45Q Research Brief

Ensuring the continued success of the American carbon management industry

May 9, 2025

Carbon Capture Coalition

Consultant Contributor: Brown Brothers Energy and Environment LLC

CARBON CAPTURE COALITION

CARBON CAPTURE COALITION

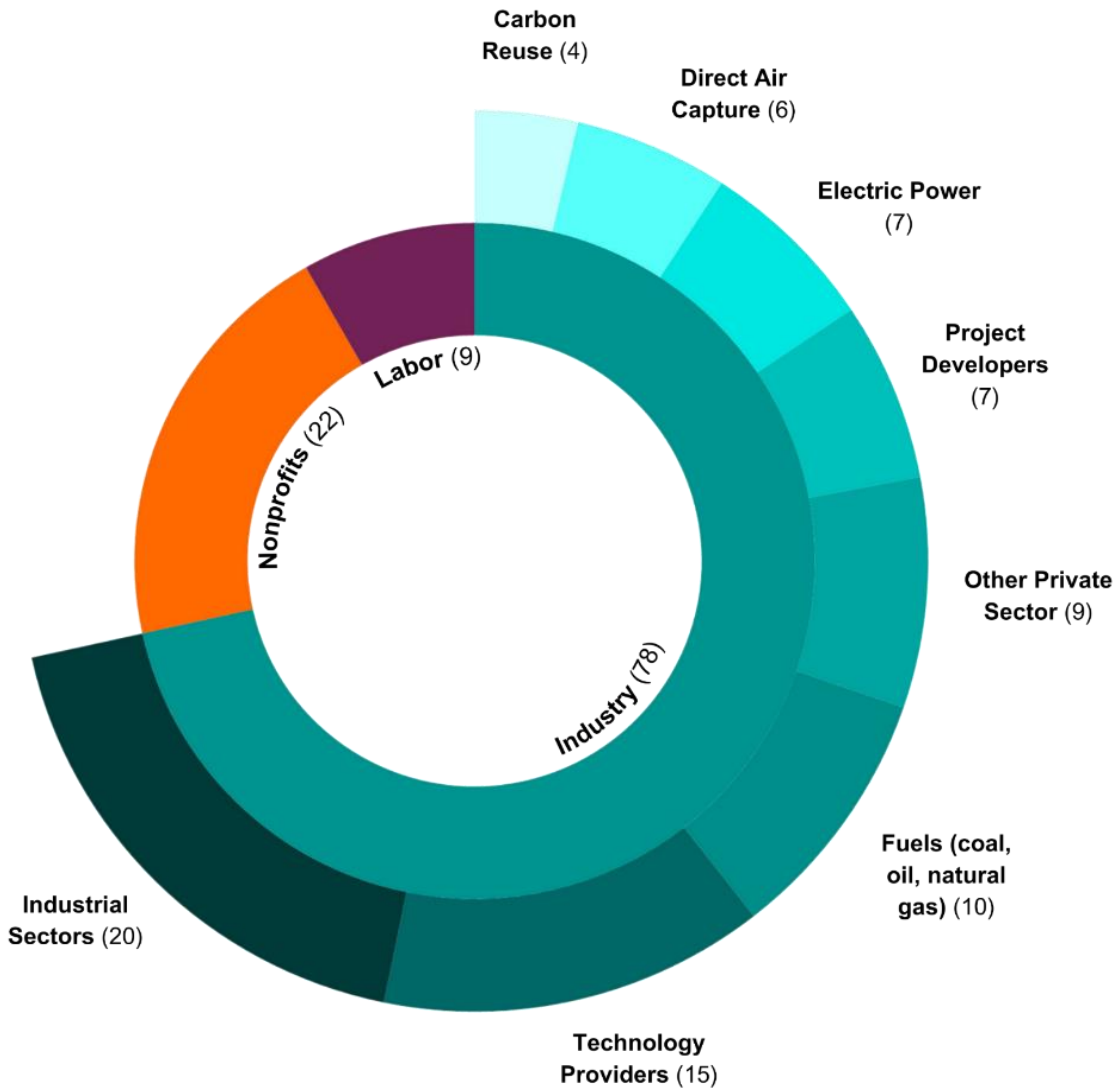
About the Carbon Capture Coalition

Mission

Build broad federal policy support for the nationwide deployment of carbon management technologies.

How We Operate

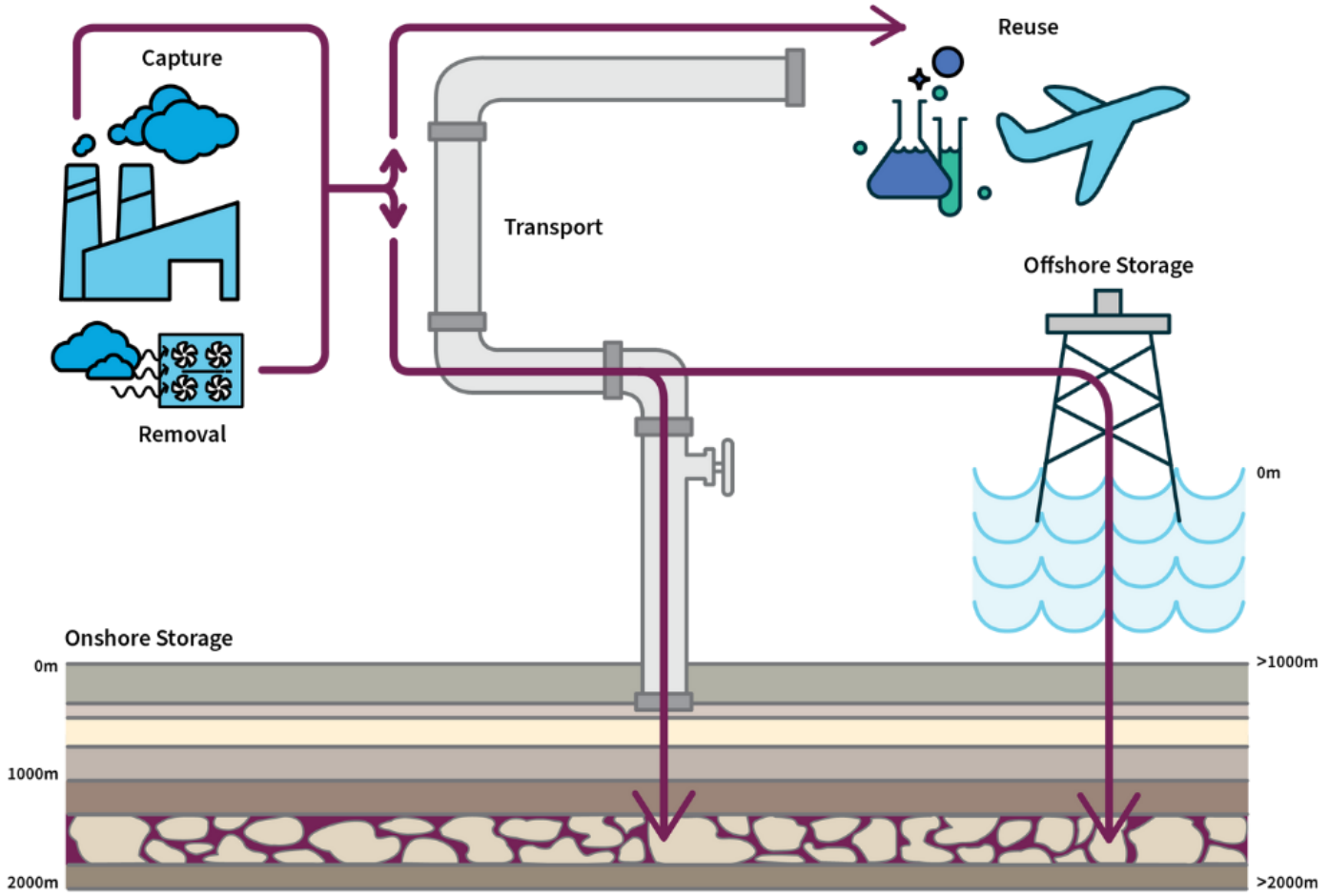
The Coalition achieves maximum impact by grounding our decision-making process in consensus, through which our 100+ members across companies, labor unions, and conservation and environmental organizations weigh in on and ultimately agree on the Coalition's top priorities.



