

WHITE PAPER

ELEVATING INDUSTRIAL DECARBONIZATION

ADVANCING MARKET SOLUTIONS TO COMBAT THE
IMPACTS OF CLIMATE CHANGE

Industrial decarbonization, particularly through carbon capture, utilization, and storage (CCUS), must be prioritized in climate strategies to effectively reduce emissions from "hard-to-abate" industries, with voluntary carbon markets playing a crucial role in supporting these efforts and driving meaningful, near-term progress.



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Industrial decarbonization, through Carbon Capture, Utilization, and Sequestration (CCUS), must be prioritized in climate strategies to achieve significant and lasting emission reductions, offering a powerful alternative to the traditional focus on "abatement vs. removal."

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The voluntary carbon credit market has been disrupted by issues like over-crediting, fraud, and greenwashing, causing many participants to disengage, while an overemphasis on carbon removal credits has hindered broader progress toward comprehensive sustainability strategies.

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CCUS, supported by quality carbon credits and long-term infrastructure development, provides a comprehensive solution to industrial decarbonization, enabling immediate and scalable emission reductions while laying the groundwork for future carbon removal technologies.

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Now is the time to invest in CCUS, as it offers the potential to decarbonize key industries, drive immediate emissions reductions, and position stakeholders as leaders in the evolving voluntary carbon markets during this critical phase of the energy transition.





The Situation

Industrial Decarbonization & CCUS

Industrial decarbonization must be elevated within the climate action toolkit if we are to achieve substantial emission reductions. Carbon capture, utilization, and sequestration (CCUS) offers project developers the ability to deliver high-quality, measurable, and “super permanent” reductions that challenge the traditional market view of “abatement vs. removal.”

With over 30% of U.S. emissions stemming from industrial sources like steel, cement, soda ash, and refining—categorized as “hard to abate” industries—simple solutions such as fuel switching or electrification won’t eliminate their carbon footprint. **CCUS presents the most effective method to reduce over 6 gigatons of CO₂ annually.**

However, the pathway is complex: intra-state carbon transportation faces regulatory hurdles, and only 4 Class VI Permits have been issued by the Environmental Protection Agency (EPA) compared to 148 waiting in the queue. Even with federal tax credits from the Inflation Reduction Act driving interest in carbon capture, post-combustion applications will require more than the \$85/ton offered under 45Q to reach a positive financial investment decision (FID).

To make industrial decarbonization and CCUS a reality, a free-market mechanism is needed to fund the substantial upfront capital investment for capture, transport, and sequestration—specifically, the voluntary carbon markets (VCM). Despite the availability of CCUS credits, they have been de-prioritized in favor of “removal” credits. Elevating currently viable CCUS technology in hard-to-abate sectors is critical as part of a pragmatic, all-encompassing solution that will simultaneously enhance industrial decarbonization and accelerate the development of removal technologies.

+30%

US Emissions Coming from Industrial Uses

Imagine the Earth's climate as a bathtub:

The faucet, representing anthropogenic emissions, is running at full force—far faster than the drain, which symbolizes carbon removal, can lower the water level. We have two choices: either (1) install a larger drain or (2) turn down the faucet. Just like reducing the flow of water, capturing and sequestering industrial emissions is just as critical as removal technologies for curbing the rise of CO₂ levels in our atmosphere.

As of July 2024, we've seen 14 consecutive months of record-high global temperatures. We must act swiftly to turn down the faucet before the bathtub overflows. **The key lies in industrial decarbonization—a scalable, cost-effective solution that must take center stage in climate discussions.**





The Challenge

Labels Impeding Growth

In recent years, the voluntary carbon credit market has faced significant upheaval, marked by instances of over-crediting, fraud, and widespread accusations of greenwashing. As a result, many potential participants and corporate climate leaders have been pushed to the sidelines, with only a select few market leaders continuing to engage. While larger buyers can reduce emissions by improving efficiencies within their supply chains, reaching true net zero—or even net negative emissions—requires the use of carbon removal credits, which are tied to activities that physically extract carbon from the atmosphere.

