Methane Emissions

Unconventional oil and gas (UOG) development and operations release pollutants into the atmosphere, including methane, which can impact human health, ecological resources, and the Earth's climate. Investments by the Department of Energy's (DOE's) Office of Fossil Energy (FE) and the National Energy Technology Laboratory (NETL) have led to substantial progress in modeling, measuring, and assessing these pollutants to mitigate emissions. Measurement and modeling efforts have accounted for regional trends, developed advanced quantification methodologies, and concluded that emissions from unconventional gas wells are intermittent.

Goals

The Administration has set a goal to reduce methane emissions from the oil and gas sector by 40-45 percent from 2012 levels by 2025. Achieving this objective requires the development of technology and best practices that will reduce the sources and flux of air pollutants. Approaching these challenges in collaboration with federal agencies, states, industry, academia, and others will advance emission reductions from the oil and gas sector.

What Is Known

Technologies that detect emissions from oil and gas operations are currently available. Effective mitigation requires accurate and consistent information on baseline conditions, as well as reliable measurement of emissions throughout the life cycle of UOG. Life Cycle Analysis (LCA) is a useful tool for identifying the best mitigation strategies for greenhouse gas emissions including methane, carbon dioxide, as well as volatile organic compounds and particulate matter. Furthermore, determining the air quality impacts of UOG development requires a combination of regional studies and site-specific investigations. Finally, emissions from unconventional gas wells are intermittent and their levels are determined by the stage of the well development.

Research Results

The work of FE, NETL, and others has contributed to improved methodologies for measuring and estimating methane emissions, analyzing data, and creating tools and information sites. Notably, work is being done to reconcile gaps between top-down (atmospheric) and bottom-up (point source) methane emission models and estimation methods. FE has sponsored research that has advanced the understanding and technologies in the area of methane emissions, including the following projects.

Emissions Measurement

- Houston Advanced Research Center's (HARC's) Environmentally Friendly Drilling Program measured emissions over large areas and developed emissions profiles for drilling sites. Currently, they are testing a boiler to generate onsite electricity in the Bakken with gas that would have otherwise been flared. They continue to monitor emissions with drones and wireless sensors.
- The Pennsylvania State University's Continuous, Regional Methane Emissions Estimates showed that emissions from unconventional gas wells are most likely intermittent and emission rates are determined by the stage of the well development. This project used top-down and bottom-up measurements to determine relative methane contributions of regional sources. Upon completion of the project, the researcher will be able to determine the contributions of industry, gas wells, landfills, and other sources to methane emissions in the area.

Figure 1. NETL's Mobile Air Monitoring Laboratory

- Carnegie Mellon University's Measurement and Modeling to Quantify Emissions from Shale Operations estimated methane emissions at producing wells were approximately 1% of production levels in the Marcellus shale play.
- Utah State University's Measurement of Hydrocarbon and Greenhouse Gas Emissions from Uncharacterized Area Sources outlined a method to characterize methane, carbon dioxide, and other emissions from area sources, which led to a Uintah basin-wide emission estimate.

Analytical Methodologies

- NETL's Fugitive Air Emissions Field Data yielded refined statistical models to represent air quality impact from Marcellus Shale drilling and hydraulic fracturing activities. This ongoing effort will improve certainty in emissions factors and NETL's shale gas greenhouse gas life cycle assessment (see Figure 1).

- GSI Environmental developed advanced analytical methods for air and stray gas emissions. Their easy-to-use software tool can predict emissions from any Wyoming disposal pit under any conditions.

Tools and Information

- Colorado State University developed a GIS-based tool to optimize fluids management in the shale gas industry. The tool will help operators track air toxins and greenhouse gases associated with fluids management, determine their water footprint, and place wells and treatment facilities in areas with less potential to impact the surrounding community.

- The Colorado School of Mines is developing a protocol to reconcile top-down and bottom-up methane emission estimates from gas basins in order to determine the relative contributions of oil and gas industry sources to regional methane emissions.

- HARC's information site enables users to learn about natural gas resources available in Arkansas. It also explains the steps followed by natural gas development companies to extract and market gas.

Direction for Future Progress

Technology development and research opportunities include reconciling top-down (atmospheric) and bottom-up (point-source) data disparity for oil and gas development; developing a tested, standardized research protocol for estimating methane emissions from specific onshore oil and gas systems anywhere in the continental U.S.; developing technological solutions to address both fugitive and non-fugitive emissions associated with UOG; improving measurement technology for midstream; and broadly identifying, developing, and transferring critical cost effective new detection technologies. In April 2016, FE issued a grant opportunity on methane emissions mitigation and quantification from natural gas infrastructure.

Policies and practices should emphasize improving methane inventory data gathering, including fugitive emission estimates. FE will need to continue working with stakeholders to encourage participation in voluntary emissions reduction programs, including EPA's Methane Challenge and CCAC's Oil and Gas Methane Partnership. NETL's LCA should be used to inform stakeholders on the effectiveness of methane emission reduction programs. The existing collaboration with organizations such as the Environmental Defense Fund and Federal agencies such as the EPA will continue, with an aim to improve the accuracy and credibility of methane emission factors from the upstream sector. Dialogues with State leadership should be continued through the National Association of Regulatory Utility Commissioners' Natural Gas Infrastructure Modernization Partnership and the Environmental Council of States' Shale Gas Caucus on methane mitigation technologies, tools, and practices throughout the natural gas supply chain.