FEDERAL POLICY BLUEPRINT

CARBON CAPTURE COALITION

APRIL 2023

Membership

Participants

8 Rivers
Accelergy Corporation
AFL-CIO
Aircapture
Air Liquide
Air Products
AK Steel International
Alto Ingredients Inc.
ArcelorMittal
Arch Resources Inc.
Archer Daniels Midland Company
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Citizens for Responsible Energy Solutions (CRES) Forum
Clean Air Task Force
Climeworks
Conestoga Energy Partners LLC
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EBR Development LLC
Elysian Carbon Management
Energy Innovation Reform Project
Equinor US
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National Farmers Union
National Wildlife Federation
Navigator CO_2 Ventures
NET Power Inc.
New Energy Risk
New Steel International Inc.
NOV Inc.
NRG Energy Inc.
Occidental
Peabody Energy Inc.
Pennsylvania Environmental Council
Prairie State Generating Company
Remora
Shell
SMART (Sheet Metal, Air, Rail and Transportation Workers) Transportation Division
Summit Carbon Solutions
Svante
The Nature Conservancy
Third Way
Thunderbolt Clean Energy LLC
United Airlines
United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry
United Mine Workers of America
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Utility Workers Union of America
Valero
White Energy

Observers

Algae Biomass Organization
American Iron and Steel Institute
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Brown Brothers Energy & Environment LLC
Carbon Engineering Ltd.
Carbon Utilization Research Council
Chart Industries
ClearPath
Enhanced Oil Recovery Institute, University of Wyoming
Environmental Defense Fund
Growth Energy
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Melzer Consulting
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National Audubon Society
Portland Cement Association
Renewable Fuels Association
Republic Services
School of Energy Resources, University of Wyoming
Systems International Inc. | The ZEROS Project
The Association of Union Constructors
The Fertilizer Institute
Waste Management
World Resources Institute

Cover image courtesy of Third Way.

Third Way partnered with Gensler to develop visual renderings that showcase examples of carbon management solutions paired with clean energy in various settings. They highlight a visual template for a future economy that provides cleaner, more affordable, secure, and reliable energy for communities across America.

Table of Contents

About the Carbon Capture Coalition

The Coalition is a nonpartisan collaboration of industry, labor, conservation, environmental policy, and nonprofit organizations. Coalition members recognize that the economywide adoption of carbon management technologies is critical to achieving net-zero emissions to meet midcentury climate goals and to strengthening and decarbonizing domestic energy, industrial production and manufacturing, all while retaining and expanding a high-wage jobs base.

Members of the Coalition work together to advocate for the full portfolio of policies required to commercialize a domestic carbon management sector and inform policymakers as well as stakeholders on the essential role this suite of technologies must play in achieving these shared objectives. Today, the Coalition stands at more than 100 members strong and is increasingly reflective of the diversity of industries and proponents that now make up the carbon management sector.

The Coalition's mission is to advance federal policies and actions that will accelerate commercial deployment of the full suite of carbon management technologies. Successful commercial deployment requires prioritizing meaningful engagement and consultation with local communities as well as associated workforce development. Broadly, carbon management encompasses:

- Technologies to capture and manage carbon dioxide (CO_2), carbon monoxide (CO) and co-pollutants from power plants and industrial facilities;
- Carbon removal technologies, including direct air capture, biomass with carbon removal and storage, and other advanced technologies that remove CO_2 already in the atmosphere;
- Transport infrastructure to carry CO_2 from where it is captured to where it can be geologically stored or put to beneficial use;

Members of the Carbon Capture Coalition (the Coalition) work together to achieve a common goal: economywide deployment of carbon management technologies. This includes carbon capture, removal, transport, reuse, and storage of carbon dioxide (CO_2) and its precursor, carbon monoxide (CO), from industrial facilities, power plants, and the ambient air.

- Reuse of captured CO_2 and CO to produce low- and zero-carbon products;
- Safe and permanent storage of CO_2, including in appropriate geologic reservoirs.

Introduction

The Carbon Capture Coalition recognizes the essential role that the full suite of carbon management technologies must play in decarbonizing the American economy and the importance of federal policy support in enabling deployment of these technologies in key sectors including industry, power, and direct air capture. A broad and growing bipartisan group of policymakers and a diverse set of stakeholders from industry, energy, and technology companies; energy and industrial labor unions; and conservation, environmental, and energy policy organizations support carbon management as an available and essential tool to meet midcentury climate goals, strengthen and expand a high-wage jobs base, and support domestic manufacturing and energy production.

The Coalition's 2019 and 2021 Federal Policy Blueprints laid the groundwork for the introduction and eventual enactment of a federal policy framework for carbon management that builds upon the landmark 45Q tax credit that was enhanced and expanded in the 2018 Furthering carbon capture, Utilization, Technology, Underground storage, and Reduced Emissions (FUTURE) Act. Over the course of the 117th Congress, the Coalition and its members played a central role in ensuring that key carbon management priorities were reflected in broadly bipartisan pieces of legislation, and eventually included in both the 2021 Bipartisan Infrastructure Law (BIL) and the 2022 Inflation Reduction Act (IRA). The U.S. policy framework is now recognized as the most comprehensive and robust federal policy support for carbon management technologies in the world.

Recently enacted legislation, which include BIL and IRA as well as the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act and annual government funding packages, together form a comprehensive policy framework for wide-scale deployment of the full suite of carbon management technologies by 2030, so that projects and infrastructure can be scaled in timeframes that enable meeting midcentury climate goals. However, there is still much work to be done to ensure the historic investments made in carbon management throughout the 117th Congress translate to widescale project deployment. This includes advocating for additional policy mechanisms to build market demand for this broad suite of technologies, working with federal agencies to provide the necessary regulatory framework, and ensuring swift and effective implementation of enacted legislation. The Coalition's 2023 Policy Blueprint outlines a roadmap of essential policy, regulatory, and implementation related activities for the 118th Congress and the administration as they support the scale-up of the carbon management industry in time frames that assist in achieving 2030 development goals.

