

Pennsylvania

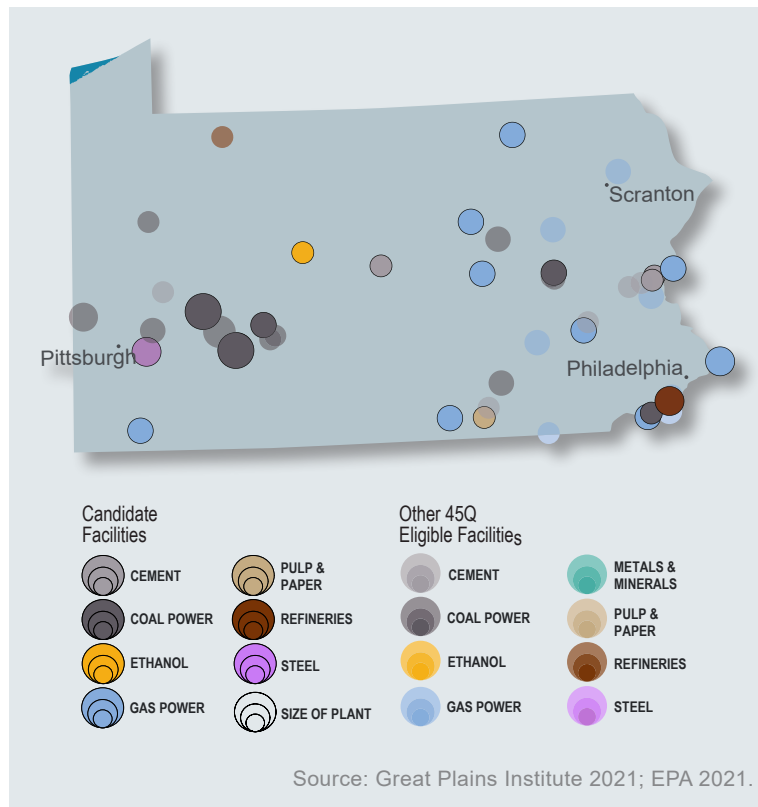
IMPLEMENTING CARBON CAPTURE AND STORAGE TECHNOLOGY

KEY TAKEAWAYS

- Pennsylvania has the estimated capacity to store roughly 2.4 billion metric tons of CO₂ through geologic storage.
- The 47 facilities that qualify for 45Q in Pennsylvania are responsible for nearly 85 percent of the state's industrial and power sectors' emissions.
- Pennsylvania is the fifth-highest CO₂ emitting state, primarily due to its prominence in the coal and natural gas field.
- The 22 facilities that have been identified as potentially economically feasible near-term candidates for carbon capture retrofit have the combined potential to capture almost 35 million metric tons of CO₂ annually.

Figure 1 (Right): Pennsylvania has several facilities large enough to qualify for the 45Q carbon capture tax credit, including cement, coal, and gas power plants. Facilities identified by the Regional Carbon Capture Deployment Initiative as potential early candidates for capture retrofit based on emissions, equipment, and estimated capture cost, are shown with outlines and darker colors. Details on these facilities are listed in the table below.

SOURCES BY INDUSTRY & VOLUME



POTENTIAL CANDIDATE FACILITIES FOR CAPTURE WITH ANNUAL EMISSIONS

Facility Name	Total Facility CO ₂ Emissions thousand tons	CO ₂ Captured Target thousand tons	Estimated Capture Cost \$/ton
6 Coal Power Plants	25,163	17,200	\$58 to \$69
9 Gas Power Plants	16,350	13,000	\$64 to \$66
3 Cement Facilities	2,225	1,866	\$60 to \$63
1 Steel Facility	3,639	1,208	\$86
1 Pulp and Paper Facility	392	1,000	\$68
1 Ethanol Facility	519	360	\$17
1 Refinery	1,448	334	\$73

Table 1: The Regional Carbon Capture Deployment Initiative estimated theoretical facility capture costs based on published capture equipment costs, facility-specific operational patterns, existing equipment and level of emissions. Most states have a large number of facilities eligible for 45Q. Of those facilities, the above table lists likely economically feasible candidates based on estimated capture cost. This list is not meant to be definitive. Commercial decisions by participating companies, and policy and regulatory decisions by state governments, will ultimately determine if a project is feasible for carbon capture. Captured Emissions refers to the amount of carbon dioxide that can be expected to be captured at a facility considering relevant technological and economic constraints. Source: GPI 2021; EPA 2021.

The **Regional Carbon Capture Deployment Initiative** brings together state officials with diverse industry, NGO, labor, and other stakeholders to promote broad scale deployment of infrastructure for carbon capture, CO₂ pipelines, enhanced oil recovery (EOR), other forms of geologic storage, and beneficial utilization of CO₂ in the Western and Midwest regions of the country.

The Initiative is staffed by the Great Plains Institute (GPI), a nonpartisan, nonprofit working to transform the energy system to benefit the economy and environment. For more information on this effort, go to carboncaptureready.org or contact Patrice Lahlum at plahlum@gpisd.net.

Maps and graphics within this document are based on work by the Great Plains Institute (GPI) to help the Regional Carbon Capture Deployment Initiative identify facilities that qualify for the federal 45Q tax credit and are optimal near-term investment opportunities for carbon capture for each state. For more information, visit carboncaptureready.org.

