

## **Oilfield Pumpjack Engines Emit Much Less NO<sub>x</sub> and More Organics Than Previously Assumed**

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We measured a comprehensive suite of pollutants emitted from 58 natural gas-fueled pumpjack engines in Utah's Uinta Basin between January and May 2021, with repeat measurements of five engines in January 2022.

Air-fuel ratios (i.e., the ratio of air taken in by the engine to the amount of air needed for combustion of the fuel) were strong predictors of emissions. Engines with higher air-fuel ratios (i.e., those that took in more air than needed for combustion) led to lower oxides of nitrogen (NO<sub>x</sub>) emissions and higher emissions of organic compounds. Engines with air-fuel ratios greater than three tended to have very low NO<sub>x</sub> emissions and a large percentage of the fuel gas passing through the engine uncombusted. Low air-fuel ratios were associated with more complete combustion, higher NO<sub>x</sub>, and the formation of more reactive organic compounds, including alkenes and carbonyls.

Average NO<sub>x</sub> emissions in this study were only 9% of average emissions from natural gas-fueled pumpjack engines in the official oil and gas emissions inventory. In contrast, volatile organic compound emissions in the study were 15 times higher than in the inventory. When we applied averages from our measurements to inventoried pumpjack engines, we found that emissions from all types of engines dropped from 58% to 37% of total inventoried NO<sub>x</sub> and increased from 2% to 16% of total inventoried volatile organic compounds. Emissions of formaldehyde and carbon monoxide from engines were also higher than inventoried values.