The available U.S. policy framework is now recognized as the most comprehensive and robust federal policy support for carbon management technologies in the world. However, there is still much work to be done to ensure the historic investments made in carbon management throughout the 117th Congress translate to wide-scale deployment.

This Blueprint focuses on federal policy priorities for carbon management technology deployment. It does not address policies specifically aimed at the production of hydrogen, though it recognizes that carbon management can be an enabler of low-cost, low-carbon hydrogen production. Additionally, it does not address state-level policies, which have an important role to play in complementing federal policies to support commercial deployment of the full suite of carbon management technologies.

The 118th Congress – An Opportunity to Reinforce U.S. Leadership

The 117th Congress made historic investments to build upon previous bipartisan legislative accomplishments and growing momentum to advance the necessary policy framework to deploy the full suite of carbon management technologies. Economywide deployment of carbon management in the United States will be necessary to fulfill emissions reduction goals while protecting and expanding a high-wage jobs base and continuing to provide reliable, affordable domestic energy.

Carbon management technologies have historically suffered from a significant lack of federal policy support necessary to de-risk, develop, and make commercially available the technologies that make up the carbon management sectors, until now. Annual research, development, demonstration, and deployment (RDD&D) funding from the U.S. Department of Energy (DOE) and the 2018 restructuring of carbon management's foundational 45Q tax credit has attracted increased interest in deploying large-scale carbon capture, removal, transport, reuse, and storage projects in the United States.

Over the course of the 117th Congress, lawmakers across the political spectrum and from across the country worked to advance groundbreaking provisions to bolster the 45Q tax credit, which remains the key federal policy mechanism to incentivize carbon management projects nationwide, and invested historic resources to deploy carbon management, industrial decarbonization technologies, and associated infrastructure. With these policy levers now in place through both the IRA and BIL, a-once-in-a-generation opportunity has been presented to scale the carbon management sector, and the industry must now work to deploy these technologies as quickly and responsibly as possible.

Building off this success, the 118th Congress can reinforce and grow the role of American leadership in the development and deployment of these technologies throughout the remainder of this decade. Therefore, it is essential that bipartisan legislation introduced this Congress include key Coalition recommendations including:

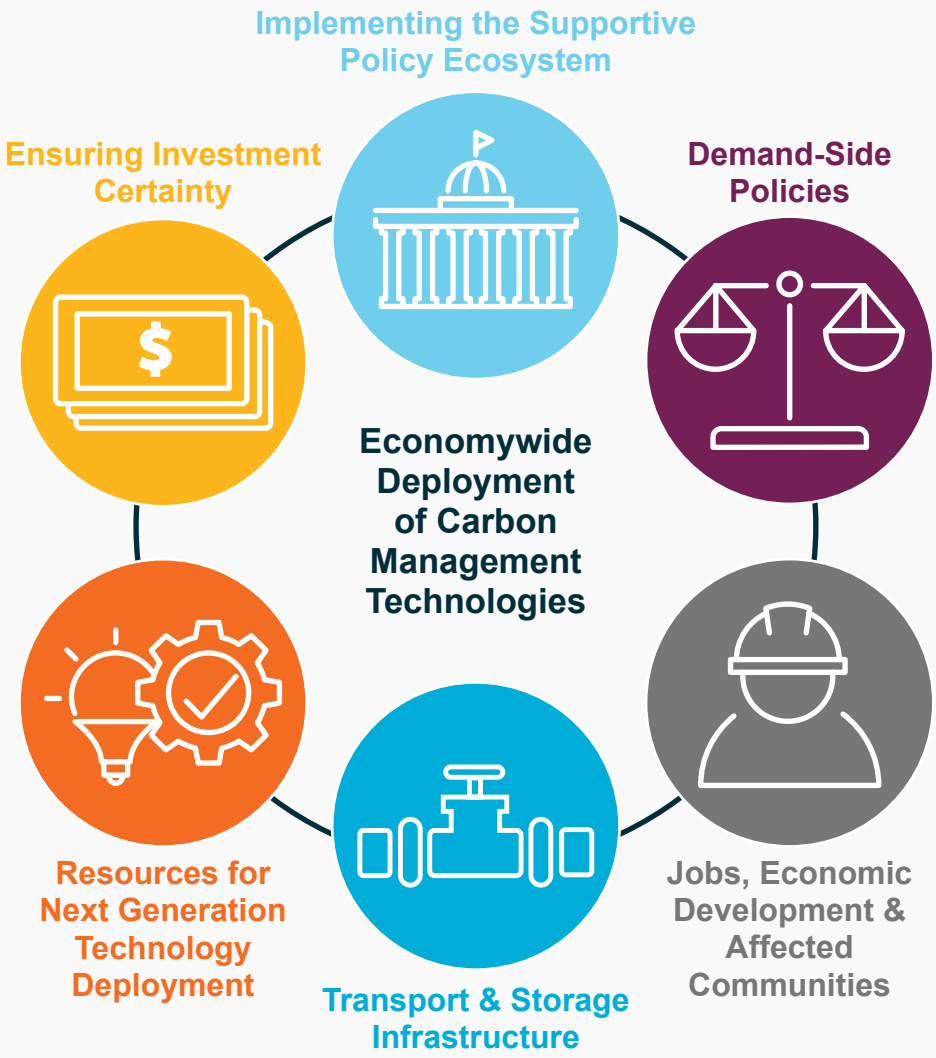
- **Provide federal resources for developing less commercially mature and next generation carbon management technologies.** Through long-term investments in carbon management technology innovation, the United States also has a once-in-a-generation opportunity to drive additional technological advancements, leading to a more efficient and effective carbon management sector that will further establish domestic leadership in affordable, reliable and exportable low- and zero-emissions technology development.
- **Complementary policies to existing laws and programs to strengthen the available portfolio of federal policy support,** to help close the cost gap between levels of financing available for project deployment and the necessary financing needed for first-of-a-kind projects or less commercially mature technologies.
- **Demand-side policies** to incentivize commercial production of products and services sourced from carbon

management projects. This includes developing monitoring standards and common frameworks for measuring the life cycle emission reductions from services and products sourced from direct air capture and products sourced from carbon reuse.