LEGISLATIVE CONTEXT

Pennsylvania recognizes the critical role that carbon capture will play in achieving its emissions goals while also creating and maintaining a strong economy, and has begun to explore the feasibility of carbon capture in the state. The Pennsylvania Climate Change Act of 2008 required a report considering the economic opportunities of carbon sequestration. Furthermore, Act 129, which passed in 2008, required a report on the potential for geologic carbon sequestration. These reports found favorable results for carbon capture and storage potential in the state. The reports built on partnerships such as the Midwest Regional Carbon Sequestration Partnership, for which Pennsylvania served as a contributing member for nearly two decades. Pennsylvania is also on track to join the Regional Greenhouse Gas Initiative (RGGI), a regional cap and invest program. The state sees carbon capture as a pathway to meet the goals of RGGI and its own emissions goals laid out in their 2018 Climate Action Plan. The Governor's Inter-Agency CCUS Work Group is coordinating the state's efforts.

CAPTURE AND STORAGE POTENTIAL

As the fifth highest CO₂ emitter in the nation, Pennsylvania holds substantial promise for capturing carbon. Twenty-two facilities in the state identified as potentially economically feasible near-term candidates for carbon capture retrofit have combined potential to capture nearly 35 million metric tons (MT) of CO₂ per year. Much of this potential comes from the state's cement and power sectors. Three of the state's eight 45Q eligible cement plants have combined potential to capture 1.9 million MT of CO₂ annually. Pennsylvania is also a powerhouse as the third-largest energy supplier in the nation, primarily due to its prominence in the coal and natural gas fields. Of the state's 15 45Q-eligible coal power plants, five have been identified as potential near-term candidates with combined potential to capture 16.4 million MT of CO₂ each year. Additionally, natural gas use is on the rise in Pennsylvania, with natural gas generating 36 percent of the state's electricity in 2018. The state has 18 45Q eligible natural gas power plants, nine of which were identified as near-term candidates with combined capacity to capture an estimated 13 million MT of CO₂ per year.

Much of the state's natural gas comes from the Marcellus Shale. The Marcellus shale not only acts as a source of natural gas, but also holds potential for geologic storage of captured carbon. A 2009 technical assessment by the Department of Conservation and Natural Resources found that Pennsylvania has estimated capacity to store 2.4 billion MT of CO₂ and support a network for sequestration in various geologic formations, particularly in well-established areas of oil and gas production.

REGIONAL CAPTURE OPPORTUNITIES

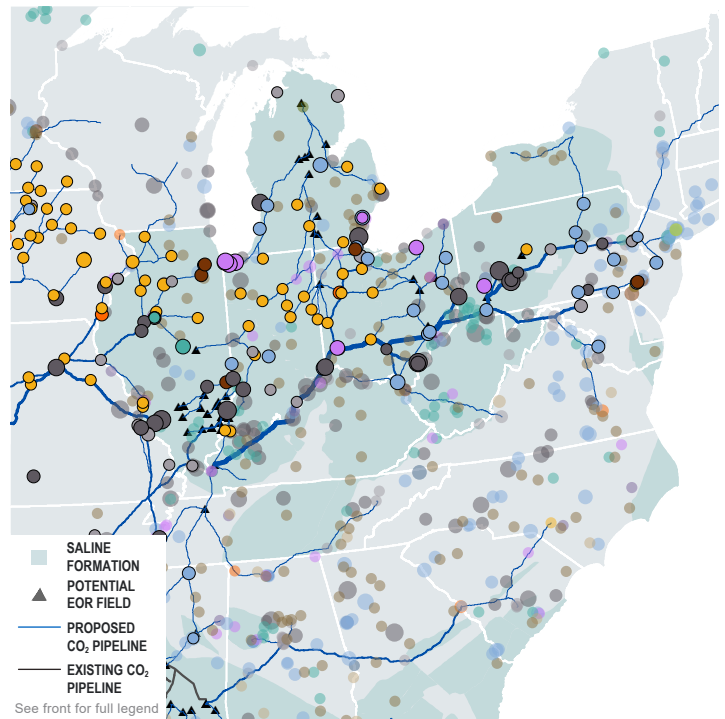
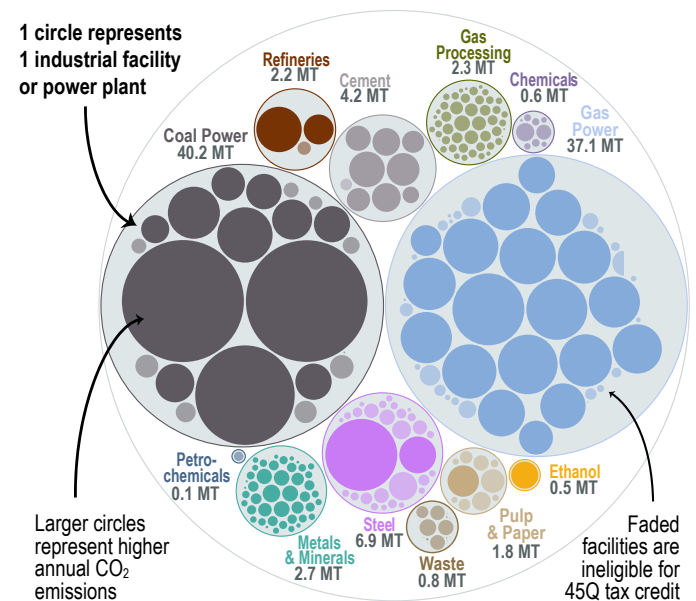


Figure 2: Potential regional CO₂ sources and pipeline corridors for transportation to utilization and storage sites as modeled by the Regional Carbon Capture Deployment Initiative.

FACILITIES AND EMISSIONS BY INDUSTRY



MT: Million metric tons CO₂

Figure 3: This bubble diagram visualizes the number of facilities and corresponding annual CO₂ emissions for each industry in Pennsylvania. The darker large bubbles are eligible for the 45Q carbon capture tax credit, while the faded bubbles are too small to be eligible. The total amount of CO₂ emissions in Pennsylvania is listed for each industry. Source: GPI 2021; EPA 2021.