the ENERGY lab

R&D FACTS

Oil & Natural Gas Development

Research on Local and Regional Air Quality Impacts of Oil and Natural Gas Development

Background

The development of shale gas and shale oil resources requires horizontal drilling and multi-stage hydraulic fracturing, two processes that have been known for many years but have only recently become common practice. In addition, fugitive atmospheric emissions can result from a variety of other operational elements (e.g., volatiles that escape from the wellhead during the drilling and production operations, large stationary power generators, increased truck traffic, water separation tanks, holding ponds, etc.); these emissions can negatively impact air quality. The environmental risks of shale gas and shale oil development may be very different from that of conventional oil and gas development and these risks are not completely known at present. Current estimates of the impact of oil and gas exploration and production activities on regional air quality based on air quality and life cycle assessment models must be updated to incorporate both results from on-site emissions monitoring and emission inventory data that accurately reflect industry operations. By providing a complete understanding of the impacts of oil and gas development on regional air quality, NETL can ensure that oil and gas development proceeds at a rate that protects the environment while ensuring an adequate domestic supply.

Goal

The NETL research effort in improving the assessment of impacts to air quality from oil and gas exploration and production activities has the following goals: (1) use NETL's stationary ambient air monitoring laboratory, vehicle-based methane plume surveying equipment, and infrared cameras to conduct targeted on-site measurements of emissions from oil and gas production activities that may impact the environment and (2) use collected data in numerical models to further understand emission rates and local and regional air quality impacts.

Capabilities

Mobile Air Monitoring Laboratory

A government-owned trailer has been modified to serve as an autonomous air emissions monitoring laboratory. The temperature controlled laboratory space houses several monitoring instruments, each capable of transmitting collected data back onsite to the

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This project is part of the DOE/NETL Complementary Research Program under Subtitle J, Section 999 of the Energy Policy Act of 2005.

NETL site via satellite. Instrumentation is as follows:

- Picarro G2112-i CRDS analyzer to measure Methane, Carbon Dioxide, and Carbon Isotopes in Methane and Carbon Dioxide;
- Thermo Fisher Tapered Element Oscillating Microbalance (TEOM) to measure PM_{10} and $PM_{2.5}$;
- Perkin Elmer Ozone Precursor Analyzer (a GC-FID with sample introduction via thermal desorption) to measure VOC's;
- Air Pollution Instruments gaseous monitors for NO_x and O_3;
- A Davis Instruments meteorological station to measure temperature, humidity, wind speed, wind direction, and other meteorological variables.

Methane Plume Surveying Equipment

A Picarro G2203 methane and acetylene CRDS analyzer measures fugitive methane emissions via acetylene tracer measurement. Mobile mapping of concentration data with integrated GPS yields spatial representation of methane plumes.

Infrared Cameras

Two FLIR GF320 infrared cameras record still shots or video of well pad emissions for qualitative interpretation of emission sources.

Accomplishments

The mobile air monitoring laboratory collected pollutant concentrations during a year-long monitoring campaign in the Allegheny National Forest, a historically productive area for oil and gas wells that has seen the number of wells increase significantly in the past few years. Results indicated minor contributions from oil and gas operations to regional air quality as evidenced by forest-wide elevated ethane concentration. Following the Allegheny National Forest air monitoring campaign, the station has been deployed to multiple sites in southwestern Pennsylvania and northern West Virginia to evaluate Marcellus Shale well pad emissions during various states of operation: well pad construction, vertical drilling, horizontal drilling, hydraulic fracturing, flowback, and production. This effort includes the first on-well pad ambient air measurements by an independent party. While data analysis is ongoing, preliminary results suggest that (1) evaluation of carbon isotopes can identify the methane as biogenic or thermogenic, allowing a distinction between background methane and methane coming from the well; and (2) it is important to consider well pad access road emissions in addition to well pad emissions as emissions from truck traffic on the access roads, especially during hydraulic fracturing, can be significant.