- **Policies and mechanisms to further ensure that benefits from project development flow to affected communities and workers** through coordinated federal actions. This includes developing stakeholder engagement best practices, as well as data and analysis to support planning, siting, and transparent reporting mechanisms, to create direct community benefits and minimize potential risks from project deployment.

In addition to advancing key legislation, a complementary agenda of rigorous and timely regulatory actions, as well as swift and coordinated implementation of recent policy gains, are needed to advance the carbon management sector towards economywide deployment. These areas are discussed in more detail in the 2023 Policy Blueprint Recommendations.

Figure 1: Coalition Vision for Economywide Deployment of Carbon Management Technologies



What is Carbon Management?

Carbon capture, removal, transport, reuse, and storage technologies, commonly referred to as carbon management, are a portfolio of safe, effective, and increasingly cost-effective emissions technologies to manage, abate, and remove CO_2 and CO emissions from industrial facilities, power plants, and directly from the air. Captured CO_2 or CO is then reused to make valuable products or transported to appropriate sites for geologic storage.

Carbon dioxide, or CO_2, is a clear gas that occurs naturally in small amounts in the Earth's atmosphere. Humans and animals breathe out CO_2 every day, and it is essential to plant life. However, CO_2 is also produced by burning fossil fuels in manufacturing, industry, and transportation, as well as in the process of electricity generation at natural gas- or coal-fired power plants. Human activity has caused there to be too much CO_2 in the atmosphere and is the main driver of climate change.

In decarbonizing the industry, energy and transportation sectors, carbon management will play an important and complementary role to other emissions reduction strategies. There are industries, such as steel and cement, that have significant carbon emissions resulting from the production process itself, regardless of energy inputs. (For more information see callout box "Industrial Emissions and Carbon Management" on page 8.)

Following is a brief description of the individual sectors that make up the full value chain of the broader carbon management industry.

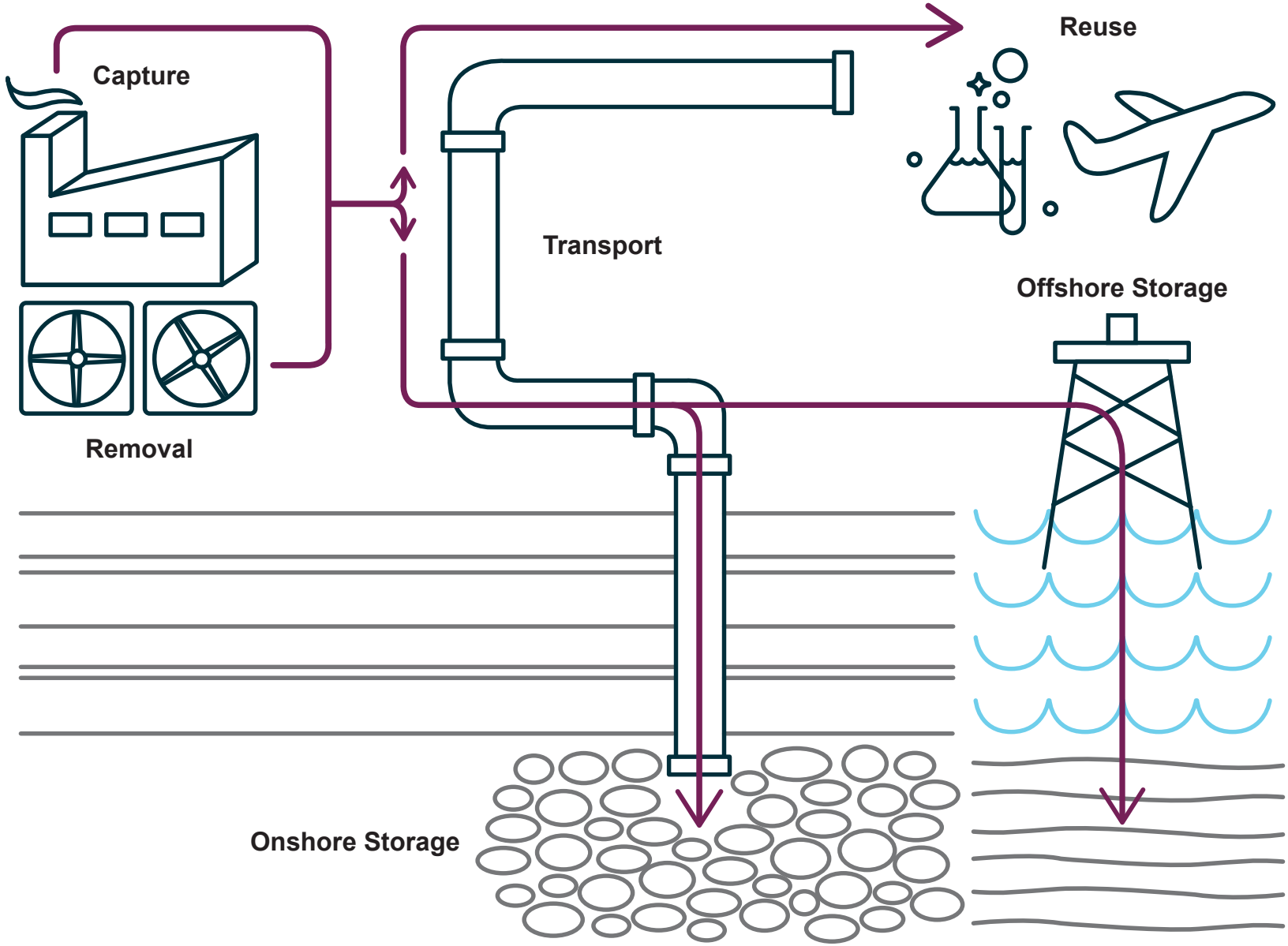
Capture: Carbon capture refers to a variety of technologies that separate carbon emissions from emissions sources including diverse industrial sectors, such as steel, cement, basic chemicals for fertilizers and fuels, hydrogen production, natural gas- and coal-fired power generation, and freight transportation. CO_2 captured from these industrial processes or electricity generation is then compressed for transport and permanent geologic storage, reused for commercial products such as building materials, fuels, and chemicals, or used to produce oil and gas from existing wells.