To learn more and view our complete membership list, visit www.carboncapturecoalition.org

About the 45Q tax incentive

45Q is the foundational policy mechanism for the build-out of the domestic carbon management industry and provides a per-metric ton credit for the capture and storage, or reuse, of carbon oxides (CO_2 or CO) from natural gas and coal-fired power facilities, industrial facilities, and directly from the atmosphere.



CARBON CAPTURE COALITION

About the 45Q tax incentive

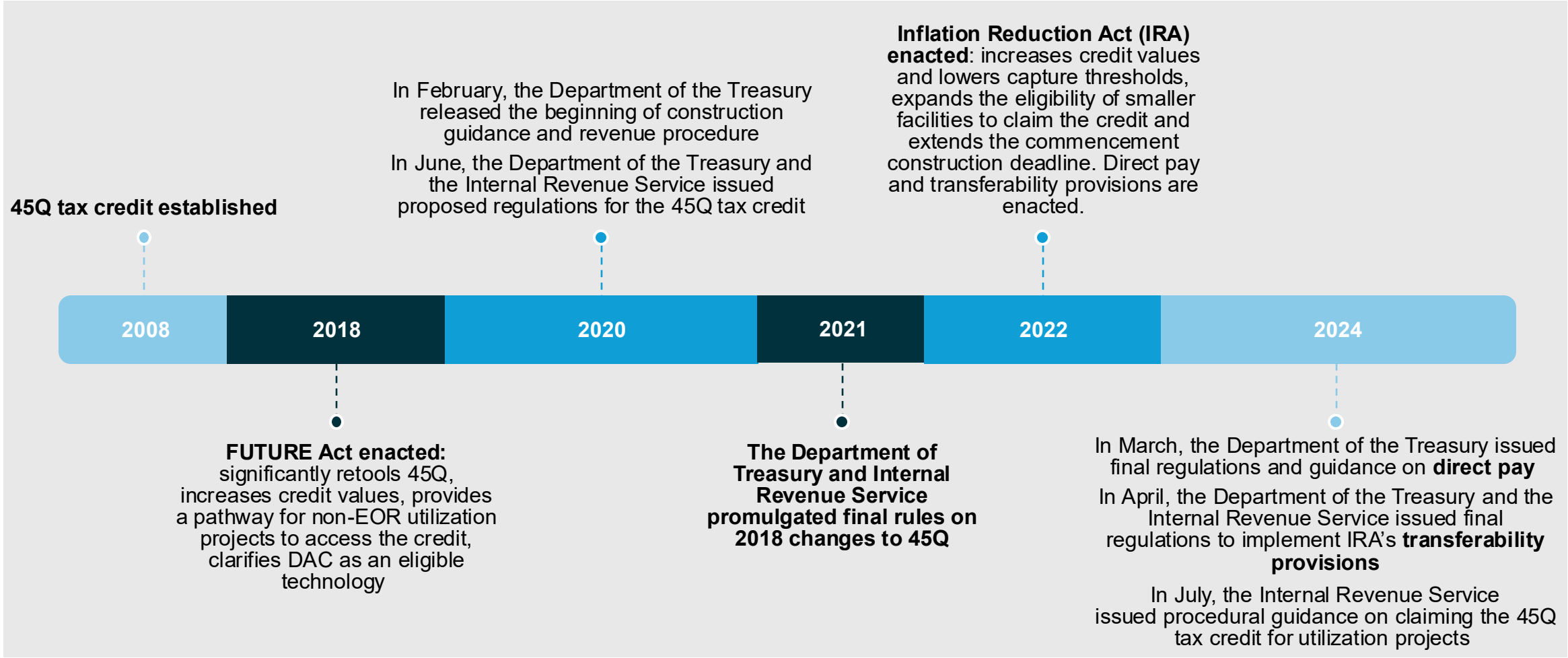
To elect the 45Q tax credit, taxpayers must comply with robust regulatory oversight established by the US Department of the Treasury and the Internal Revenue Service. The US Environmental Protection Agency and the Department of Energy oversee complementary programs that underpin the 45Q tax credit for electing either dedicated geologic storage or carbon reuse.

45Q credit depends on project type and end-use of the captured carbon dioxide:

	For dedicated storage of CO_2 in **saline or other geologic formations**	For **carbon reuse projects** to convert carbon into useful products (e.g., fuels, chemicals, products)	For secure geologic storage of CO_2 in **oil and gas fields**
Industry & Power	$85/metric ton	$60/metric ton	$60/metric ton
Direct Air Capture	$180/metric ton	$130/metric ton	$130/metric ton

