

Fact Sheet: The Present and Future of Pipelines in the Pennsylvania Commonwealth

Overview

Pipelines are a form of linear infrastructure, like roadways or power lines, purpose-built to transport liquids and gasses using a system of pumps, compressors, valves, and vast networks of pipes. In an energy context, pipelines are instrumental in conveying energy products like oil, natural gas, steam, and other energetic or hazardous chemicals over long distances. While pipelines are most closely associated in the public imagination with fossil fuels – indeed, the US relies on pipelines to transport two-thirds of all oil products and almost all natural gas – pipeline networks are critical to the feasibility and success of many other energy products, including low- and zero-emission fuels and carbon dioxide.

The size, composition, and precise operation of pipelines can vary with the product and the project, but the cumulative footprint of pipeline networks is both substantial and difficult to quantify. The continental US is served by an expansive web representing over 3 million miles of federally regulated interstate pipelines, a web that is fully integrated with pipelines in Canada and partially integrated with those in Mexico. But this figure, large as it is, fails to account for the small-diameter gathering lines and distribution infrastructure that represent the first- and last-mile in the natural gas distribution system. From gathering to transmission to distribution, the majority of homes in the Lower 48 are served and impacted by pipelines and pipeline policy.

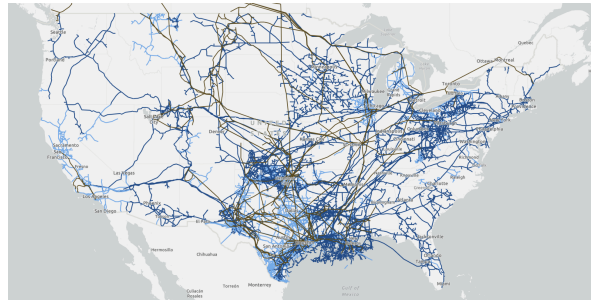


Fig. 1 US oil and gas transmission pipelines; gathering and distribution lines are not pictured.
US Energy Information Agency, 2023.

The reasons for this integration and for the heavy reliance on pipelines as a means of transportation for energy and energy products amount to the substantial advantage of pipelines over their alternatives. Unlike tanker ships, rail cars, or tractor trailers, pipelines are largely insulated from weather and climatic conditions and rely on stationary infrastructure like compressor and pumping stations. Pipelines are not subject to interstate traffic or border controls, and are relatively easy to monitor and control. While pipelines are not without their drawbacks and challenges – especially with regard to rights of way and land use – these factors, among others, mean that pipelines are a relatively safe and highly efficient means of distributing liquid and gas products.

Background

While most of Pennsylvania lacks the density of pipeline infrastructure (particularly interstate pipelines) of Texas, Louisiana, and Oklahoma, pipelines and the molecules they carry remain foundational to Pennsylvania's industrial economy. The advent of hydraulic fracturing and the resulting boom in shale gas production in the Marcellus Formation in Appalachia fed a rapid expansion in gathering and transmission pipelines in the Commonwealth. The decline in natural gas prices precipitated a shift away from coal and towards natural gas in heavy industry



and power production. As a result, the regional trends of the energy transition over the last two decades have made Pennsylvania's economy more reliant, not less, on pipeline infrastructure and the products those pipes carry. Major Pennsylvania-based industries like steel and chemical manufacturing are difficult to electrify, meaning this reliance on liquid and gaseous energy, and thus pipelines, is expected to continue even as the Commonwealth pursues net-zero emission climate goals. Reducing and ultimately eliminating atmospheric emissions from difficult-to-abate sectors while expanding Pennsylvania's economy therefore requires both zero-carbon fuels such as hydrogen and ammonia and carbon capture technology.

In particular, the successful adoption of these decarbonization strategies depends on ready and affordable access to these energy services. Though hydrogen can be safely blended with natural gas up to a certain percentage (anywhere from 5-20 percent), a stream of pure, clean-burning hydrogen requires new and purpose-built infrastructure with specially-treated pipes that will not become brittle or allow the smaller hydrogen molecules to escape. For its part, carbon capture technologies can take advantage of both new and repurposed natural gas infrastructure for the transportation, use, and storage of CO₂. However, the potential volume of captured CO₂ that deep-decarbonization would produce would almost certainly require significant additions to the existing pipeline network, especially long-distance CO₂ pipelines to connect Pennsylvania industries to storage solutions in the Midwest or offshore.

Policy Considerations

The enormous tax incentives for hydrogen production and carbon capture in the Bipartisan Infrastructure Law of 2021 and the Inflation Reduction Act of 2022 and the establishment of the Regional Clean Hydrogen Hub program affirmed the centrality of these technologies to widespread economic decarbonization. Despite this substantial financial commitment, however, uncertainty about public oversight and economic regulation threatens the success of hydrogen and carbon management networks.

The siting, construction, and operation of traditional pipelines are all regulated by a constellation of federal and state agencies, which can vary from project to project based on a range of factors. However, federal regulation of interstate hydrogen and CO₂ pipelines remains largely unclarified – one among several barriers to the successful and safe distribution and adoption of hydrogen fuels and carbon management technologies. In areas where the Pennsylvania Public Utility Commission and the Pennsylvania Department of Environmental Protection claim jurisdiction for traditional oil and gas pipelines, state agencies have so far been unable to adopt clear policies on hydrogen and CO₂ because of a lack of certainty about their jurisdiction over these products. Even if Pennsylvania state agencies were granted greater responsibility, they would require additional legal authority and institutional capacity to meet the expectations of pipeline stakeholders and ensure the protection of the public].

Rulemaking, at least at the federal level, is likely to evolve and solidify with the deployment of demonstration projects, including the federally-backed Regional Clean Hydrogen Hubs. Until that time, however, the increased uncertainty associated with the undefined and untested regulatory structure for hydrogen and CO₂ pipelines presents a steep barrier to entry for project developers.



Environmental and Social License Considerations

The rapid expansion of pipeline networks in the Pennsylvania Commonwealth coincided with the rapid expansion of communities that surrounded them. As a result, major pipeline projects benefited from relatively quick permitting and faced limited objections from neighboring or host communities. Project developers have seen these conditions change as Pennsylvanians looked to preserve their natural and built environments and safeguard public and environmental health.

The future viability of pipelines and, by extension, of decarbonization tools like hydrogen and carbon storage, will depend in no small part on the ability of project developers to understand and adapt to the concerns of rural, suburban, and metro-area communities and reconcile them with project goals, budgets, and deadlines. In addition, regulators must also have the ability to perform more effective and comprehensive analysis in siting and permitting decisions, accounting for community impacts as well as decarbonization goals. Just like energy infrastructure itself, outreach, engagement, and education are key strategies for decarbonization. It is in the best interests of the public, companies, and decision-makers to mutually identify and work toward solutions.

Resources

"Maps: Oil and Natural Gas Exploration, Resources, and Production," US Energy Information Agency, <https://www.eia.gov/maps/maps.php>.

Paul W. Parfomak, "Oil and Gas Pipeline Infrastructure and the Economic, Safety, Environmental, Permitting, Construction, and Maintenance Considerations Associated with That Infrastructure," Congressional Research Service, June 14, 2016, <https://crsreports.congress.gov/product/pdf/TE/TE10011>.

"Marcellus Matters: Engaging Adults in Science and Energy," Penn State University College of Earth and Mineral Science, 2016, <https://www.e-education.psu.edu/marcellus/>.