Carbon sequestration

Options for a low-carbon future

As demands from government, industry, and consumers lead a global effort to reduce greenhouse gas emissions, carbon sequestration figures to play an important role in a successful low-carbon future. Carbon sequestration is the deep injection and permanent storage (sequestration) of carbon dioxide (CO_2), primarily from industrial process (pre- or post-combustion), into geologic formations as a pore-filling liquid. These formations include saline formations, depleted oil and gas fields (including potential for enhanced oil and natural gas recovery), and deep coal seams (also providing potential enhanced gas recovery opportunities).

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While carbon sequestration is an expensive venture, when looking at the industrial sector, carbon capture and sequestration provides an opportunity to mitigate potential emissions from some operations that currently have limited to no other pathway toward decarbonization. The success of carbon sequestration, and more specifically, the amount of carbon captured in such ventures, will depend on the economics with the costs per ton of carbon capture varying by industry. The substantial investments already being made demonstrate a significant investment in carbon management and a commitment to the protection of our environment.

What are the risks?

In general, geological storage sites should have adequate capacity, a satisfactory sealing caprock, and a stable geological formation that will withstand any issues that could compromise the integrity of the site.

Risks include, but are not limited to:

- Seismic activity
- Subsidence
- Catastrophic failure of the formation
- Leakage through well failures from either continuous leak or blowouts
- Leakage through abandoned wells, including mapped and unmapped
- Leakage through undetected faults
- Soil or groundwater acidification, including impacts to aquifers or other ecosystems

The viability of an oil or gas field seal rock can be characterized by various testing processes, each of which are crucial for successful geological storage:

- Site characterization
- Selection
- Performance prediction

Testing techniques for characterizing geological storage sites include the following. Soil and groundwater testing and CO_2 monitoring may also be useful for directly detecting CO_2 leakage.

- Seismic imaging
- Pumping tests
- Cement integrity logs

While even accidental leakages from single-point failures like a well blowout can result in extremely large releases to the atmosphere (similar to the Aliso Canyon event in California in 2015), a strong industry/insurance partnership can ensure these risks are underwritten effectively. The economic incentives and viability of carbon sequestration have provided new opportunities, but the science behind such projects has roots far older. The earth has stored oil, natural gas, and even naturally occurring carbon dioxide in underground formations for millions of years (including large volumes in Colorado, Mississippi, New Mexico, Texas, Utah, West Virginia, and Wyoming.

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Why?

There is no one way toward a green energy future.

Liberty aims to support innovation that can significantly impact the pace and design of the transition to a low-carbon economy. We favor a "3-Rs" strategy for our operations' low-carbon transition roadmaps, with preference being given to:

- **Reducing** our emissions through improved efficiency
- Investing in **renewable**/alternative technologies and businesses
- Buying **RECs** (renewable energy credits) and offsets

An important part of this transition, the sequestering of carbon captured before it enters the atmosphere allows industrial operations to mitigate their greenhouse gas emissions and permanently store CO_2 underground for centuries or millennia. According to the 2005 Intergovernmental Panel on Climate Change (IPCC) report on carbon capture and storage, it is "very likely" that 99 percent of stored CO_2 will stay in place over the first 100 years and "likely" that the same percentage would stay in place over 1,000 years. United States Environmental Protection Agency (US EPA) published figures estimate that, in 2019, CO_2 accounted for about 80 percent of all U.S. greenhouse gas emissions from human activities. A study completed by Professor Gary Shaffer conducted with the University of Copenhagen and the University of Concepción in Chile demonstrated that stored gas leaking at 1 percent every 100 years would keep global temperature rise close to 2 degrees Celsius. If leakage is maintained at a 1 percent leak rate every 1,000 years, Shaffer concluded global warming levels would remain at a "manageable" threshold below 2 degrees Celsius — an important threshold and goal as determined by the IPCC founded to assess science related to climate change on behalf of the United Nations.