45Q provides an important market signal for commercial deployment

Timeline of 45Q implementation

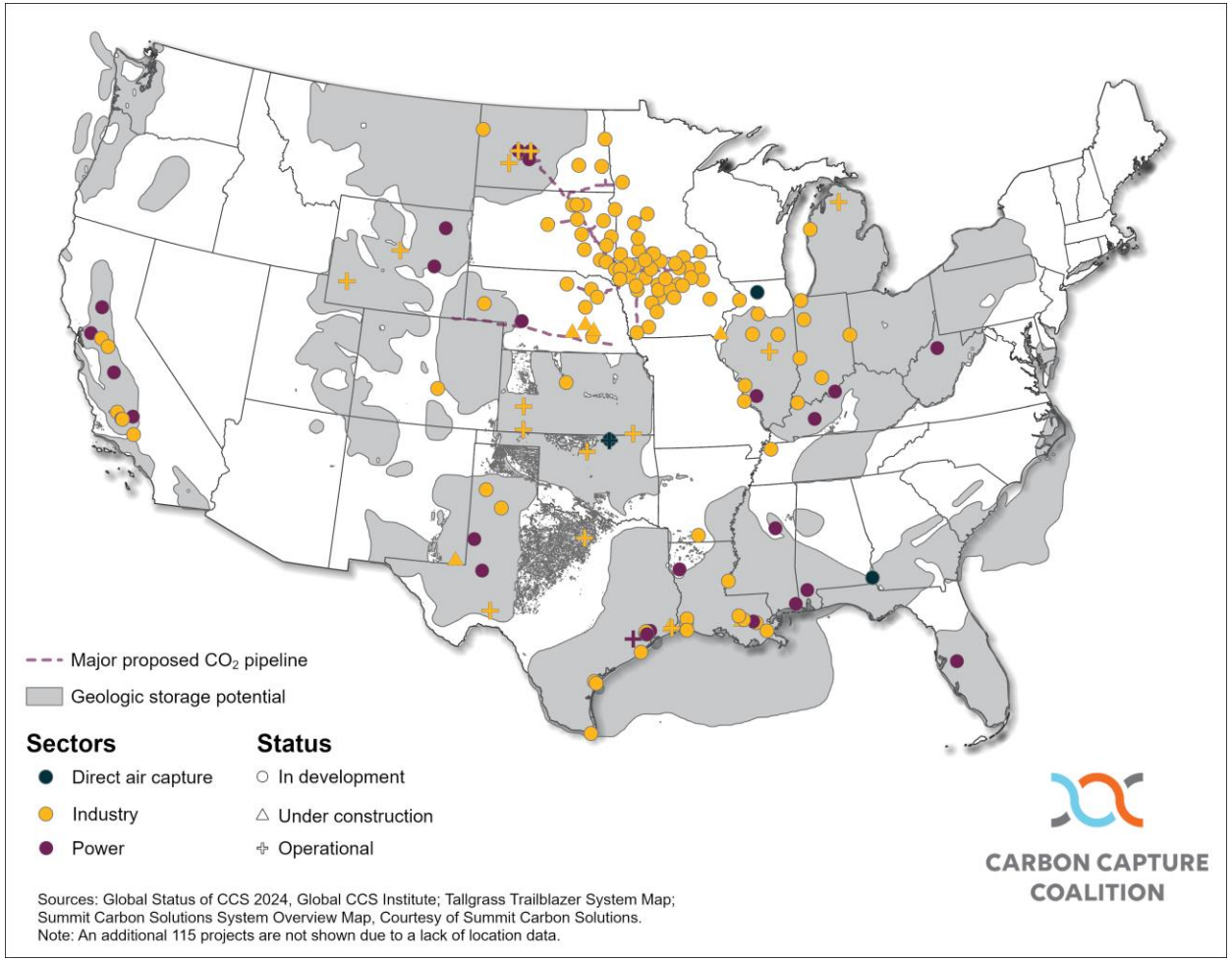


45Q is the foundation for nationwide deployment

Today, thanks to the bipartisan-supported 45Q tax credit and subsequent enhancements to the credit over its history, there are now **more than 270 announced carbon management projects**—across US emitting sectors and regions.

Over **190 of these projects** have been announced since the 2022 enhancements to the tax credit.

Announced domestic carbon management projects

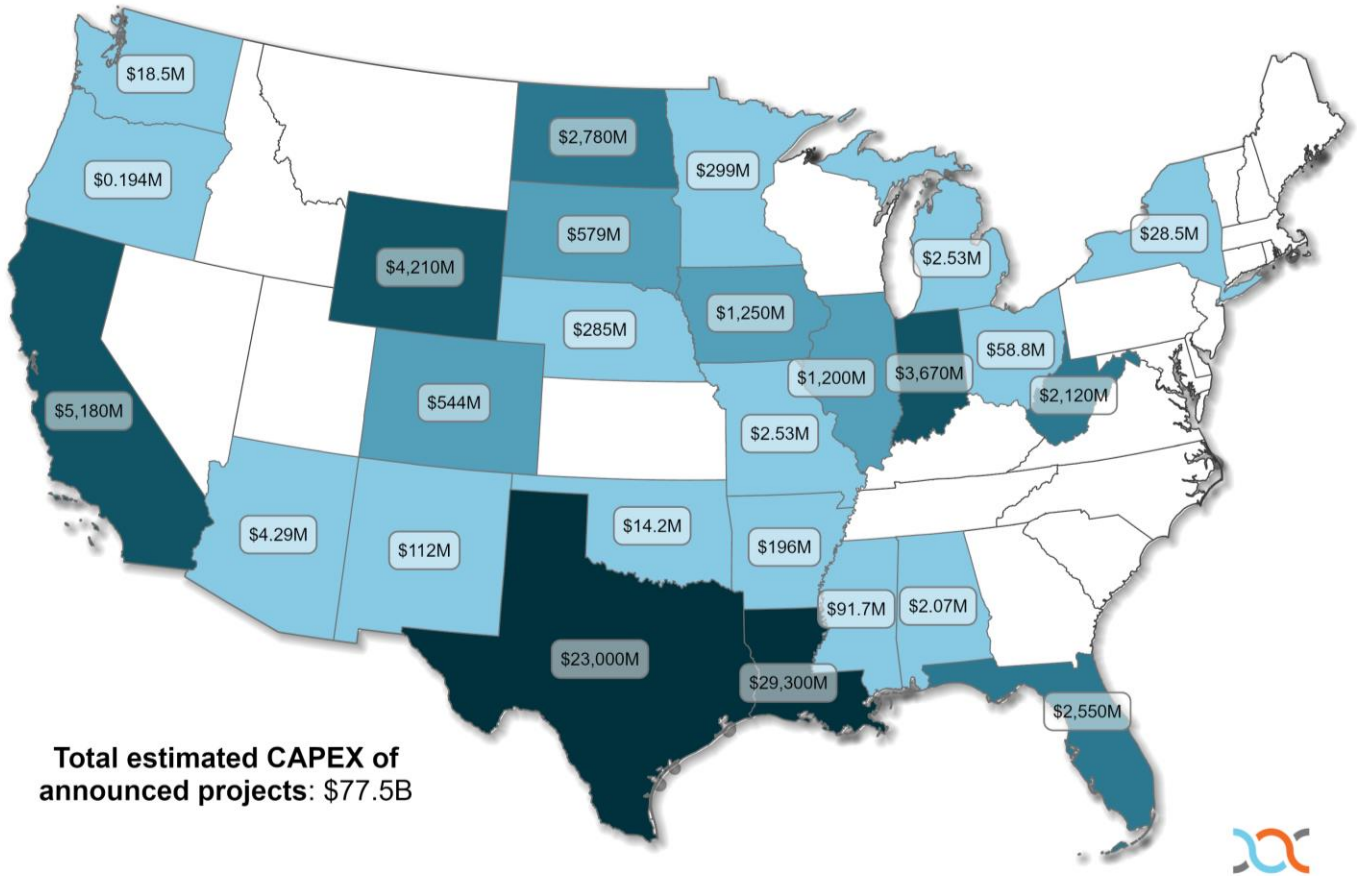


45Q is already driving investments

45Q continues to deliver the appropriate market signal for projects to deploy across the nation. It is clear that the credit is critical to ensuring that these announced projects put steel in the ground and become operational.