In addition to capturing CO_2 from emissions sources, both carbon capture and reuse can also reduce the amount of air pollutants released to the atmosphere that are harmful to human health. This process requires pretreatment to remove or greatly reduce sulfur oxides, particulate matter, and nitrogen dioxide emissions which have been linked to lung disease, cancer, and a shortened life span. This reduction in air pollutants occurs primarily because prior to CO_2 capture, emissions from these facilities must undergo pretreatment to remove or significantly reduce pollutants that can damage the carbon capture equipment.[1]

Removal: Carbon dioxide can be removed from the atmosphere by a variety of nature-based and engineered methods and in recent years has received increased focus from a wide range of policymakers and the private sector. Scaling the full suite of available carbon dioxide removal (CDR) methods is increasingly recognized as a central component to both offsetting emissions in those sectors with challenging-to-abate emissions, such as shipping and aviation, and post-2050, reducing the concentration of CO_2 remaining in the atmosphere. Within carbon dioxide removal strategies, the Coalition focuses on technological, sometimes referred to as engineered, carbon dioxide removal technologies.

Direct air capture (DAC) is one type of engineered CDR that offers permanent removal of CO_2 from the atmosphere when paired with geologic storage; alternatively, captured CO_2 can also be reused to produce essential fuels, chemicals, and products. Currently, there are 18 direct air capture plants operating worldwide, capturing 10,000 tons of CO_2 per year—these facilities are pilot scale, except for Climeworks' Orca, the world's first commercial-scale DAC facility. Additionally,

Figure 2: The Carbon Management Value Chain



Industrial Emissions and Carbon Management

According to EPA emissions data, the industrial sector is responsible for 30 percent of domestic emissions when associated emissions from electricity use at industrial facilities are included. Nearly half of industrial emissions occur in just three sectors: steel, cement, and basic chemicals. These sectors provide the essential building blocks for modern lifestyles and provide family-sustaining jobs.

Certain industrial processes have limited or no emissions reduction strategies beyond carbon capture. This is for two primary reasons. First, the industrial sector relies on fossil fuels to provide high-temperature heat that cannot be easily substituted with renewable sources. Additionally, many industrial processes directly emit CO_2, meaning these emissions are directly produced and emitted by the chemical or physical conversion of raw materials into finished goods, and cannot be abated without carbon capture. These so-called process emissions are responsible for approximately one quarter of the emissions from the industrial sector.

the 1PointFive direct air capture facility began construction in late 2022 in the United States and is expected to capture up to 500,000 metric tons of CO_2 per year, with the ability to scale up to capture 1 million metric tons per year. While this progress is encouraging, to meet net-zero by midcentury, this nascent but important sector must be scaled up globally to capture more than 85 million tons of CO_2 per year in 2030, and nearly 1 gigaton (or billion tons) of CO_2 per year by 2050.[2]

Transport: Some areas of the country lack appropriate deep geologic storage sites for CO_2, necessitating the safe and cost-effective transport of captured CO_2 to geologic storage sites, or to points of reuse. Currently, there are more than 5,000 miles of CO_2 transport pipelines in the United States, but economywide deployment of regionally interconnected carbon management hubs will require significant buildout of this network.[3] The scale and timing of this necessary buildout warrants careful consideration of the footprint and location of this network to minimize potential impacts to local communities and ecosystems.

According to a Great Plains Institute analysis, carbon and hydrogen hubs development is an important strategy to help achieve economies of scale in the deployment of decarbonization technologies, including carbon management.[4] Decades of safety data show that CO_2 pipelines can be operated at the highest safety standards by best-practicing operators. CO_2 pipelines have been operating in the U.S. for fifty years, currently transporting nearly 70 million metric tons of CO_2 per year, with an excellent safety track record over that time period.[5] Additional modes of transport for CO_2 include cargo ships, rail, and trucks as a demand-flexible solution for CO_2 transport from capture sites with too little volume to warrant dedicated pipelines.

Reuse: Carbon reuse, also referred to as carbon utilization or conversion, is the reuse of CO_2 or CO to produce valuable products, such as low- and zero-emissions fuels, building materials, and other products that reduce greenhouse gas emissions as compared to products or processes that are

The ability to inject and safely store CO_2 deep underground is regulated by the U.S. Environmental Protection Agency's Underground Injection Control Class VI program.

typically derived from fossil fuels. While still nascent relative to the other technologies in the carbon management value chain, carbon reuse can provide an important and valuable component to building the carbon management marketplace.

Increasingly, carbon reuse is seen as an important complement to large-scale carbon storage, as it provides value-added markets and carbon reuse opportunities for carbon capture operations, while also creating long-term, circular supply chains. The National Academies of Science has estimated that globally, reuse pathways could use up to 1 gigaton of captured CO_2 per year.[6] This growing carbon-to-value market could be worth an estimated $800 billion annually by 2030.[7]

Storage: Once transported to storage sites, compressed CO_2 is injected deep into suitable geologic formations typically over a mile underground. Suitable storage locations are separated from underground sources of drinking water and occur below impermeable rock layers that ensure the CO_2 is permanently trapped in the target geologic formation.