Though carbon removal technologies like direct air capture are crucial, they represent only one part of a broader sustainability strategy. Unfortunately, the market’s narrow focus on these "removal" projects has led buyers and brokers to overlook or devalue other types of carbon credits, stalling progress on vital solutions beyond simple removal.

What is a “Hard-to-Abate” Industry?

According to the Department of Energy it is an industry that is tough to decarbonize “due to high-temperature and high-pressure processes that are **difficult to economically electrify** or through other carbon-free methods.”

Why do they matter?

Hard-to-abate industries produce essential goods like **cement, steel, lime, soda ash, refining, paper, and petrochemicals**, which are critical to the United States economy.

What is the market opportunity?

Nearly half of America’s industrial emissions come from hard-to-abate industries, with **479 million tons of CO2 emitted annually in the United States and 9.5 billion tons globally**.

How can we address their emissions?

Carbon capture and sequestration is the best solution, but it requires **deployment, investment, and innovation supported by voluntary carbon markets**.



The Challenge

“Removal” Creates a Carbon Credit Chokehold

Why would corporate buyers invest in a 10,000-ton carbon reduction at \$500 per ton in 2030, when they can achieve a 100,000-ton reduction at \$50 per ton today?

The scale of investment in carbon removal has surged dramatically, with recent announcements indicating that the marginal cost of removal credits remains high, between \$300–500 per ton. However, in global compliance markets, where carbon prices are set based on the marginal cost of abatement for regulated facilities, the price is notably lower, ranging between \$50–75 per ton. This more closely aligns with the cost of projects aimed at reducing emissions, such as carbon abatement or “turning down the faucet.”

To unlock the billions of dollars needed each year to decarbonize by 2050 and prevent a climate disaster, industrial decarbonization credits must be recognized as essential drivers of climate investment. The next wave of large-scale investment in carbon reduction must come from corporations currently sidelined, many of which are striving to meet their 30% reduction targets.

However, most companies cannot implement carbon-reducing supply chain initiatives without severely impacting the quality or cost of their products. Additionally, they often lack the internal resources to evaluate and invest in emerging carbon removal technologies. So, where can these companies turn for a viable solution?

EPA Hard-to-Abate Emissions by Industry (2021)

Industrial Sector	Annual US Scope 1 CO2e Emissions (MM TPA)
Aluminum	3
Ammonia	34
Cement	69
Glass	8
Iron-Steel	66
Lime	27
Petrochemicals	63
Paper	25
Refining	165
Soda Ash	5
LNG	14
Total Hard-to-Abate	479

4 Notable examples include EU ETS, UK ETS, California LCFS, and Alberta TIER.



The Solution

Carbon Capture, Utilization, & Storage

The voluntary carbon market (VCM) faces several challenges that can hinder its effectiveness, but carbon capture, utilization, and storage (CCUS) presents practical solutions to overcome these obstacles. Below is a comparison of common VCM issues and how CCUS can address them, offering more reliable, scalable, and regulated pathways to decarbonization.

VCM Problem	CCUS Solution
Over Crediting	Carbon sequestration is a precise science: wells and pipelines are equipped with real-time meters, enabling operators to accurately monitor and verify the safe, permanent storage of CO2 underground.
Fraud	Almost every component of the CCUS value chain is strictly regulated by federal agencies such as the EPA, FERC, and PHMSA, as well as by state-level environmental departments.
Greenwashing	Many essential heavy industries must capture and store CO2 to achieve full decarbonization, as fuel switching and electrification alone are insufficient.
Speculative Technologies	CO2 separation from gas streams has been a proven technology in energy and industrial applications for over 60 years.
Isolated Projects Offering Minimal Synergies	Maximize value by capitalizing on existing infrastructure.
Long Development Timeline	CCUS projects provide an immediate solution to slow the rising concentrations of CO2 in our atmosphere.
High Pricing for “High Quality” Credits	The price of carbon should align with the upfront investment required for each project. Industrial decarbonization, due to its scale, offers a more cost-effective option for offset buyers.