Providing a strong 45Q ensures that the estimated $77.5 billion in capital expenditures (CAPEX) already invested by project developers will translate into operating carbon management projects, corresponding jobs, and additional economic benefits.

Total estimated capital expenditures of announced carbon management projects through the end of 2024



Total estimated CAPEX of announced projects: $77.5B

Source: Estimated CAPEX for announced projects in carbon management and related projects. Q4 2016 through Q4 2024. Clean Investment Monitor. Accessed 5/7/2025.
Note: Alaska and Hawaii do not have actual investments reported.

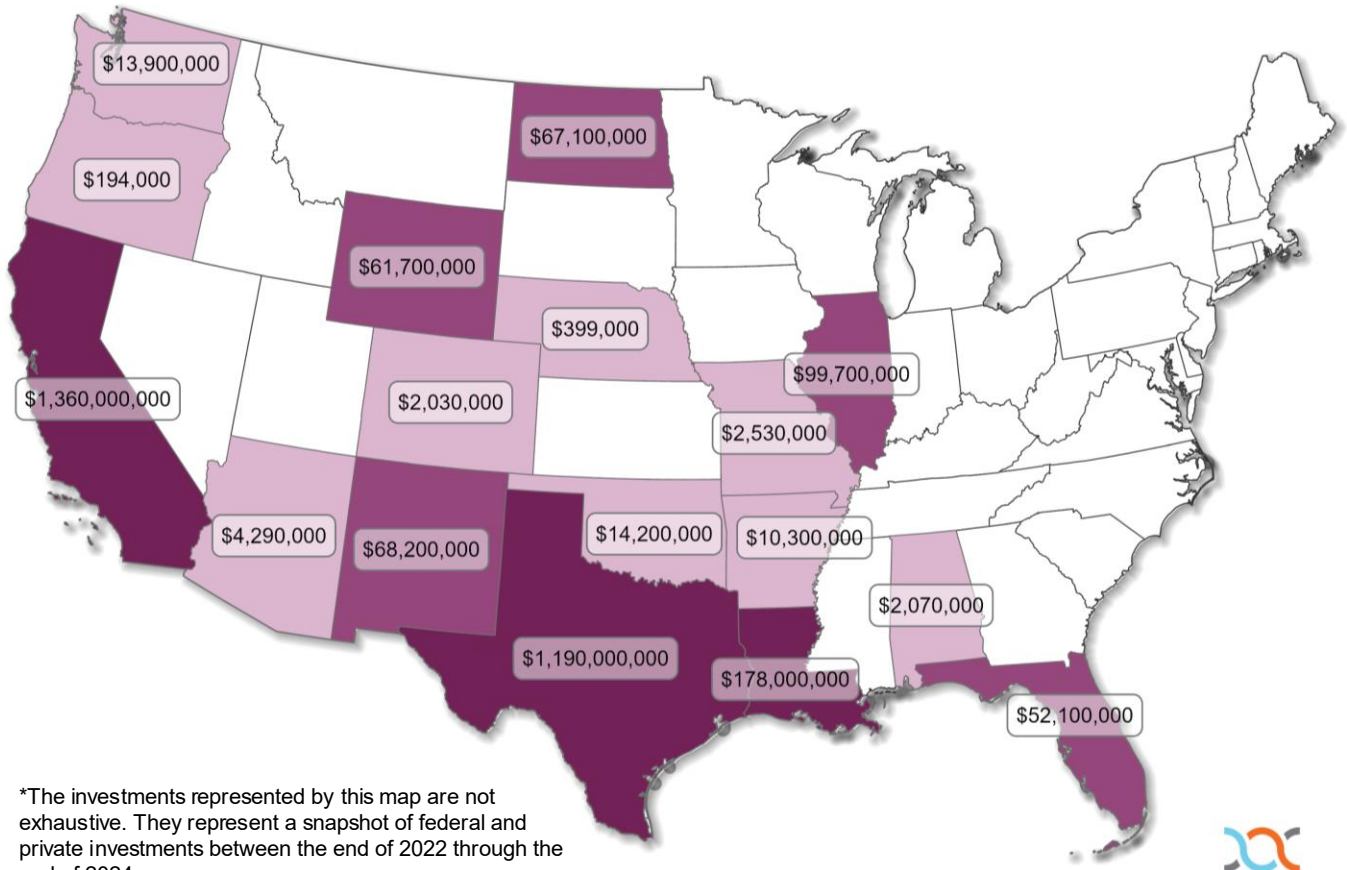
CARBON CAPTURE COALITION

45Q is already driving investments

45Q is a key economic driver across the country, with project announcements already translating to billions of dollars in combined private and federal investment across states and regions.

These federal and private domestic investments are key to driving US leadership in carbon management innovation and creating and sustaining jobs for American families.

Federal and private domestic investments in carbon management between a two-year period*



*The investments represented by this map are not exhaustive. They represent a snapshot of federal and private investments between the end of 2022 through the end of 2024.

Source: Actual investments in carbon management and related projects. Q4 2022 through Q4 2024. Clean Investment Monitor. Accessed 5/7/2025.
Note: Alaska and Hawaii do not have actual investments reported.