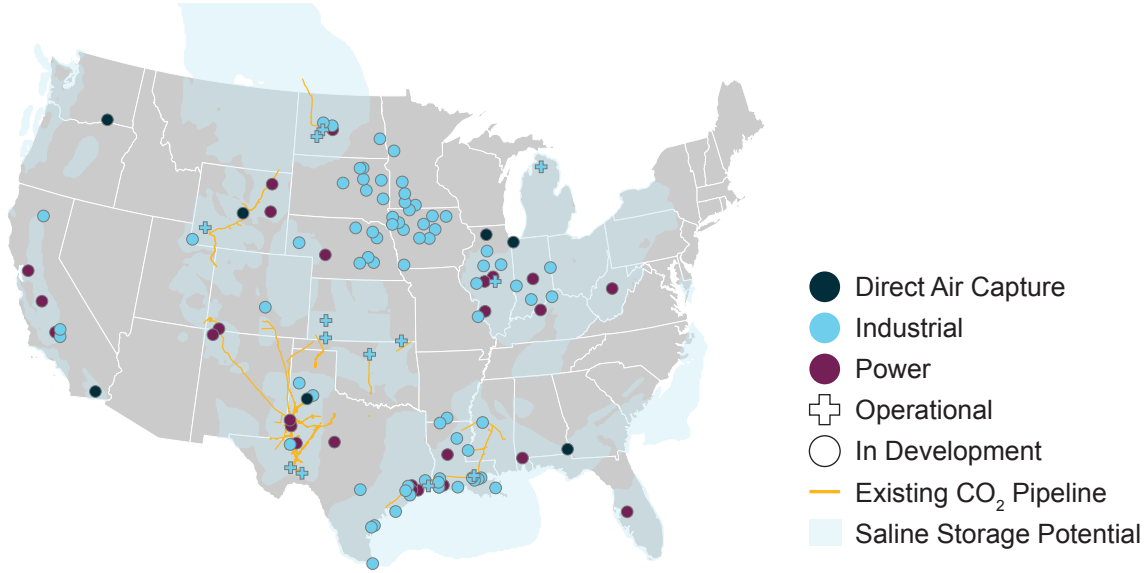
Large-scale geologic storage of CO_2 is well understood. The longest operating CO_2 storage facility, the Sleipner carbon capture and storage project operating offshore of Norway in the North Sea, has successfully and permanently stored about 1 million tons of CO_2 per year since storage operations began in 1996.[8] The United States has some of the most abundant and well characterized geologic storage, and the DOE has been studying and working to identify potential U.S. CO_2 storage sites since the early 2000s. Prior to storage, potential sites are identified and appropriately characterized by storage project developers. The ability to inject CO_2 and safely store CO_2 deep underground is regulated by the U.S. Environmental Protection Agency's (EPA) Underground Injection Control (UIC) Class VI program. Before potential storage sites are allowed to move forward, they must provide highly detailed models to federal or state regulators, depending on which entity has authority over Class VI wells.

Carbon Management as an Essential Suite of Net-Zero Technologies

The year 2030 is widely seen as a critical benchmark for meeting midcentury climate targets. Technologies and strategies for meeting 2050 goals need to be commercially available and deployed at a significant scale by the end of the current decade in order to meet midcentury targets. Modeling by the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) shows that emissions must be reduced 50 percent by 2030 to meet net-zero emissions economywide by midcentury and limit dangerous global temperature increases to 1.5˚C. Accordingly, the administration has set a target of reducing domestic emissions 50 percent by 2030 relative to 2005 levels and achieving net-zero emissions in the electricity sector by 2035.

Thanks to robust and sustained bipartisan congressional support, the United States provides the most forward-looking policies in the world for the deployment of carbon management technologies. Looking ahead, Coalition members will work to capitalize on this momentum, ensuring that commercial deployment of this portfolio of technologies can accelerate by 2030 at the pace and

Figure 3: Publicly Announced Carbon Management Projects. These projects span the development cycle from early stages of development to project construction.



scale required to meet net-zero ambition while simultaneously providing benefits to affected communities and regional economies through associated air quality benefits as well as the preservation and creation of family-sustaining jobs.

Status of carbon management

Since the passage of the 2018 FUTURE Act, which restructured and significantly expanded the 45Q tax credit, interest and investment in the carbon management sector has significantly increased. The pace and scope of project development has been steadily accelerating over the past two years and is evidenced by a number of measurable factors—the number and diversity of project announcements, applications to the EPA or state primacy programs for Class VI permits, which are required to permanently store CO_2 in appropriate geologic formations, and relevant funding announcements made by the DOE.

Additionally, the administration is embracing a "carbon hubs" approach following the enactment and eventual implementation of the more than $12 billion investment in carbon management programs and funding provided by the BIL. These carbon hubs are intended to help the carbon management sector shift from developing single capture sources and storage or reuse locations, to a network of shared transport and storage infrastructure.

Increasing the number and diversity of projects

Today, in the United States there are 14 commercial-scale facilities with the capacity to capture and store approximately 21.4 million metric tons of CO_2 per year, representing nearly half of the global deployment of the technology to-date.[9] In direct reaction to the passage of the 2018 FUTURE Act, there have been more than 120 projects announced in the United States, with 34 announced in the last year alone and more projects being announced each month.[10] It is anticipated that as the enhancements to the 45Q tax credit included as part of the IRA are implemented in the coming months, the pace and number of project announcements will increase rapidly. Prior to these policy enhancements, with the exception of the limited number of commercially deployed projects, project developers lacked the appropriate framework for economywide deployment of carbon management technologies.

