REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE

Oklahoma

IMPLEMENTING CARBON CAPTURE AND STORAGE TECHNOLOGY

KEY TAKEAWAYS

- Oklahoma was one of the first states to inject anthropogenic, or manmade, CO_2 underground in 1982 and is one of the only states to recognize the potential to reuse stored CO_2 for industrial and commercial applications.
- The state joined the Governors' partnership for Carbon Capture in 2018, a group providing leadership on state level carbon capture deployment and policy.
- There are 29 facilities in Oklahoma likely to be eligible for the 45Q tax credit. Emissions from these facilities account for 85 percent of the state's total emissions.
- Modeling indicates that an additional 480 miles of CO_2 pipelines can be added within Oklahoma and Kansas, creating significant opportunities for Enhanced Oil Recovery (EOR) development, and associated geologic storage within the state.

SOURCES BY INDUSTRY & VOLUME

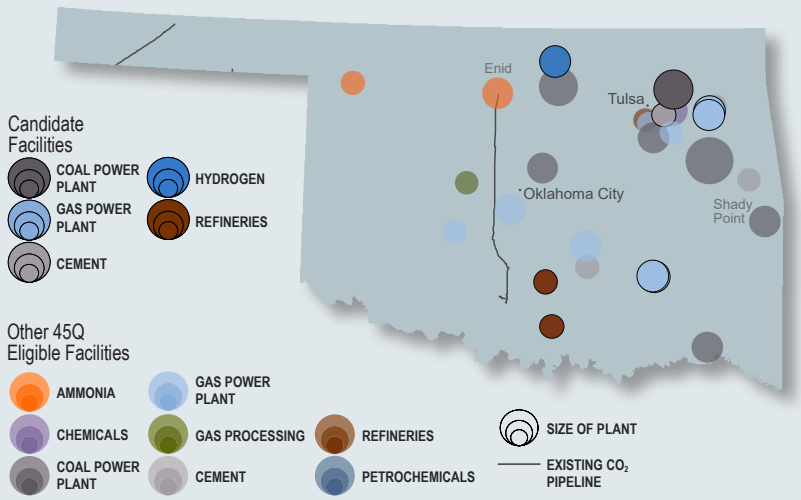


Figure 1: Oklahoma has many facilities large enough to qualify for the 45Q carbon capture tax credit, including coal and gas power plants, gas processing facilities, and petroleum refineries. Facilities identified by the Regional Carbon Capture Deployment Initiative as potential early candidates for capture retrofit based on emissions, equipment, and estimated capture cost, are shown with outlines and darker colors. Details on these facilities are listed below. Two existing capture facilities are also labeled on the map. Source: Great Plains Institute 2019; EPA 2018.

POTENTIAL CANDIDATE FACILITIES FOR CAPTURE WITH ANNUAL EMISSIONS

Facility Name	Location	Industry	Total Facility CO_2 Emissions thousand tons	CO_2 Captured Target thousand tons	Estimated Capture Cost $/ton
Northeastern	Oologah	Coal Power Plant	3,020	1,600	$57
Grand River Dam Authority	Chouteau	Gas Power Plant	1,084	800	$59
Chouteau Power Plant	Pryor	Gas Power Plant	1,101	800	$59
Tenaska Kiamichi Unit 1	Kiowa	Gas Power Plant	1,255	800	$59
Tenaska Kiamichi Unit 2	Kiowa	Gas Power Plant	1,255	800	$59
Eagle Materials	Tulsa	Cement	514	464	$59
Wynnewood Refining	Wynnewood	Refineries	794	456	$59
Valero Ardmore Refinery	Ardmore	Hydrogen	998	268	$67
Phillips 66 Ponca City	Ponca City		1,984	116	$55

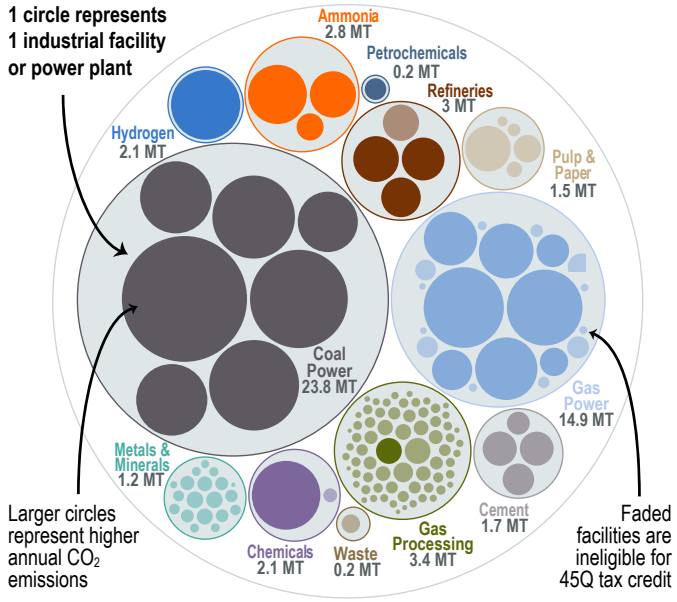
Table 1: The Regional Carbon Capture Deployment Initiative estimated theoretical facility capture costs based on published capture equipment costs, facility-specific operational patterns, existing equipment, and level of emissions. Most states have a large number of facilities eligible for 45Q. Of those 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 2019; EPA 2018.