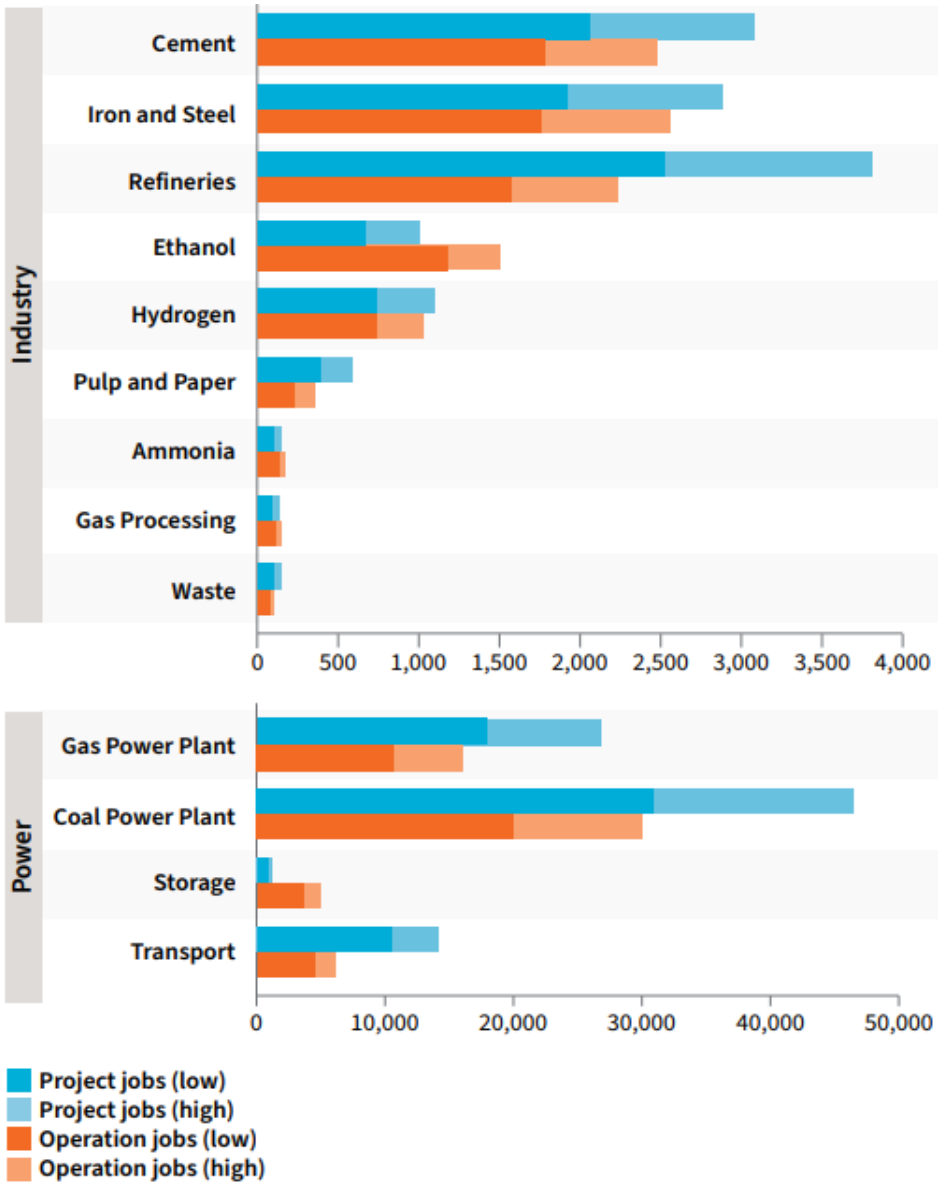
CARBON CAPTURE COALITION

45Q's economic and workforce development benefits

Retrofitting facilities with carbon capture equipment creates and preserves a range of jobs that form the backbone of regional economies and support American families.

Recent analyses show that across key sectors in the US, these technologies can create and sustain more than **100,000 jobs per year in the investment phase and more than 67,000 operations jobs per year.**[1]

Near- and medium-term carbon capture jobs potential per year in the US by sector, 2023–2038 (Source: Rhodium Group[1])



[1]Rhodium Group's interactive tool on Carbon Capture and Storage Workforce Development: State-by-State

CARBON CAPTURE COALITION

Executive summary

The Carbon Capture Coalition commissioned Brown Brothers Energy and Environment LLC to conduct a techno-economic analysis of the 45Q tax credit to better understand its present value to project developers.

Key Findings:

- 45Q is the **most significant market signal for the domestic deployment of carbon management technologies** and is the foundation of a growing domestic industry. The tax credit must be preserved in any broader energy or tax provisions taken up by Congress.
- However, 45Q's value proposition has significantly eroded since 2022 due to inflation and other factors. Therefore, as was the case before the 2022 tax credit increases, the costs of deploying carbon capture technologies continue to exceed the present value of the 45Q tax credit for many sectors.

Executive summary

Today, installing carbon capture equipment at most industrial and power sector facilities, which account for 80 percent of total US stationary emissions, is not economically feasible.

To ensure 45Q's market signal, the credit must be adjusted for inflation sooner than the law allows, and its value must be increased.

Without further adjustment to the 45Q tax credit, **the more than 270 announced projects in the development pipeline and their corresponding significant economic impact are at risk**—as are future projects across energy, industrial, and direct air capture sectors.

Key definitions of analysis

Carbon capture costs:

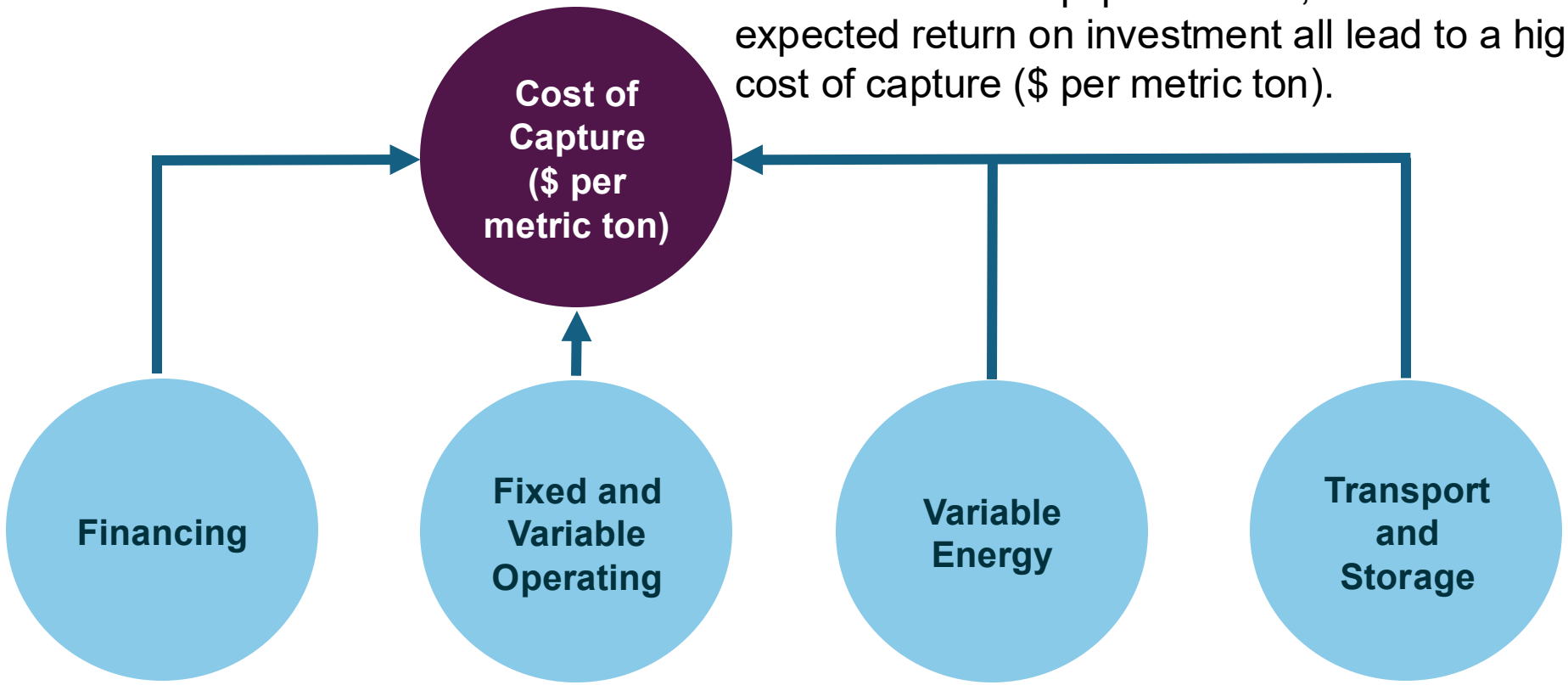
- The **“cost of capture”** (per metric ton) represents the expenses required to break even on all project-related fixed and variable costs across the lifetime of the project, i.e., construction costs = “CAPEX” and long-term operating costs = **“OPEX”** costs.
- The **“cost of equipment”** (per metric ton each year) is calculated by dividing the initial carbon capture investment by the annual capture capacity; this is the **“CAPEX”** cost.

