



Carbon Dioxide Pipelines: Safety Issues

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Carbon dioxide (CO₂) pipelines are essential components of carbon capture and storage (CCS) systems which are proposed to reduce atmospheric emissions of man-made CO₂, a greenhouse gas. Pipelines are needed to transport the CO₂ from where it is captured (e.g., power plants) to the underground geologic formations where it can be stored. Approximately 5,000 miles of pipeline already carry CO₂ in the United States, primarily linking natural CO₂ sources to aging oil fields where the CO₂ is used for enhanced oil recovery. However, a much more expansive CO₂ pipeline network could be needed for CCS to meet national goals for greenhouse gas reduction. One recent study suggests that such a network could total some 66,000 miles of pipeline by 2050, requiring some \$170 billion in new capital investment. Because CO₂ in high concentrations can be hazardous to human health, building out a national CO₂ pipeline network raises safety issues which may affect nearby communities and may hinder CCS deployment.

CO₂ Pipeline Safety

CO₂ occurs naturally in the atmosphere and is produced by the human body, so it is often perceived to be relatively harmless. However, as concentrations increase, CO₂ displaces oxygen—which may cause a range of negative health impacts, including suffocation. Pipeline CO₂ also may contain potentially hazardous contaminants, such as hydrogen sulfide. Because CO₂ is colorless, odorless, and heavier than air, an uncontrolled release may spread undetected near the ground or in confined spaces. Therefore, CO₂ pipelines pose a public safety risk, as demonstrated by a 2020 CO₂ pipeline rupture in Sartoria, MS, which led to a local evacuation and caused 45 people to be hospitalized.

Transporting CO₂ in pipelines is similar to transporting fuels such as natural gas and oil; it requires attention to pipeline design, protection against corrosion, monitoring for leaks, and safeguards against overpressure, especially in populated areas. The Pipelines and Hazardous Materials Safety Administration (PHMSA) within the Department of Transportation (DOT) has statutory authority over CO₂ pipeline safety. PHMSA promulgates and enforces regulations (49 C.F.R. §190, 195-199) for the construction, operation and maintenance, and spill response planning for CO₂ pipelines. Although CO₂ is listed as a Class 2.2 (non-flammable gas) hazardous material under DOT regulations, PHMSA currently applies safety requirements to CO₂ pipelines similar to those for pipelines carrying hazardous liquids such as crude oil and anhydrous ammonia.

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Prior to the Satartia accident, according to PHMSA statistics, CO₂ pipeline operators reported only one injury and no fatalities caused by regulated pipelines over the last 20 years. However, stakeholders have argued that PHMSA's regulations for CO₂ pipelines are insufficient with respect to hazard zones around CO₂ releases, potential pipeline fractures, and corrosion of CO₂ pipeline steel, among other things. In response to these criticisms and findings from its own Satartia accident investigation, PHMSA announced on May 26, 2022, a rulemaking to update its CO₂ pipeline safety standards and a research solicitation to study the impact of CO₂ pipeline releases. The agency also issued a Notice of Proposed Violation of its regulations to the Satartia pipeline operator and proposed \$3.9 million in civil penalties.

CO₂ Pipeline Opposition

Concerns about CO₂ pipeline safety have emerged as an issue for proposed CCS projects, especially in the Upper Midwest. Summit Carbon Solutions is pursuing a project to carry CO₂ from over 30 ethanol plants in five states through a 2,000-mile pipeline network to a carbon storage site in North Dakota. Navigator CO₂ Ventures is developing a similar project to transport CO₂ from ethanol and fertilizer plants in five states through a 1,300-mile pipeline network to sequestration sites in Illinois. Wolf Carbon Solutions has proposed a third, 350-mile CO₂ pipeline project in Iowa. These pipelines face opposition among affected landowners and advocacy groups for reasons including risks to public safety. As a consequence, the developers reportedly have faced resistance securing voluntary agreements with landowners for pipeline rights-of-way through their properties. Without voluntary agreements, developers may still secure rights-of-way through eminent domain authority, which typically accompanies siting permits from state utility regulators with jurisdiction over CO₂ pipeline siting. However, CO₂ pipeline siting authorities, landowner rights, and eminent domain laws reside with the states and vary from state to state, so securing rights-of-way for interstate projects is not guaranteed. Furthermore, there have been regulatory interventions and legislative efforts to limit state eminent domain authority for such projects.

Considerations for Congress

Consistent with other federal initiatives to promote CCS deployment, Congress has acted to facilitate the construction of regional CO₂ pipeline networks. The USE IT Act (Section 102 of Division S of P.L. 116-260) clarified CO₂ pipeline eligibility for streamlined review of any necessary federal permits (e.g., for federal lands) which might be required and directed the Council on Environmental Quality to set guidance to expedite CO₂ pipeline development. The Infrastructure Investment and Jobs Act (P.L. 117-58) establishes a Carbon Dioxide Transportation Infrastructure Finance and Innovation (CIFIA) program for CO₂ pipelines and authorizes \$2.1 billion over five years for low-interest CIFIA loans and grants. These acts and other legislative proposals deal primarily with financial and administrative issues, however, rather than CO₂ pipeline safety.

Given the fundamental need for pipelines in CCS systems, actual or perceived safety risks associated with CO₂ pipelines may limit the potential of CCS as a greenhouse gas mitigation option. Siting opposition due to safety concerns may prevent CO₂ pipeline development in certain localities and increase development time and costs in others. Some advocates have suggested that Congress take a more active role by directing federal agencies to develop safety regulations specifically tailored to the distinct characteristics of CO₂ pipelines. How PHMSA might update its CO₂ pipeline safety standards remains to be seen, but CO₂ pipeline safety, and its implications for CCS deployment, may be an oversight issue for Congress.

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