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A tailored-down version of the Build Back Better Act (BBBA) focuses on the $555 billion in funding dedicated to fighting climate change. These funds include a plan to pioneer facilities that demonstrate carbon capture retrofits for large steel, cement, and chemical production facilities, all while ensuring that overburdened communities are protected from increases in cumulative pollution. In conjunction with the bipartisan SCALE Act, a comprehensive infrastructure package that would support the buildout of CO_2 transportation infrastructure, the plan will support large-scale sequestration efforts that leverage the best science and prioritize community engagement. In order to make the economics work, the plan reforms and expands the bipartisan Section 45Q tax credit, making it direct pay and easier to use for hard-to-decarbonize industrial applications, direct air capture, and retrofits of existing power plants.

What is 45Q?

45Q provides an income tax credit for the following:

- The capture of carbon dioxide from a qualifying industrial facility and its disposal in permanent geological storage (“disposal”)
- Use as a tertiary injectant to stimulate oil and gas production from marginal wells in a process commonly referred to as enhanced oil recovery (EOR)
- Or other utilization in a manner that qualifies under section 45Q(f)(5).

As previously mentioned, provisions included within the BBBA, in conjunction with the funding provided by the Infrastructure Investment and Jobs Act (IIJA), have provided the opportunity to deploy carbon capture at scale by improving the critical lever of U.S. carbon management market development: the 45Q tax credits. The value of the credit derived from section 45Q varies depending on when the carbon capture equipment was originally placed in service and whether the captured carbon was disposed of in secure geological storage, injected in an EOR project, or utilized in an otherwise qualifying commercial way. According to CATF, the world’s leading energy modelers and climate scientists agree carbon capture, removal, use, and storage are required to meet midcentury decarbonization goals.

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The market for industrial applications seeking to use this benefit has increased tremendously following the release of the Internal Revenue Service (IRS) Revenue Ruling 2021-13. The latest IRS guidance seemingly improved confidence in the 45Q program. Economic opportunities tied to carbon sequestration are extensive, with farmers, large industry, contractors, materials suppliers, and many others likely to see benefits. The program and carbon capture, utilization, and sequestration (CCUS) generally are thus prominently featured in President Biden’s job-creating climate strategy.

Section 45Q program highlights include:

(NOTE: This is not tax guidance and only highlights certain sections of program)