Maturity stages for carbon capture applications:

- **“FOAK”** (First-of-a-Kind) refers to the first deployment of a carbon capture system in a specific industry. Subsequent deployments, up to approximately 5 to 10 units, are called “FOAK generation”.
- **“NOAK”** When the technology is proven and has been sufficiently demonstrated at FOAK facilities, projects are known as NOAK (Nth-of-a-Kind). Typically, FOAK equipment costs are at least 40% higher than NOAK.

What is included in the 'per metric ton' cost of capture?

The increase in equipment cost, loan interest rates, and expected return on investment all lead to a higher overall cost of capture ($ per metric ton).

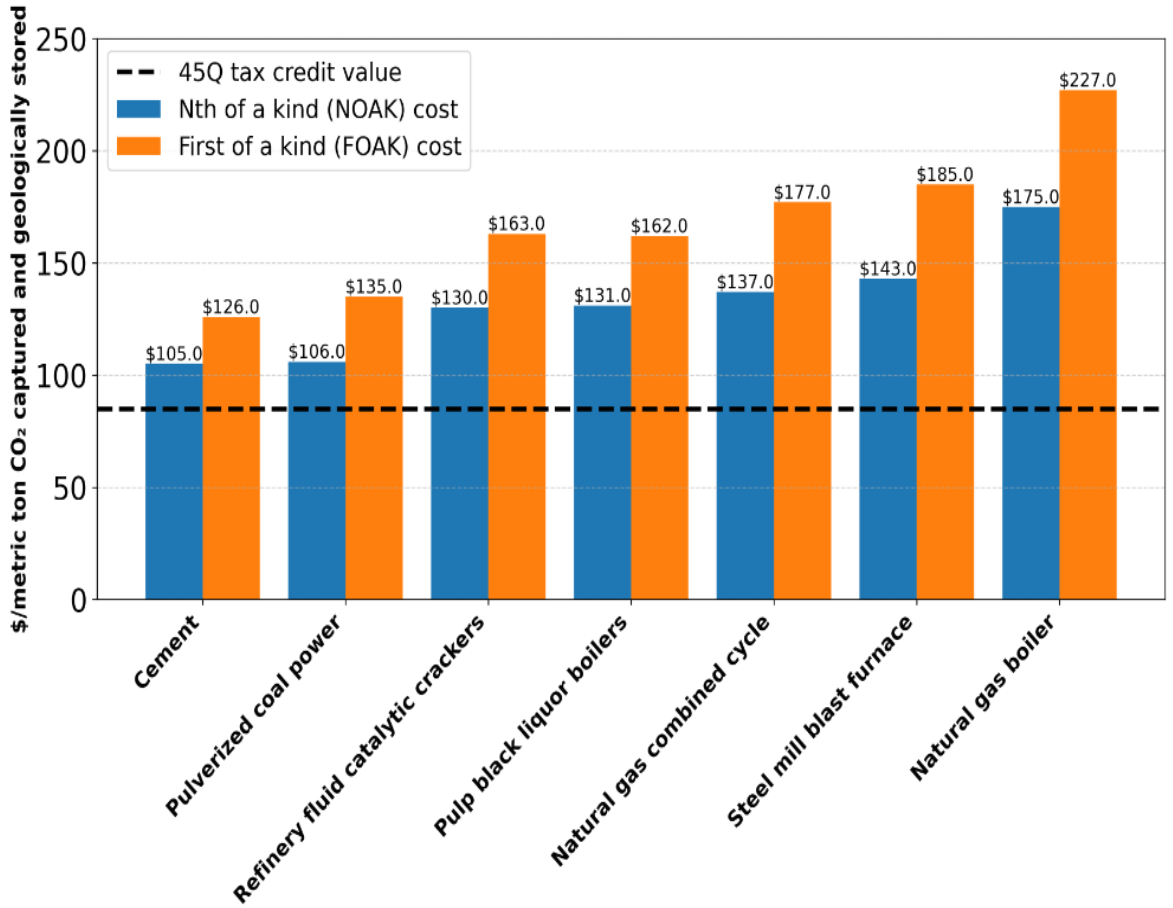


Rising costs for project deployment undermine our edge in global industrial competition

Inflation, combined with rising borrowing costs and other factors, have significantly diminished the benefits of the 45Q tax credit's most recent modifications in 2022.

The cost of capture and storage exceeds today's value of the 45Q tax credit across heavy industrial sectors and power sectors, **including sectors that are key to maintaining US leadership and economic competitiveness against countries like China.**

Current 45Q credit levels across most sectors are falling short of covering NOAK costs.[1]



[1] Unlocking Private Capital for Carbon Capture and Storage in Industry and Power, Energy Futures Finance Forum, 2025.

Inflation, materials, and costs of borrowing are diminishing 45Q

Inflation has significantly increased several critical components of deploying carbon capture and direct air capture projects. From 2020 to 2024 we've seen the following trends:

Interest rates for corporate debt have increased by approximately 3 percentage points, roughly doubling

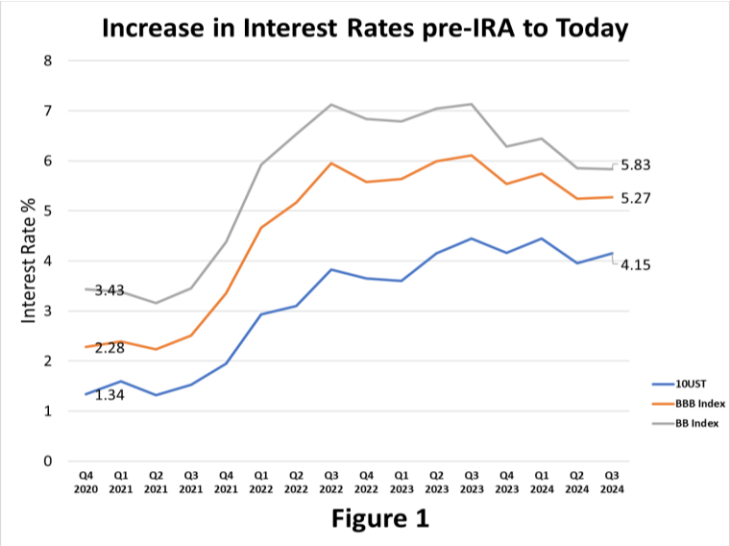


Figure 1

Prices for construction, equipment, engineering contracts, and labor rose from 30 percent to 40 percent