Among announced projects, sectoral and geographic diversity is continuing to expand (see Figure 3). The current catalog of announced projects spans multiple industry sectors, electric power, transportation fuels, and direct air capture technologies as well as carbon dioxide transport and storage. Additionally, more than half of announced projects have expressed their intent to store captured CO_2 in dedicated geologic storage sites.

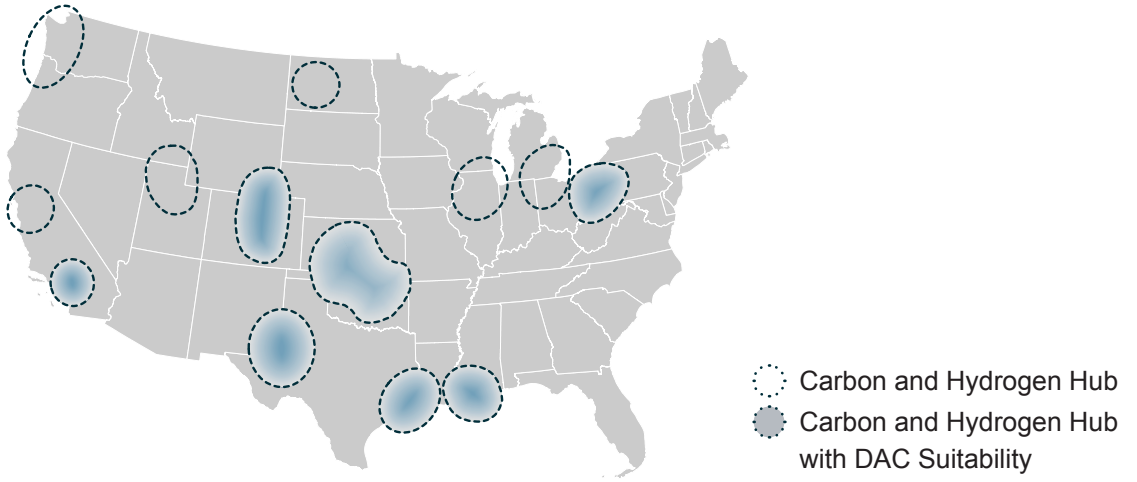
As the U.S. continues to lead the charge on supportive policy levers to enable economywide deployment of these technologies, globally, the momentum and support for carbon management deployment is making similar strides. Around the world today, there are more than 150 facilities in various stages of development, with more than half of those projects in construction or advanced phases of development with a combined capture capacity estimated at nearly 200 million metric tons per year.[11] However, despite impressive advances in the sector over a short period of time, the current pace of development is not on track to meet economywide decarbonization, with carbon management needing to capture and store at 1.6 gigatons (billion tons) of CO_2 globally per year by 2030 and subsequently increasing to 7.6 gigatons per year by midcentury.[12] These levels of deployment will require additional policy, regulatory and legal frameworks at the federal and state level, as well as increased coordination between project proponents, local communities, government, and stakeholders.

Shared infrastructure is key to 2030 goals

Increasingly, industry, government, and stakeholders are moving towards a "hubs" approach where shared infrastructure can help realize economies of scale. To reach economywide deployment, the industry must move from a single source-sink model to one where large-scale carbon storage sites serve as hubs for multiple capture sources. Regional analyses of 45Q eligible facilities show several clusters or "carbon hubs" that are excellent opportunities for shared carbon management infrastructure that are near suitable long-term storage options (see Figure 4).

To enable this shared infrastructure approach, the DOE is focusing attention and funding opportunities on the development of regional, interconnected carbon and hydrogen hubs, where shared transport and storage infrastructure can help deploy the industry at-scale, as evidenced by the funding

Figure 4: Domestic Carbon, Hydrogen, and Direct Air Capture Hub Opportunities[13]



provided in the Bipartisan Infrastructure Law. A networked system of shared transport and storage is necessary to realize economies of scale and help to grow carbon management industries at the pace necessary to meet 2030 deployment goals.

Monitoring, verification and reporting are central to deploying climate scale carbon storage

Federal and state authorities are tasked with ensuring safe and permanent storage in appropriate geologic formations through the EPA's Underground Injection Control (UIC) Class VI injection well program. Class VI wells are used to inject CO_2 into deep geologic formations solely for the purpose of permanently storing CO_2. The Class VI program rules address the permanent storage of CO_2 and ensure that wells are appropriately sited, constructed, tested, monitored, funded, and closed once CO_2 injection activities are completed.

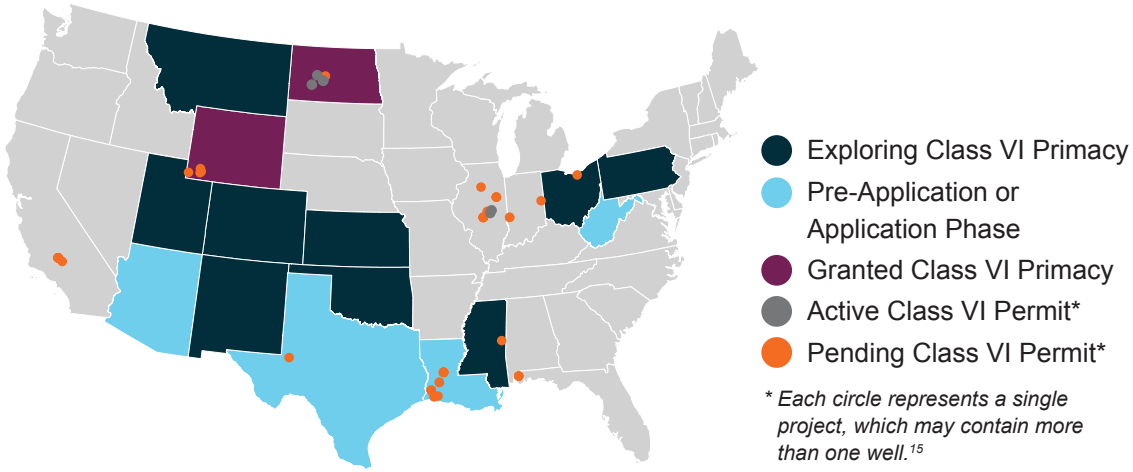
EPA can grant primary enforcement authority—referred to as primacy—to individual states, territories, or Tribal nations, which delegates authority to administer certain injection well classes under the UIC program in accordance with federal regulations. Importantly, states, territories, or Tribal nations can be approved for this delegation of primacy only when their regulations meet or exceed the federal UIC requirements. EPA has already granted primacy over other well classes (I–V) to many states. Delegating primacy authority to states may allow for more efficient permitting of projects as it places decision-making on individual well applications in the hands of practitioners with deep understanding of a state's specific CO_2 storage resources and geology. However, the Coalition recognizes that states and EPA regulators are the best determinants of a state's capacity and ability to implement Class VI primacy programs; the Coalition advocates equally for resources for both federal and state permitting authorities, where appropriate. In addition to the Class VI program, the federal government has been tasked with promulgating and