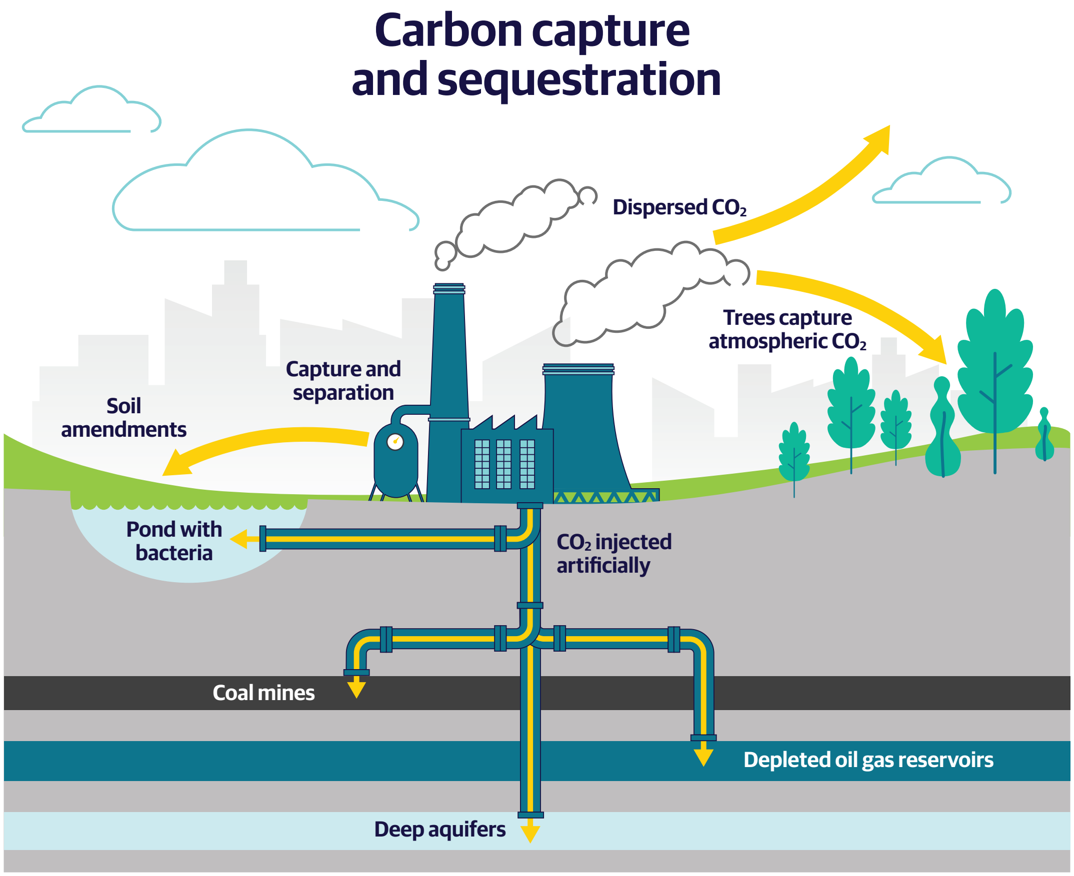
- A credit of the applicable dollar amount per metric ton of qualified carbon dioxide captured by the taxpayer using carbon capture equipment originally placed in service at a qualified facility on or after February 9, 2018
- Tax code Subpart RR and CSA/ANSI ISO 27916:2019 both provide for mass balance accounting methods of accounting for qualified carbon dioxide.
- Under the tax code, the IRS may recapture tax credits if, during the three-year recapture period, carbon dioxide for which a credit has been previously claimed has leaked to the atmosphere — with limited exceptions to recapture provided for volcanic activity and terrorist attacks.

Where?

The oil and gas industry has extensive experience using the injection of carbon dioxide into oil reservoirs for EOR, with millions of tons already injected underground. Mature sedimentary basins may be prime targets for CO_2 storage because:

1. they have well-known characteristics;
2. hydrocarbon pools and/or coal beds have been discovered and produced;
3. some petroleum reservoirs might be already depleted, nearing depletion, or abandoned as uneconomic; and
4. the infrastructure needed for CO_2 transport and injection may already be in place.

The presence of wells penetrating the subsurface in mature sedimentary basins can create potential CO_2 leakage pathways that may compromise the security of a storage site (Celia and Bachu, 2003).



Site characterization, selection, and performance prediction are crucial for successful geological storage.

To support the development of regional infrastructure for carbon capture and storage (CCS), the U.S. Department of Energy (DOE) created a network of seven Regional Carbon Sequestration Partnerships (RCSPs). The RCSP Initiative began in 2003 with characterization of each region's potential to store CO_2 in different geologic formations. The "Characterization Phase" was Phase I of the RCSP Initiative and included cataloging regional CO_2 sources, characterizing CCS prospects, and prioritizing opportunities for future CO_2 injection field projects. The "Validation Phase", initiated through a series of small-scale field laboratory projects, followed in 2005 and included the validation of the most promising regional storage opportunities. This led to the successful completion of 19 small-scale field projects in a variety of storage complexes (8 in oil and gas fields, 5 in unmineable coal seams, 5 in saline formations, 1 in basalt), providing information on reservoir and seal properties of regionally significant formations, testing, and initial validation of modeling and monitoring technologies. The "Development Phase" began in 2008 and turned focus to large-scale field laboratories in saline formations and oil and gas fields with a target of injecting at least 1 million metric tons (MMT) per project. Numerous applied research technologies have been integrated into these projects and the results have been essential in further technology development of CCS.

