



# Transportation and Storage

Transportation and storage infrastructure—the networks of pipelines, wires, storage, waterways, railroads, and other facilities—form the backbone of our energy system. Ensuring the resilience, reliability, safety, and security of transmission, storage, and distribution (TS&D) infrastructure is a national priority and vital to American competitiveness, jobs, energy security, and a clean energy future. To address the challenge of an expanding and aging transportation and storage infrastructure, investments by the Department of Energy's (DOE's) Office of Fossil Energy (FE) and the National Energy Technology Laboratory (NETL) have helped analyze the policies, technical specifications, and logistical program structures needed to mitigate the risks associated with TS&D infrastructure. In a changing global marketplace, FE and its partners can modernize U.S. energy infrastructures that are reliable and provide energy security benefits, support fuels diversity, and reduce environmental footprints through research, demonstration, and analysis.

## Goals

The goals of transportation and storage efforts are to: 1) ensure the safe, cost-effective, robust, efficient, and flexible transport and delivery of fossil fuel resources, while developing a science-based understanding of issues involving the transportation of various types of crude oil, hydrocarbon gas liquids, and natural gas resources; and 2) assess and mitigate the risks of resource transportation and storage to maximize efficiency and improve the ongoing expansion of the nation's midstream infrastructure for energy delivery to the public domain.

## What Is Known

New producing regions have come online and legacy producing regions are declining, resulting in changes to regional supply-demand balances. These changes require the redirection of transportation and storage through existing, aging infrastructure and the addition of new transport capacity. Challenges to the nation's midstream infrastructure include: reducing carbon dioxide, methane, and other emissions; monitoring and increasing operational efficiency; and potentially increasing the storage capacity to effectively respond to rapidly changing energy demand profiles while ensuring the safe and secure transport of energy resources.

## Research Results

DOE-sponsored collaborations with industry, universities, national laboratories, and state agencies address the challenges of economic and regulatory barriers to infrastructure development. It also seeks improvements in the best available and safest technologies and operating practices to ensure the sustainable expansion of U.S. transportation and storage infrastructure. Results from the Office of Fossil Energy include the following:

### *Technologies of the Future for Pipeline Monitoring and Inspection*

The University of Tulsa has initiated research on an [inexpensive alternative method of pipeline inspection](#) that utilizes small-scale sensors to continuously measure temperature, pressure, and other quantities inside the pipeline, providing real-time safety assurances.

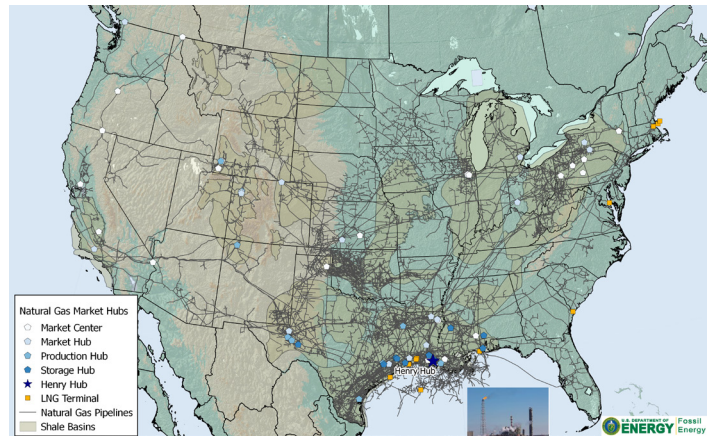


Figure 1. U.S. natural gas pipelines.

### *Crude Oil Properties Relevant to Handling and Fire Safety in Transport*

To understand risks associated with frequent and large volume rail transport of crude oil, DOE and Sandia National Laboratory cooperated with the Department of Transportation (DOT) to develop a review of available crude oil chemical and physical property data and [literature related to crude oil](#) potential for ignition, combustion, and explosion.

### *Development of GIS-Based Tool to Optimize Fluids Management in the Shale Gas Industry*

Colorado State University's interactive, [GIS-based tools](#) optimize management decisions related to pipe infrastructure, stationary, and mobile treatment systems, and reduce environmental and community impacts.

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## Other accomplishments include:

- Technology created to facilitate live insertion and removal of pipeline components, particularly for high-pressure transmission lines, would eliminate emissions and avoid recompression costs (Gas Technology Institute).
- In association with the National Association of Regulatory Utility Commissioners, DOE created the [Natural Gas Infrastructure Modernization Partnership](#) that provides guidance for enhanced pipeline reliability and security and supports modernization policies for the gas distribution system.
- Building on the DOE/DOT Tight Crude Oil Flammability and Transportation Spill Safety Project, a [Sampling, Analysis and Experiment](#) plan will characterize tight and conventional crudes based on key chemical and physical properties, and identify properties that may contribute to increased likelihood and/or severity of combustion events that could arise during transportation and storage, informing regulators of oil stabilization best practices.



Figure 2. Location of sensor on magnetic flux leakage pig.

- A competitive grant program was established to promote innovative solutions to enhance energy infrastructure resilience, reliability, and security in support of updates and expansion of state energy assurance plans. DOE identified important research gaps related to the need for a scientific evaluation framework for assessing the viability and performance of transportation and storage infrastructure.

- DOE-supported competitive programs were created to accelerate pipeline replacement and enhance maintenance programs for natural gas distribution systems to support environmental health and safety initiatives.
- Opportunities for increasing the operational efficiency of natural gas infrastructure and in detecting and eliminating leaks were identified.

## Direction for Future Progress

**Technology development** opportunities include advanced materials research to install transportation and storage infrastructure that are corrosion proof, impermeable, and durable, with self-monitoring and self-healing capabilities. Ongoing TS&D investments will support the development of smart sensors to enhance pipeline operational efficiency, continuous in-pipe communication of operational parameters, leak detection and measurement to maximize performance, improve transportation and storage safety, and mitigate environmental impacts.

**Policies and practices** should support a comprehensive Interagency Methane Strategy to pursue a collaborative approach with state governments and the private sector to cover all methane emitting sectors as part of the President's Climate Action Plan and develop better methods for predicting, monitoring, and optimizing transportation and storage system performance; support improved standards for pipeline data collection, sharing, and safeguarding; identify existing authorities, incentive-based opportunities, and best practices for reducing emission; and assess current emissions data and address data gaps. Through these transportation and storage efforts, FE can support advanced research and policy options to ensure environmentally sustainable domestic and global supplies of oil and natural gas.

For more information, please visit  
[energy.gov/fe/science-innovation/oil-gas-research](https://energy.gov/fe/science-innovation/oil-gas-research)