentrations of methane are high enough to displace oxygen in a breathing space, it can impair normal breathing. Methane in air can explode at concentrations between 5 percent (lower explosive limit) and 15 percent (upper explosive limit).

Methane can be created when carbonaceous rock formations under the earth are subject to heat and pressure. This “thermogenic” process forms the methane in natural gas extracted from shale. Methane is also created by “biogenic” processes, where microbes “break down” organic matter and create methane that is typical of shallow formations, landfills or marshes.

What is Methane used for?

As the primary component of natural gas, methane is primarily used as a source of energy. Uses for methane include: heating homes, cooking, power generation and petrochemical/chemical manufacturing.

What methane emissions are associated with natural gas development?

The purpose of drilling a gas well is to collect and sell natural gas. The more natural gas that escapes to the atmosphere, the less there is to sell. Owners and operators of gas wells take measures to minimize gas releases, however, it is not realistically possible to eliminate all methane emissions to the atmosphere during the development and operation of a gas well.

According to the United States Environmental Protection Agency (USEPA), **methane emissions from natural gas field production decreased approximately 38 percent from 2005 to 2013 while methane emissions from natural gas systems (field production, processing, transmission and storage) declined by about 11 percent in the same period**, due to a number of improved designs and practices associated with modern shale gas development. These decreased emissions resulted from both voluntary reduction activities and compliance with the 2012 New Source Performance Standards regulations for oil and gas.

What are the potential risks of methane?

Methane is not known to be toxic, and consuming water that contains methane or breathing methane in air does not present a toxic health hazard. Exposure to methane does not cause cancer or other health effects related to toxicity. At highly elevated concentrations methane can impair normal breathing by displacing oxygen.

Methane is lighter than air and methane gas may accumulate within an enclosed space such as a wellhead, subsurface well vault, or within a poorly ventilated basement or crawl space where it could present a risk of explosion if allowed to build up.

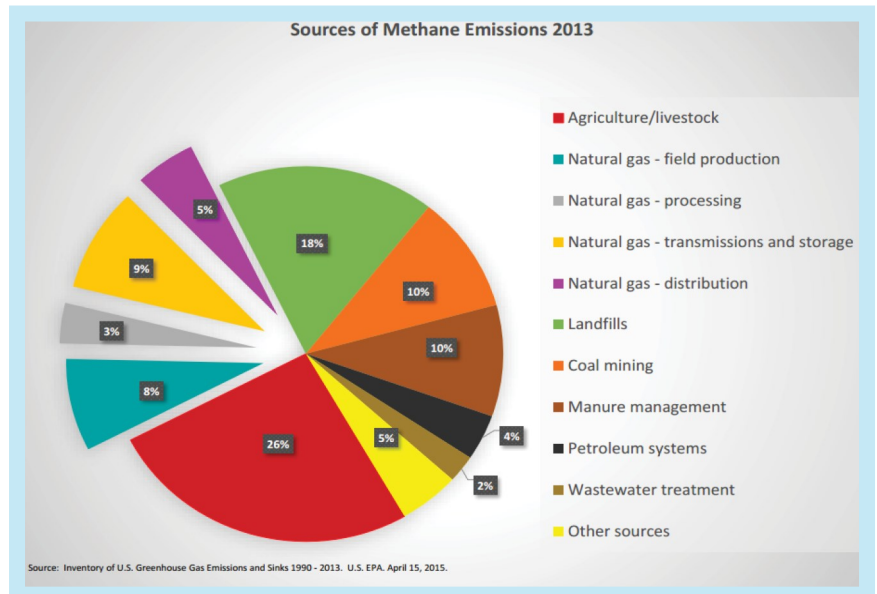
What are the sources of methane emissions to the environment?

According to the USEPA, the relative levels of methane emissions to the atmosphere from various sources are shown in the diagram to the right. As indicated, most methane emissions originate from biogenic sources such as agriculture, manure management, landfilled garbage and biological wastewater treatment.

How can people be exposed to methane?

Methane exposures to humans can occur in the following ways:

- Inhalation of releases to ambient air:** Because it is lighter than air, methane emitted to the atmosphere quickly rises above the typical human breathing zone and is diluted by ambient air. As such, inhalation of methane released to ambient air is not a significant exposure pathway.
- “Stray gas migration” into buildings:** Methane can migrate below ground through preferential pathways into buildings. These pathways may include poorly constructed or unplugged abandoned wells or openings and cracks in foundations. While there are cases where this methane intrusion has been related to drilling for natural gas, there are a number of other possible sources of this “stray gas migration”, such as when a structure is in proximity to a methane-producing source such as a coal bed, landfill, septic system, or swamp. In addition, indoor gas leaks from distribution piping, furnaces, and appliances are additional sources of methane inside buildings.
- Exposure to groundwater containing methane:** The presence of methane in water wells is relatively common, and is regularly detected in sampling performed prior to any drilling for natural gas. It may occur naturally, generated within the groundwater’s source rock formation, or as the result of migration through natural pathways. However, it may also be present when current or historical human activities such as landfills, coal mining and drilling for oil and gas create conditions for gas migration.



What is industry doing to prevent methane releases?

The shale oil and gas industry has implemented improved procedures to reduce methane emissions. Some of these improvements include:

- Eliminating venting and flaring by directing the gas that flows back during well completion activities directly into pipelines.
- Using vapor recovery systems, collecting vapors from dehydrators, water trucks and tanks.
- Using air instead of gas for pumps and pneumatic controllers.
- Using Leak Detection and Repair (LDAR) equipment to identify and eliminate leaks.