Site characterization, selection, and performance prediction are crucial for successful geological storage. Before site selection takes place, the geological setting must be characterized to determine if the overlying caprock will provide an effective seal, if there is a sufficiently voluminous and permeable storage formation, and whether any abandoned or active wells will compromise the integrity of the seal.

Techniques developed for the exploration of oil and gas reservoirs, enhanced oil recovery sites, natural gas storage sites, and liquid waste disposal sites can help lead the way in characterizing geological storage sites for CO_2.

CO_2 storage in hydrocarbon reservoirs or deep saline formations is generally expected to take place at depths below 800 meters, where the ambient pressures and temperatures will usually result in CO_2 being in a liquid or supercritical state. A well-sealed caprock over the selected storage reservoir is important to ensure that CO_2 remains trapped underground.

Other economic impacts

The economic impacts of this large-scale carbon sequestration initiative are widespread and will create both opportunities and risks throughout the country. Carbon capture will provide critical regional economic opportunities, creating jobs in communities where industrial operations will need to be retrofitted with carbon capture equipment and connected to new transportation pipelines that will need to be constructed. According to the Rhodium Group, an estimated 64,000 jobs will be created by the capital investment in retrofits for ethanol, hydrogen, cement, refineries, steel, and power generation facilities. Financial agreements between project investors and regional stakeholders, including farmers and other landowners, will create opportunities for residents of areas intersecting these projects. Construction and maintenance will provide continued economic opportunities as well.

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In addition to direct economic incentives, industrial operations that utilize carbon sequestration to reduce or eliminate their carbon emissions will also gain access to other indirect benefits. U.S. Executive Order No. 14030 provides that, where appropriate and feasible, agencies should "give preference to bids and proposals from suppliers with a lower social cost of greenhouse gas emissions." Under the proposed rule, an offeror's greenhouse gas emissions disclosure will be a driver of competition.

By lowering an ethanol plant's carbon emissions for example, the biofuel it produces becomes marketable in states that require low-carbon standards. As a result, ethanol producers have already signed on to various multibillion dollar projects that will cross the Midwest with pressurized carbon dioxide pipelines to carry CO_2 from the Midwest to various injection sites.

Publicized projects already include:

- Estimated $2 billion project to help finance and construct carbon dioxide capture equipment; safely transport the captured CO_2 over a newly built 1,300-mile pipeline network; and permanently sequester 10-15 million metric tons of CO_2 into a safe and secure, underground sequestration site (emissions equivalent to the annual emissions from approximately 3.2 million cars driven)
- Project to connect ethanol plants in Iowa and Illinois to a new pipeline that will deliver 12 million tons of CO_2 per year to be stored almost 8,000 feet underground in Decatur, Illinois
- $4.5 billion project to convert 31 Midwestern partner ethanol facilities to net zero emissions by 2030 on track with plans to transport and permanently store up to 12 million tons of CO_2 every year at a facility in North Dakota

Ironshore Environmental has the capabilities, nimbleness, and flexibility to support this growing market.

Numerous opportunities for insurance industry to evolve to cover new and emerging risks. Ironshore is proud to help!

Ironshore Environmental has the capabilities, nimbleness, and flexibility to support this growing market — we have flexibility in our policy forms to handle the exposures and are working with many of our insureds to help. In addition, past experience with underground geologic storage provides our team with the expertise to understand carbon sequestration projects.We have extensive expertise in the energy industry, including experience with regional carbon sequestration partnerships in various formations and we have and continue to dedicate significant resources to this space. Ironshore Environmental has a broad appetite for this business within both our SPILLS and CELL product lines from construction through operational phases. This could include standard pollution cover, financial assurance, and 45Q tax credit cover. We are also open to considering certain risks on the EPIC (with auto appetite following EPIC). The offerings for each product and coverage point will be evaluated on a risk-by-risk basis.

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