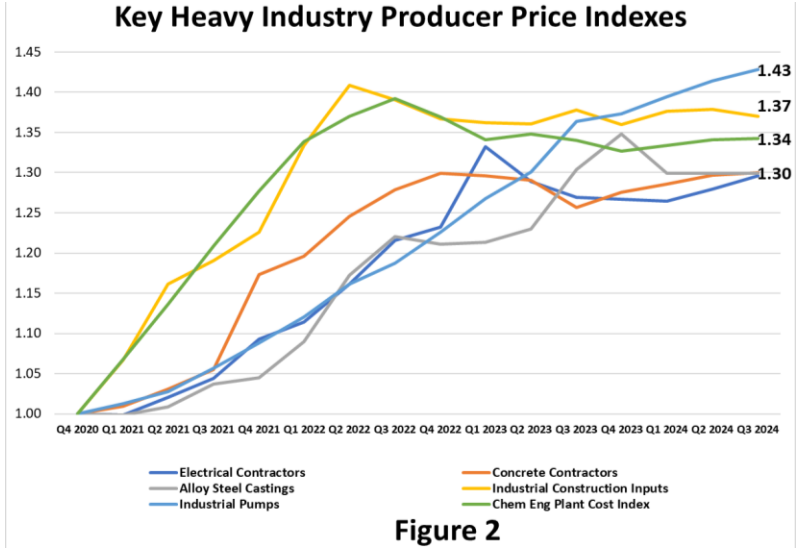


Figure 2

Corporate investors required annual rate of return increased by 3.5 percentage points

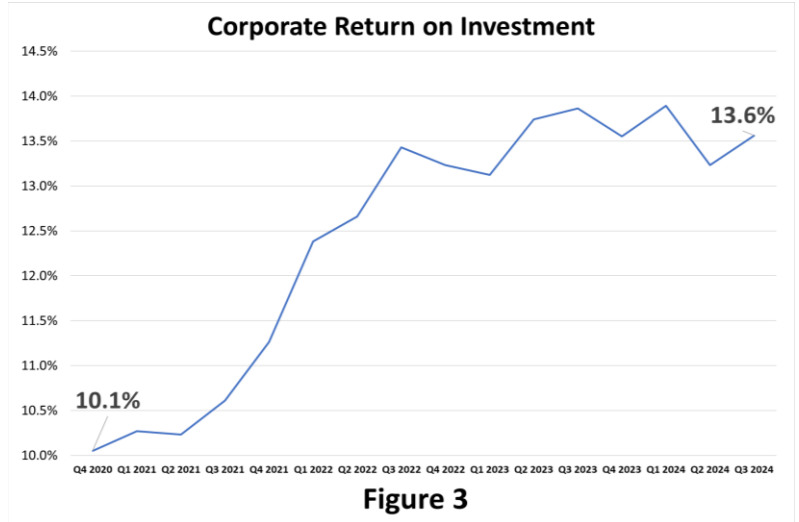


Figure 3

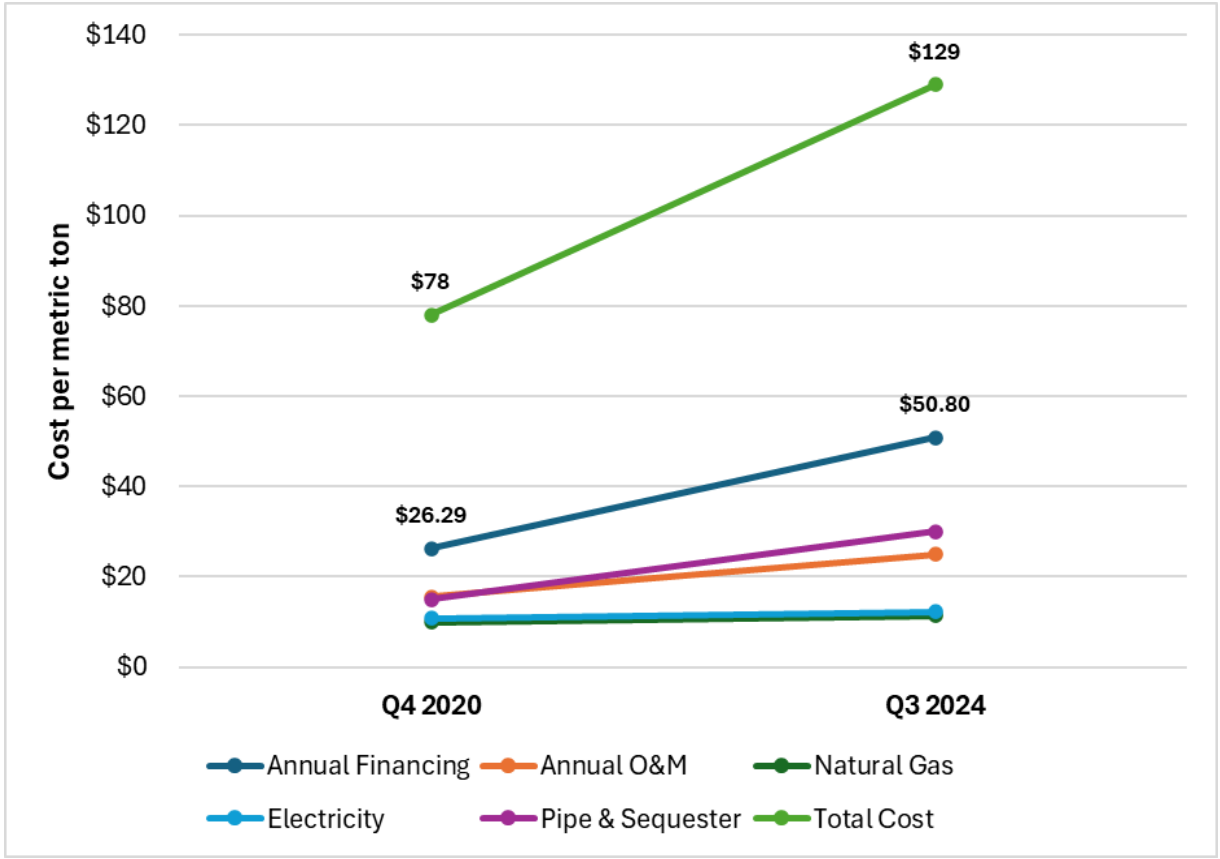
A combination of factors led to increased costs over the most recent four-year period

Inflation, combined with rising interest rates, increased the costs of inputs for installing technologies across the energy and industrial sectors, including carbon capture technologies.

This impacts project costs across project deployment—everything from energy prices to pipeline and sequestration costs to operations, which include labor costs, and more.

This has significantly increased the total cost of installing carbon capture projects.

Change in cost items over the most recent four-year period



Note: The cost per metric tons represents the average cost of capture across the industry sectors under the current provision of 12 years of 45Q payment window.

Rising costs due to a combination of inflation, interest rates, and siting complexities

Inflationary pressures, plus interest rate increases, caused approximately 59 percent of the increase in the per metric ton cost of capture between the end of 2020 and mid-2024.

Inflation in equipment and construction costs are roughly double that of general consumer inflation.