The Solution

Quality Credits

Credit buyers must conduct thorough due diligence beyond the basic requirements set by registry boards. Several key factors should be considered when assessing the quality of a CCS credit:

Additionality



For most post-combustion applications, 45Q incentives alone are insufficient. It's crucial to understand the full-cycle economics of a project—not just indicative capture costs—to accurately assess the value of a voluntary carbon offset credit. With multiple stakeholders involved, precise calculation of transportation, storage, monitoring, and financial assurance costs is essential to evaluate the true project-level economics. Additionally, buyers must carefully assess the regulatory environment to ensure there is no double-counting due to legal requirements for carbon capture.

Source of Emissions



Not all emissions are the same, and buyers should consider several key questions, such as:

- Are there alternative ways for this facility to decarbonize besides CCS?
- How stable and consistent are the emissions?
- What is the expected operational lifespan of the facility?
- Are customers specifically demanding a "green" product?

Local Support



CCS developers must establish a well-planned "ground game" to build strong stakeholder support. While carbon capture technologies have been in use for decades, the CCS business model remains relatively new. Engaging and educating landowners, along with fostering cooperation, will be critical to developing long-lasting infrastructure that can support these projects for decades to come.

Co-Benefits



Industrial CCS projects offer substantial benefits to local communities, including the creation of long-term white- and blue-collar jobs, increased investment in scalable infrastructure, and improved public health through the removal of harmful co-pollutants. These projects also support environmental justice and economic revitalization by providing essential job training and reinvestment opportunities, particularly in rural areas historically reliant on hydrocarbon or coal production.

MRV Plan



A key component of the CCS value chain is ensuring carbon remains securely stored through a robust monitoring, reporting, and verification (MRV) plan. This includes baseline monitoring, continuous seismic surveys, annual plume modeling, and regular soil sampling. CDR buyers and CCS developers must work together to ensure that all stakeholders adhere to the highest industry standards, guaranteeing the integrity of carbon storage.

