Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Geological Survey (BGS)

The mission of the Bureau of Geological Survey is to collect and disseminate information about the geology of Pennsylvania. We provide sound science to support good decision-making regarding Pennsylvania's geologic resources and environment. Our products are available to government agencies, the private sector and the public. Our work includes many subjects affecting Pennsylvania's physical and economic health – water resources, mineral resources, energy, infrastructure, geologic hazards and the environment. Carbon storage is just one example of the multidisciplinary, applied scientific work we do for the commonwealth.

Carbon Capture Utilization and Storage (CCUS) in Pennsylvania

What is CCUS?

Carbon capture, utilization and storage (CCUS) refers to those technologies, activities and applications associated with the removal of carbon dioxide (CO_2) from the atmosphere for beneficial use applications and/or permanent disposal in porous, subsurface rocks by way of injection wells.

Why is CCUS important?

Full-scale CCUS projects have been successfully deployed, both domestically and abroad, and offer a proven means to permanently dispose of CO_2. Currently, about 31 million tonnes of CO_2 is injected annually for CCUS applications around the world.

Experts agree that climate change mitigation requires the deployment of a multi-disciplinary portfolio of policies and technical approaches that will work together to reduce and eventually eliminate carbon emissions to the atmosphere. CCUS is an integral component of such an approach for achieving decarbonization by the mid-21st century.

CCUS will be necessary for meeting emission reductions in power, industry and other sectors, not only because of the relatively large storage volumes afforded by many subsurface geologic units but also because CCUS provides industrial emitters (e.g., cement and steel) a pathway to eliminate CO_2 emissions when decarbonization cannot be achieved solely by fuel-switching.

What is Pennsylvania's experience in the CCUS arena?

Since 2003, the Department of Conservation and Natural Resources (DCNR) and its Bureau of Geological Survey (BGS) have been committed to finding geologic solutions to climate change. Many of these technical research efforts have been regionally focused, whereas others concentrated specifically on Pennsylvania. Based on this work, we know that:

- Pennsylvania has significant and varied geologic resources that could be used to beneficially use and/or permanently store CO_2;
- Stacked storage opportunities (i.e., multiple storage reservoirs at different depths) may be needed to accommodate carbon emissions in a given area, and would minimize the footprint of surface operations; and
- Technical, regulatory and stakeholder coordination will be required as part of a larger, comprehensive climate change mitigation strategy to ensure the responsible management of the commonwealth's terrestrial and geologic natural resources.

What else do we need to know to deploy CCUS here in Pennsylvania?

Deep geology – Pennsylvania's geology has been tapped for oil, gas, coal and mineral resources for more than a century. Most of this activity has focused on rock units a mile or less deep. To understand the full potential of Pennsylvania's subsurface geology from a carbon storage perspective, we must investigate the deep subsurface (~5,000 to ~20,000 feet) in the western and north-central portions of the state using remote sensing techniques and deep drilling, coring and logging methods. To be sure, these characterization methods are pricy and only get more expensive the deeper the area of investigation is, so securing funding and/or data sharing from external sources (e.g., the federal government and industry partners) will be vital.

Pore space access – Despite the findings and recommendations in DCNR's 2009 carbon storage technical assessment reports, there remains a lack of clarity regarding access to pore space for carbon injection and storage. Severance of surface and subsurface ownership complicates matters here in Pennsylvania, as do the related legal and liability issues that come along with injecting gases underground.

Regulatory guidance – The Pennsylvania Department of Environmental Protection (DEP) has not accepted primacy for of the U.S. Environmental Protection Agency (EPA)'s Underground Injection Control (UIC) Program. This means that operators wanting to permit injection wells must go through a permitting process with EPA as well as with DEP Bureau of Oil and Gas Management. Technical guidance documents or some other way of clearly communicating the processes for permitting and operating injection wells, particularly those that would dispose CO_2 here in Pennsylvania, will be essential.

What CCUS activities are currently happening in Pennsylvania?

CCUS Inter-Agency Work Group – This work group was established by the Wolf Administration in October 2019 and is comprised of representatives from DCNR, DEP and the Department of Community and Economic Development (DCED). We offer industry and stakeholders streamlined access to the technical, regulatory and economic professionals committed to supporting emerging CCUS projects and the commonwealth's climate mitigation goals. Two examples of this initiative in action are the Keystate and CoalFIRST projects (see below).

CO_2 Transport Infrastructure Action Plan – Pennsylvania is one of seven states supporting a memorandum of understanding (MOU) for the preparation of a regional CO_2 transport infrastructure action plan. This work began on October 1, 2020 and will continue through September of this year. By cooperating in this multi-state venture, Pennsylvania seeks to drive responsible infrastructure placement (including pipelines and geologic storage hubs) for the greater Appalachian region.

Keystate Natural Gas Synthesis Project (Clinton County) – Keystate seeks to demonstrate a low-carbon future for Pennsylvania and a pathway to the hydrogen economy with this project, expected to initiate commercial operations in 2024/2025. The project will use onsite natural gas to manufacture blue hydrogen, blue ammonia and blue nitrogen products while capturing and storing CO_2 emissions in deep geologic formations below the site.

CoalFIRST Power Plant (Washington County) – CONSOL Energy recently received funding from the U.S. Department of Energy (DOE) to build and deploy an advanced pressurized fluidized bed combustion (PFBC), carbon-negative, coal-based power plant in southwestern Pennsylvania. This innovative, modular plant has the potential to capture ~2.2 million tons of CO_2 annually, which CONSOL intends to dispose in deep geologic formations underlying the facility. BGS will be supporting this project over the next three years by providing geologic expertise for the identification and assessment of deep rock units that may be capable of storing these emissions.

Midwest Regional Carbon Initiative (MRCI) Project – Pennsylvania is a collaborating member in this new regional initiative, which is funded by DOE and represents 20 states across the Midwest and Northeast U.S. BGS is one of many geological surveys tasked with preserving and advancing the important geologic mapping, characterization and communication efforts to accelerate CCUS deployment in the Appalachian region and beyond. Work commenced in 2019 and will continue through at least 2024.

What can CCUS mean for Pennsylvania?

CCUS is not only an environmental imperative for decarbonization but also an economic opportunity for Pennsylvania. CCUS stands to offer job security to existing industries and give rise to innovative, new industries such as hydrogen. By implementing CCUS technologies, Pennsylvania's electricity generators, fossil fuel producers and processors, and high-emitting industries will be poised not only to survive the transition to a decarbonized future but also thrive in a zero-carbon economy.