Ensuring Public Confidence in the Permanence and Safety of CO_2 Storage

The Section 45Q tax credit is unique in that taxpayers must successfully demonstrate secure geologic storage of captured or utilized CO_2 to claim the tax credit. This occurs through robust and transparent monitoring, reporting, and verification (MRV), or life cycle analysis (LCA), of the reused carbon through processes established by the Treasury and the Internal Revenue Service and overseen by the U.S. Environmental Protection Agency and Department of Energy.

These transparency measures were advocated for by the Coalition and are central to maintaining taxpayer and policymaker confidence in carbon management technologies as an emissions reduction technology.

Figure 5: Class VI Well State Primacy Status and Pending Well Applications at EPA[14]



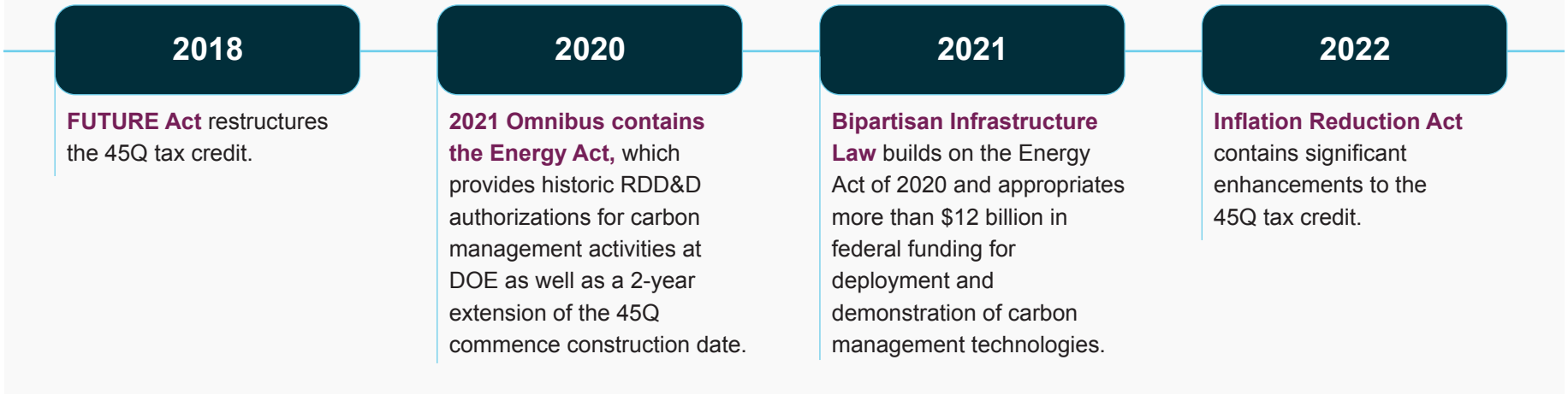
implementing regulations governing the safe and permanent storage of CO_2 on federally managed lands, which includes both onshore and offshore CO_2 storage.

At the federal level, the EPA has permitted two active Class VI wells with more than fifty well applications for approximately two dozen projects pending as of February 2023. To date, North Dakota and Wyoming have been granted primacy, with Louisiana's final determination from EPA expected imminently. Several other states are actively exploring Class VI primacy. North Dakota has permitted two Class VI wells under its state primacy program (see Figure 5).

The Federal Role in Commercializing Carbon Management

Throughout the 117th Congress, bipartisan lawmakers and administration officials enacted and began implementing a suite of policies, regulations, and federal investments that will leverage significant private investment in carbon capture projects. Project developers now have important certainty provided by robust federal policy support to move the carbon management sector forward and develop the next generation of carbon management projects in the industry, power, and direct air capture sectors. These investments will spur continued innovation, increased scale, and improved performance, while driving down costs and attracting further investment—which will all translate to accelerated deployment of this critical climate mitigation tool. Similar to other low- and zero-emissions technologies, the pace of deployment of carbon management technologies must significantly increase by 2030 to enable meeting both midcentury net-zero emissions and climate goals.

Figure 6: Timeline of Relevant Carbon Management Laws



The 117th Congress's accomplishments accelerated the United States' progress towards addressing climate by enacting two landmark pieces of legislation. The Bipartisan Infrastructure Law appropriated $12.1 billion for the large-scale demonstration and commercial deployment of the full suite of carbon management technologies—the single largest investment in carbon management technologies in history. The Inflation Reduction Act contains crucial enhancements to the foundational 45Q tax credit to make it more accessible to the industry, energy, and manufacturing sectors.