Drivers of higher cost	Increase (per metric ton)	% of total change	Source of change
Inflation (capital and energy)	$22.2	43%	Disruption of supply and demand balance due to pandemic
Extra cost of higher financing rates	$8.6	16%	Increase in the interest rates from the Federal Reserve and the expected corporate return on investment
Extra cost of retrofits vs. greenfield build	$11.0	22%	Engineering methodology
Higher Pipeline and Storage costs	$10.0	19%	Change in estimations due to siting complexities
Total changes	**$51.8**	**100%**	

What is the appropriate value for the 45Q tax credit?

The **cost of carbon capture varies by industry**, largely depending on the concentration of CO_2 emissions. Sectors with emissions sources with higher CO_2 concentrations typically face lower capital expenses (CAPEX), while those with lower concentrations tend to have higher CAPEX.

Additionally, **a project's ability to offset costs through the 45Q tax credit depends on the ownership structure of the parent company**—whether the project is backed by a large corporation with sufficient tax liability to fully utilize the credit, or a smaller entity that must rely on tax equity financing to monetize the tax credit.

What is the appropriate value for the 45Q tax credit?

To present a comprehensive picture of costs across types of projects, this analysis evaluates the cost of capture (per metric ton) across four scenarios:

Installation costs

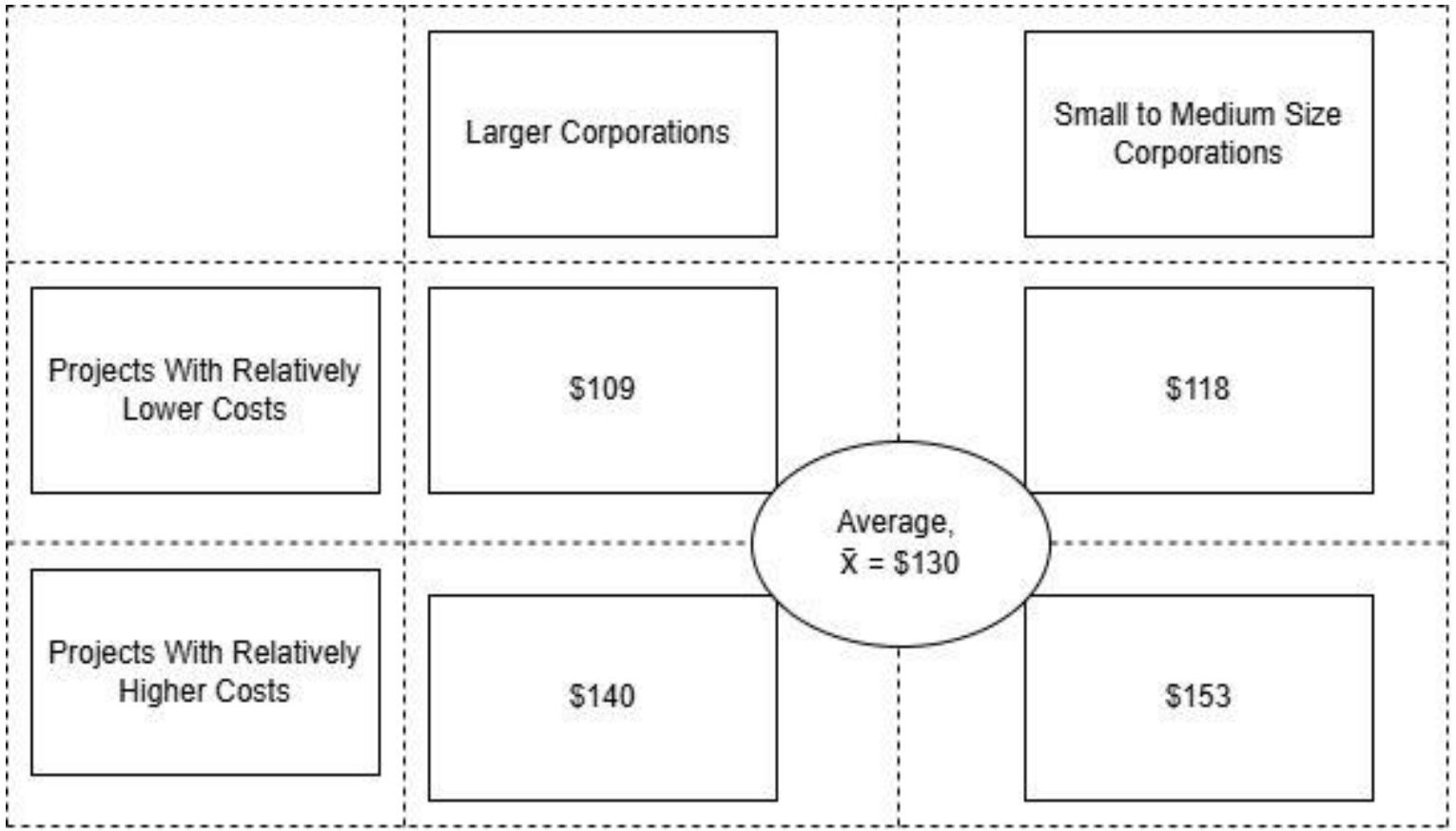
- High
- Low

Ownership

- Large corporation (able to utilize 45Q tax credits)
- Smaller entity (relies on tax equity financing)

This analysis accounts for the tax credit's **current 12-year payment window,** assumes that it is **indexed for inflation with a base indexing year of 2021,** and **calculates the breakeven cost across the four scenarios** in 2024 dollars.

Costs of deployment in today's dollars



Note: All figures represent dollar per metric ton in Q4 2024 terms

Based on the analysis across the four scenarios, the 45Q tax credit would need to be increased to between $109 to $153 per metric ton over the 12-year payment window for point source capture projects to breakeven with the NOAK cost of capture.

$130 per metric ton represents the average across the four scenarios for point source capture projects.

Summary of findings

The cost of capture exceeds the present value of the 45Q tax credit across most emitting sectors, including sectors that are key to maintaining US technology leadership and economic competitiveness. **In heavy-emitting industrial and power sector applications, the costs of deploying the technology are anywhere from one and a half to twice as much as the present value of 45Q.**

The value of 45Q in today's dollars must be addressed by indexing the credit for inflation using 2021 as the base year and increasing the per-ton credit value.

A higher credit value of $130 per metric ton represents an average estimate of costs for a range of carbon capture project types across industry and power, and for different types of companies commercializing these projects.

Recommendations & next steps

Congress must act swiftly to ensure the value proposition of 45Q enables projects in the development pipeline to proceed to construction while further diversifying the application of the technologies across emitting sectors. This can be achieved by:

Adjust the 45Q tax credit's inflation index to reflect a 2021 base index year.
This reflects the congressional intent of 2021 marker bills to enhance the credit.

Increase credit levels for point-source capture projects.
There are current proposals in the House and Senate to enhance 45Q credit levels.

Provide parity for CCU projects under 45Q.

Thank you

For queries and follow-up:

Sangeet Nepal

Technology Specialist

Carbon Capture Coalition

snepal@carboncapturecoalition.org

CARBON CAPTURE COALITION