Geologic Carbon Storage

Dedicated geologic storage involves injecting CO₂ into rock formations deep underground, where it remains stored for tens of thousands of years. It is a critical climate technology and will be essential to scaling technological carbon removal.

Geologic storage can be paired with a variety of processes, including industrial and power operations. It is estimated that the US currently has billions of tons of capacity for geologic storage, totaling more than 5,000x its 2018 CO₂ emissions. Current estimates for the costs of geologic storage range from $1 to $18 per ton of carbon dioxide.

How does geologic storage work?

**Step 1: Site Selection**
A geologic site is selected based on a set of criteria (see right) that will ensure storage is long term and secure.

**Step 2: Capture**
CO₂ is captured from the air by direct air capture plants.

**Step 3: Transportation**
Captured CO₂ is compressed and transported through pipelines to the selected geologic site.

**Step 4: Storage and Monitoring**
Captured carbon is injected deep underground. Post-injection monitoring, reporting, and verification (MRV) is important to ensure carbon does not leak into the air or nearby water systems.

**SITING CONSIDERATIONS**

- **Injectivity**
  Rate at which CO₂ can be injected underground

- **Storage resource**
  Amount of space a site has to hold CO₂

- **Integrity**
  Ability of a site to hold CO₂ safely without a leak

- **Depth**
  Distance downward a storage site must have to properly hold CO₂ at a certain pressure

**REDUCING VS. REMOVING**

Geologic storage can help reduce CO₂ emissions or result in permanent carbon removal. Whichever system it’s applied to, geologic storage ensures carbon won’t be released back into the atmosphere.

- **Carbon Capture**
  An emissions reduction technology that captures CO₂ from large point sources (like power plants), preventing it from entering the atmosphere.

- **Carbon Removal**
  A suite of climate mitigation practices and technologies, like direct air capture and carbon storage (DACCS), that remove CO₂ from the ambient air.
CONSIDERATIONS

Underground injection and geologic storage are not new — the process for geologic storage builds on practices and technologies that have been widely used for decades in oil and gas production.

However, there are potential risks to environmental and human health associated with geologic storage. The CO₂ injection process could potentially cause earthquakes, ground heaving, and effects on underground minerals while CO₂ leakage risks groundwater and drinking water contamination. These possibilities are all relatively low risk, but further research is needed to better understand them.

Increased investment in research and development (R&D) as well as the establishment of widely accepted oversight and regulations can protect public health and address safety considerations surrounding geologic storage.

REFERENCES

- Capturing Leadership: Policies for the US to Advance Direct Air Capture Technology, Rhodium Group
- Carbon Dioxide Capture and Sequestration, EPA
- Carbon Storage Assurance Facility Enterprise (CarbonSAFE), NETL
- Carbon Storage FAQs, NETL
- CO₂ Storage Resource Methodology, NETL
- Injection and Geologic Sequestration of Carbon Dioxide, CRS
- Negative Emissions Technologies and Reliable Sequestration, National Academies of Sciences, Engineering, and Medicine
- The Concept of Geologic Carbon Sequestration, USGS
- The US Section 45Q Tax Credit for Carbon Oxide Sequestration, Global CCS Institute
- The 2020 Omnibus Bill Elevated Carbon Removal Like Never Before, Carbon180
- U.S. Energy-Related CO₂ Emissions Rose In 2018 For The First Year Since 2014, EIA
- The 2020 Omnibus Bill Elevated Carbon Removal Like Never Before, Carbon180
- U.S. Energy-Related CO₂ Emissions Rose In 2018 For The First Year Since 2014, EIA

Current Policy Support

The US has spent decades researching and developing geologic storage technologies and infrastructure. The Department of Energy (DOE) leads federal R&D of geologic storage as part of the Carbon Storage Program. DOE also supports public-private partnerships surrounding geologic storage through its Regional Carbon Sequestration Partnerships (RCSP) Initiative. The Environmental Protection Agency (EPA) also plays an essential role in geologic storage oversight through the Underground Injection Control (UIC) program’s Class VI permit system, established under the Safe Drinking Water Act.

Despite this early support, there remain a number of policy gaps that will need to be addressed as we move to deploy geologic storage at scale, including a need for additional research into potential social and environmental risks, cost-effective MRV for demonstration and deployment, strengthened interagency coordination, and financial support for associated infrastructure.

Several recently enacted and introduced bills include provisions on large-scale carbon sequestration infrastructure and R&D for commercial storage, verification, and piloting. Fiscal year 2021 appropriations allocated $3 million to the UIC Class VI program to expand expertise and capacity to improve the safe and secure geologic storage of carbon. The existing Class VI permit program is backlogged with numerous proposals from state governments and project developers; additional resources are needed to ensure timely, equitable, and safe storage.

H.R. 1512, the CLEAN Future Act, would support geologic carbon sequestration by providing the EPA with additional funding for the Class VI program and provide grants for states to establish their own geologic storage permitting programs. S. 799/H.R. 1992, the SCALE Act, would provide similar regulatory support to the EPA and states, and would also finance shared CO₂ transport infrastructure and provide grants for state and local governments to procure CO₂ utilization products, such as fuels and building materials.