

Measuring and Modelling Air Pollution and Noise Exposure Near Unconventional Oil and Gas Development in Colorado

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Background. The United States is now the world's largest producer of both oil and natural gas (O&G). Large increases in O&G production in recent years have been driven by significant improvements in directional drilling and hydraulic fracturing techniques that characterize unconventional O&G development. In some parts of the country, including Colorado, substantial O&G development is happening in populated areas, raising concerns about potential impacts to those living, working, or attending school nearby. These include concerns about noise and emissions of air pollutants, particularly during drilling and completion of large, multi-well pads.

Methods. We are utilizing a combination of new and existing measurements of noise and air pollutants around well-pads to characterize impacts during particular O&G operations in the Denver-Julesburg Basin. Our focus is on large pads (~10-30 wells) as they undergo key development steps, including drilling, hydraulic fracturing, flowback, and early production. Monitoring is coordinated with well development activities by three major O&G operators. These operators provide key operational information needed to interpret field measurements and model activity-based emissions. Air pollution measurements include fast and time-integrated measurements of methane and approximately 50 volatile organic compounds (VOCs), nitrogen oxides, and PM_{2.5}. Both mobile and fixed-location monitoring platforms are included. Measured concentrations will be used to assess potential acute and chronic exposure to air toxics during specific O&G operations and to test the TRACER air emissions model being developed in collaboration with another HEI-Energy team at the University of Texas- Austin.

Results. Our first deployment during drilling operations is complete. Prior observations collected using similar approaches during development of several large well-pads in Broomfield, Colorado reveal clear increases in concentrations of air toxics and other VOCs throughout well development at distances up to and beyond current setback requirements. Weekly average concentrations of benzene and other air toxics around these operations remained below health guideline values for chronic exposure; however, high benzene concentrations sometimes reaching 100 ppbv or more, have been observed in transient plumes downwind of O&G operations. These high concentration episodes typically persist less than an hour at a given location. The transient nature of these plumes, which can reflect variable emissions and/or shifting plumes, necessitates the use of high time resolution measurement techniques to fully characterize plume composition and potential short-term exposures. Differences in operational practices (e.g., use of grid-powered drill rigs, choice of drilling mud composition, use of closed-loop fluid handling systems) have also been observed to alter air quality impacts of O&G operations.