



Natural Gas and Infrastructure

NETL is developing next-generation technologies to strengthen the security, reliability, and flexibility of the nation's natural gas infrastructure. Through advancements in sensing systems, hydrocarbon loss monitoring, material performance, and pipeline integrity, NETL provides solutions that support affordable energy delivery, protect critical infrastructure, and enable emerging opportunities. These efforts help ensure that natural gas continues to serve as a resilient foundation for the U.S. energy economy.

R&D Applications

- Emerging Play Characterization
- Recovery Efficiency Improvement
- Detection and Mitigation To Prevent Methane Loss
- Pipeline Integrity and Infrastructure
- Wellbore Materials Development and Evaluation
- Natural Gas Extraction and Processing Methods
- Data Collection and Mapping
- Field Validation Data and Tools
- Technoeconomic and Systems Analysis
- Beneficial Uses of Produced Water

Corrosion-Resistant Materials and Embedded Sensors

In advancing pipeline materials, NETL developed an innovative zinc-rich material that can be applied as a coating through a cold-spray process to protect pipelines from the effects of corrosion. This coating was tested at a NW Natural Gas Company site. By developing material and sensor technologies, NETL enhances pipeline durability, public safety, and operational efficiency. Further, sensor technology research helps the U.S. move toward more intelligent pipeline systems that can continuously monitor the infrastructure for vulnerabilities or faults.



Researchers conduct targeted on-site measurements to monitor potential hydrocarbon loss.



Researchers use the Severe Environment Corrosion Erosion Research Facility to examine materials in extreme environments.



Research Highlights

New Energy Infrastructure Outlook

NETL publishes the New Energy Infrastructure Outlook to highlight projects advancing toward commercial operation across the continental U.S. The report covers progress on power plants, electric transmission systems, natural gas pipelines, and liquefied natural gas terminals that have moved beyond early development stages. It also provides insights into reserves by summarizing coal, natural gas, and petroleum stockpile volumes.

Enhancing Oil Recovery in Unconventional Reservoirs

Rich natural gas and carbon dioxide (CO₂) injection is a promising method for enhanced oil recovery (EOR) in unconventional shale reservoirs. Preliminary research indicates that oil recovery may be improved by the dissolution of surfactants into rich natural gas CO₂ to change wetting properties from oil-wet to gas-wet. Through DOE's Hydraulic Fracturing Field Laboratories, NETL has access to real-world testing and validation of EOR technologies. Improving the efficacy will enhance oil recovery in shale, reduce the existing needs for water, provide a market for anthropogenic CO₂, and enable reuse of rich natural gas.

Sensing Technology for Pipeline Corrosion

NETL's optical fiber-based sensor system enables real-time, spatially resolved corrosion monitoring in inaccessible areas of gas pipelines. A distributed optical fiber interrogator (a device that reads data from the fiber optic sensor) serves as both the laser source and the detector, injecting light into the core of the optical fiber and collecting backscattered light along the fiber to achieve spatially distributed sensing. The sensors are small, passive, wireless, and low cost.

Identifying Historical Infrastructure with Remote Magnetometer Techniques

NETL is using aerial drones to enhance the performance of America's energy infrastructure. The hydrocarbon energy industry uses sensors on drones to inspect wells, pipelines, and processing facilities for methane leaks. NETL has successfully deployed drone-based magnetometers to assist in finding prior oil and natural gas infrastructure that could impact the new hydrocarbon energy infrastructure buildout. These drones can reveal undocumented wells that predate modern regulations and recordkeeping.

Publications

- Belarbi, Z., Chinn, R. E., & Doğan, O. N. (2024). Corrosion of zinc cold spray coatings in a wet sweet and sour gas environment. *Corrosion*, 80(7). <https://doi.org/10.5006/4491>.
- Khutal, H., Kirchner-Ortiz, K., Blackhurst, M., Willems, N., Matthews, H. S., Rai, S., Yanai, G., Chivukula, K., Priyadarshini, Hoffman, H., Carr, S., Jamieson, M., & Skone, T. J. (2024). *Life cycle analysis of natural gas extraction and power generation: U.S. 2020 emissions profile update*. (DOE/NETL-2024/4862). U. S. Department of Energy National Energy Technology Laboratory. <https://doi.org/10.2172/2483883>.
- Kim, K.J., Culp, J.T., Ellis, J.E., & Reeder, M.D. Real-time monitoring of gas-phase and dissolved CO₂ using a mixed-matrix composite integrated fiber optic sensor for carbon storage application. *Environmental Science & Technology*, 56(15), 10891-10903. <https://doi.org/10.1021/acs.est.2c02723>.
- Littlefield, J., Rai, S., & Skone, T.J. (2022). Life cycle GHG perspective on U.S. natural gas delivery pathways. *Environmental Science & Technology*, 56(22), 16033–16042. <https://doi.org/10.1021/acs.est.2c01205>.
- Mackey, J., Bain, D. J., Lackey, G., Gardiner, J., Gulliver, D., & Kutchko, B. (2024). Estimates of lithium mass yields from produced water sourced from the Devonian-aged Marcellus Shale. *Scientific Reports*, 14 (1), 8813. <https://doi.org/10.1038/s41598-024-58887-x>.

NETL is a U.S. Department of Energy (DOE) national laboratory dedicated to innovating and accelerating the nation's energy solutions in hydrocarbons, geothermal energy, and critical minerals production. The Lab further strengthens its impact by engaging with industry, academia, and other stakeholders through four strategically located Centers of Excellence: Coal, Critical Minerals & Advanced Alloys, Oil & Gas, and Geothermal. With research sites in Albany, Oregon; Morgantown, West Virginia; and Pittsburgh, Pennsylvania, NETL operates as one laboratory to create advanced energy technologies that support DOE's mission and enable affordable, reliable and, secure energy to fuel human prosperity.



U.S. DEPARTMENT
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September 2026