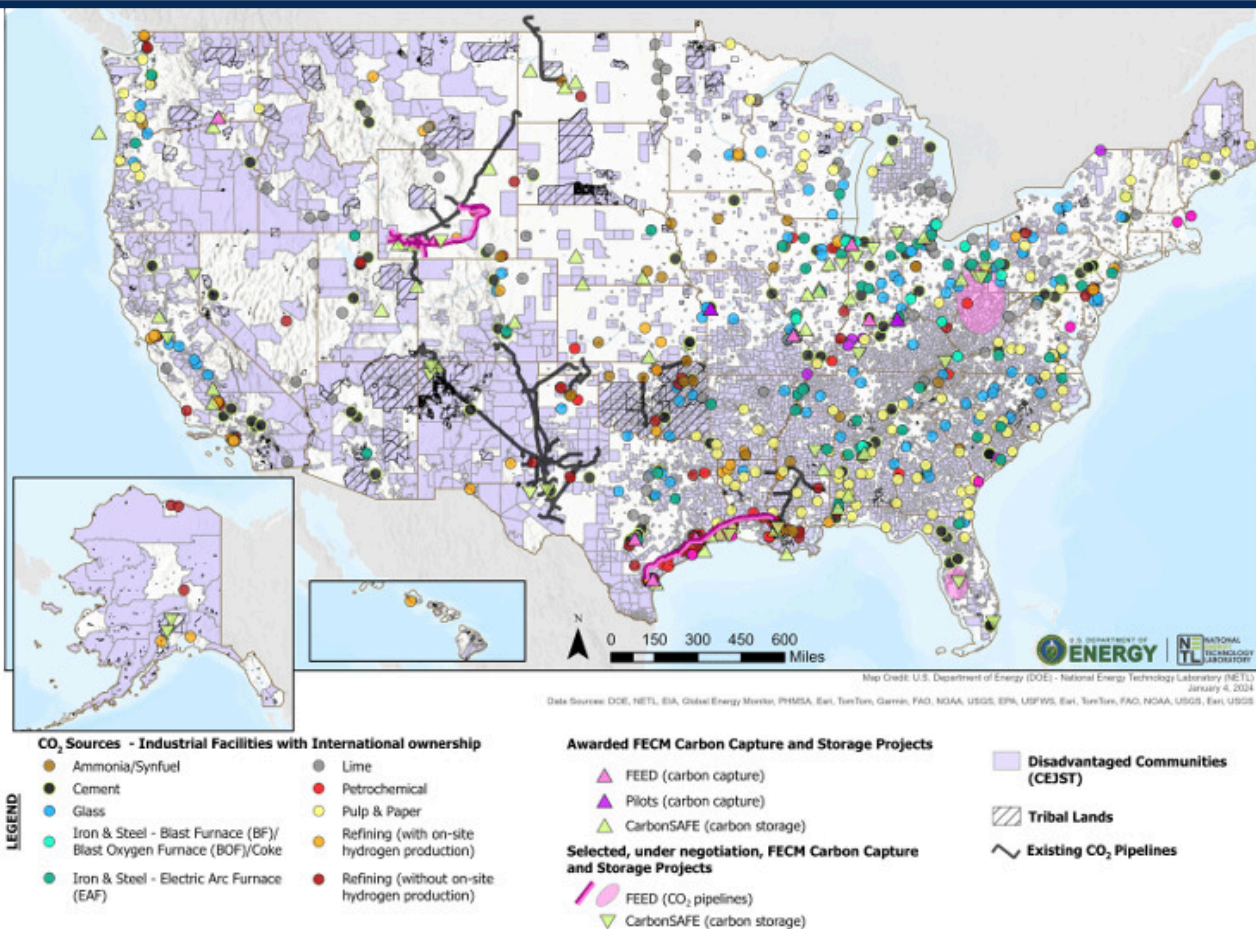


The Solution

Infrastructure for the Long Run

Removal technologies will require significant upgrades to utilities and sequestration systems, and we cannot afford to wait for these to develop in isolation. By leveraging the existing infrastructure for industrial decarbonization, we can accelerate the deployment of removal technologies, making them more efficient and cost-effective.

Basin-scale sequestration projects are already being developed across key industrial corridors in the U.S., from Louisiana's petrochemical sector to Wyoming's soda ash industry. These projects are supported by essential infrastructure—power, water, and pipelines—designed for industrial decarbonization. When paired with sequestration, this infrastructure can be harnessed to fast-track carbon removal efforts. However, these industrial decarbonization projects and their infrastructure require backing from the voluntary carbon market to reach final investment decision (FID), without which, the scale-up of removal technologies will be significantly slower.



Supporting hard-to-abate industries and industrial CCS projects enables us to make an immediate and substantial impact on the climate. By combining these efforts with the co-development of carbon removal technologies, we can amplify their effectiveness, driving meaningful and long-lasting change.



The Action

The Time Is Now

"We're in the age of urgency. Investment in clean energy and net zero technologies is higher than ever, but 2024 started out warmer than ever recorded, following a year that already broke through the annual average 1.5-degree C mark. People & companies are waking up to the fact that we need to act, fast, as they see the effects of climate change all around them."

-2024 Climate Week

Conclusion

The greatest challenge for widespread CCUS adoption—and industrial decarbonization—is convincing stakeholders that the investment is worth the return. These projects demand significant capital and human resources, but they hold the potential to decarbonize key American industries and lay the groundwork for faster deployment of carbon removal technologies. By adopting CCUS, carbon dioxide removal (CDR) buyers can not only diversify their climate portfolios but also position themselves as early leaders in a market poised to deliver substantial and immediate emissions reductions.

We are at a pivotal moment in the energy transition and the evolution of voluntary carbon markets (VCM). CCUS represents a powerful tool to drive near-term progress in the fight against climate change, but meaningful participation from the carbon markets is essential. The time to act is now.

The Situation for Action

Storage Need

Modeling studies show that achieving U.S. energy transition goals will require capturing and storing millions of tons of CO₂ annually by 2050, utilizing both point-source carbon capture, utilization, and storage (CCUS) and carbon dioxide removal technologies.



Available Capacity

With over 20 MTPA of capture capacity, the U.S. leads the world in carbon management. The favorable policy and resource environment makes the U.S. a prime location for further CCUS deployment.



The Time Is Now!

CCUS industrial decarbonization projects offer substantial, scalable climate solutions. Right now, opportunities in industries with high-purity CO₂ streams are aligning with large-scale transportation and storage infrastructure, creating a strong foundation for deployment in hard-to-abate industries.