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**.

LEGISLATION

The state of Oklahoma has provided policy support for carbon capture for over a decade. The Carbon Capture and Geologic Sequestration Act (SB 610, 2009) sets out key principles on the regulation of CO_2 storage, including permitting, property and resource rights, and the respective jurisdictions and powers of the Corporation Commission and Department of Environmental Quality. This legislation also features a unique provision for the potential to recycle CO_2. Since the state of Oklahoma recognizes the capture, recovery and geologic storage of CO_2 will benefit Oklahoma's citizens, and that CO_2 is a valuable commodity to its citizens, the amendment allows for the withdrawal of CO_2 for commercial, industrial or other uses. More recently, former Governor Mary Fallin publicly displayed her support for carbon capture and storage by joining the Governors' Partnership for Carbon Capture in 2018. The Partnership is a bipartisan group of the nation's governors that provides leadership, focus and a stronger state voice for mutual carbon capture policy and deployment priorities.

FACILITIES AND EMISSIONS BY INDUSTRY



MT: Million metric tons CO_2

Figure 3: This bubble diagram visualizes the number of facilities and corresponding annual CO_2 emissions for each industry in Oklahoma. 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 CO_2 emissions in Oklahoma is listed for each industry.
Source: GPI 2019; EPA 2018.

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, CO_2 pipelines, enhanced oil recovery (EOR), other forms of geologic storage, and beneficial utilization of CO_2 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**.

REGIONAL CAPTURE OPPORTUNITIES

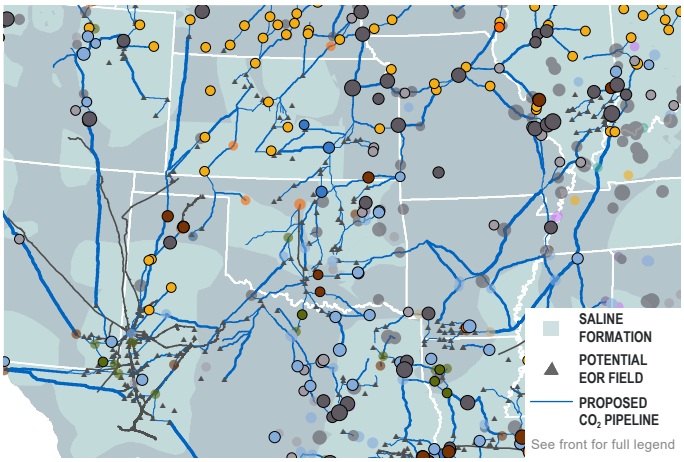


Figure 2: Potential regional CO_2 sources and pipeline corridors for transportation to utilization and storage sites as modeled by the Regional Carbon Capture Deployment Initiative.

CAPTURE AND STORAGE POTENTIAL

Oklahoma is beneficially positioned to incorporate both carbon capture and geologic storage throughout a variety of industrial sectors. As of 2016 there are 29 facilities within Oklahoma that are eligible for the newly revamped 45Q federal tax credit as seen in Figure 1. If all 45Q-eligible coal, cement, and refinery facilities implemented carbon capture technology, and captured 100 percent of their total emissions, they would have the ability to capture nearly 30 million MT of CO_2 emissions, representing over half of the state's total emissions and underscoring the potential for carbon capture to help Oklahoma manage the bulk of its carbon emissions. Oklahoma is the third largest producer of natural gas and the fourth largest crude oil producer in the US. The US Department of Energy (DOE) estimates Oklahoma could produce another 9 billion barrels of oil and potentially up to 20 billion barrels of oil through EOR, adding $1.2 billion annually in gross revenue (at $60 per barrel). Thus, the state is poised to play a crucial role in storing CO_2 from other states via CO_2 pipelines, especially based on the potential for early carbon capture deployment at ethanol plants in nearby states. Several examples of successful deployment of carbon capture and storage technology already exist today in Oklahoma. In 1982, Koch Nitrogen Company's Enid Fertilizer Plant began supplying CO_2 to oil fields. In 2013, Chaparral/CVR Energy's Coffeyville Gasification Plant in Kansas began capturing CO_2 and transporting it to an Oklahoma oil field for EOR.

A recent economic analysis of CO_2 capture, compression, and pipeline transport from Midwestern ethanol plants was undertaken by the Kansas Geological Survey for the CarbonSAFE project. In one of the modeled scenarios, a pipeline network linking ethanol plants throughout nearby states gathers 9.85 million MT of CO_2 annually, routing through Oklahoma to an existing CO_2 pipeline network in the Permian Basin of Texas and New Mexico. This scenario adds to the 480 miles of CO_2 pipelines within Oklahoma and Kansas, with this additional supply of CO_2 going through Oklahoma creating significant additional opportunities for EOR development and associated geologic storage within the state.

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**.