According to recent analyses,[16] the carbon management policies and funding contained in the 2021 Bipartisan Infrastructure Law, combined with the 45Q enhancements in the 2022 Inflation Reduction Act, if swiftly and properly implemented, will result in a 13-fold scale-up of domestic carbon management capacity and 210 to 250 million metric tons of annual emissions reductions by 2035.[17]

Recent enhancements to the federal section 45Q tax credit

Recent enhancements to tax-based incentives made by the 117th Congress included the Coalition's top two legislative priorities: a multi-year extension of the deadline to meet the 45Q commence construction window and a mechanism for project developers to optionally receive the 45Q tax credit as an overpayment on their taxes (direct pay).

- **Extension of commence construction:** The law provides a seven-year extension of the commence construction window, which will allow for additional investment certainty around projects and increase 45Q's efficacy. Moving forward, any carbon capture, direct air capture, or carbon reuse project that commences construction before January 1, 2033, will qualify for 45Q. This extension establishes a crucially needed investment horizon for the development of projects in the

industry, power, direct air capture, and CO_2 transport, reuse and storage sectors.

- **Direct pay:** For the first time, for-profit entities may elect direct pay for the full value of the 45Q tax credit for the first five years after the carbon capture equipment has been placed in service. The remaining seven years of the credit must be financed through alternative means. Nonprofit entities may elect direct pay for the full twelve years of the credit. A direct pay mechanism allows project developers to leverage greater private capital for investment in projects, given that traditional tax equity investors in carbon capture, direct air capture, and other less commercially mature technologies typically require a significant portion of the value of the tax credit. For every dollar expended by the federal government through the 45Q incentive, direct pay will deliver greater value for the American taxpayer by yielding more deployment of carbon capture, removal, and reuse technologies—and thus greater climate, jobs, and economic benefits.

In addition to the multi-year commence construction window extension, Congress increased credit levels for industry, power, and direct air capture applications, reduced annual capture thresholds, and provided a transferability mechanism allowing for qualified claimants of the credit to transfer or sell their 45Q credits at a negotiated discount to other taxpayers (see Figure 7). Together, these enhancements represent the most significant policy support for carbon management technologies since the foundational 45Q tax credit was restructured in the passage of the 2018 FUTURE Act.

The 117th Congress enacted the most significant policy support for carbon management technologies since the foundational 45Q tax credit was restructured in the passage of the 2018 FUTURE Act.

Figure 7: 45Q Tax Credit Structure and Eligibility Requirements as Amended by the Inflation Reduction Act of 2022

	Annual Carbon Capture Thresholds (metric tons of CO_2/CO per year)	Credit value for secure storage of CO_2 **in saline or other geologic formations**	Credit value for **carbon reuse projects** to convert CO or CO_2 into useful products (e.g., fuels, chemicals, products)	Credit value for secure geologic storage of CO_2 **in oil and gas fields**
Direct Air Capture Facilities	1,000 or more	$180 per ton	$130 per ton	$130 per ton
Industrial Facilities (e.g., ethanol, steel, cement, and chemicals)	12,500 or more	$85 per ton	$60 per ton	$60 per ton
Electric Generating Units (e.g., coal, natural gas and biomass-fired powered plants)	18,750 or more	$85 per ton	$60 per ton	$60 per ton

Timing: Projects must begin construction before January 1, 2033, and may claim the credit for up to 12 years after being placed in service.

Eligibility: Carbon capture and direct air capture projects that capture and reuse or geologically store carbon oxides (CO_2 or CO) are eligible to claim the credit so long as they demonstrate amounts of CO_2 stored or utilized using existing EPA regulations.

Project Wage and Labor Requirements: To claim the full credit level, project developers must comply with project wage and labor requirements as outlined by the U.S. Department of the Treasury and Internal Revenue Service.[18]

Funding to scale carbon management in the Infrastructure Investment and Jobs Act

The Infrastructure Investment and Jobs Act of 2021, commonly referred to as the Bipartisan Infrastructure Law, includes groundbreaking, widely supported, bipartisan provisions needed to deploy carbon management and industrial decarbonization technologies at commercial scale.

The historic package includes $12.1 billion in federal funding over five years for commercial deployment, large-scale demonstrations, and activities to enable the deployment of carbon capture, removal, transport, reuse, and storage technologies (see Figure 8). As of March 2023, nearly $9 billon of this funding has been made available through funding announcements from the Department of Energy.

Now with the foundational portfolio of policies needed to commercialize the sector in place, lawmakers and the administration must turn toward the swift and efficient implementation of enacted legislation and ensure that the appropriate regulatory environment is in place to reach 2030 goals.

Figure 8: Bipartisan Infrastructure Investment and Jobs Act – Carbon Management Provisions

Program	Funding
Carbon Capture Demonstration Projects Program	$2.54 B
Carbon Capture Large-Scale Pilot Projects	$937 M
Carbon Capture Technology Program, Front-End Engineering and Design for Carbon Dioxide Transport	$100 M
Carbon Dioxide Transportation Infrastructure Finance and Innovation Act (CIFIA)	$2.1 B
Carbon Storage Validation and Testing	$2.5 B
Carbon Utilization Program	$310 M
Commercial Direct Air Capture Technologies Prize Competition	$100 M
Regional Direct Air Capture Hubs	$3.5 B

Carbon Management's Role in Addressing Climate Change and Air Quality

As the U.S. and nations around the globe incorporate climate and energy considerations into their broader policy agendas, the world's climate scientists agree: carbon management technologies are a necessary part of a broad portfolio of strategies to reduce carbon emissions and address climate change.

Modeling done by the United Nation's Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) to assess pathways to achieve 2050 climate goals continues to reaffirm the essential role that economywide and dramatically accelerated commercial deployment of carbon management technologies must play in managing emissions from existing industrial facilities and power plants, balancing emissions from challenging-to-decarbonize sectors, and removing legacy CO_2 emissions from the atmosphere.

The IPCC's most recent report uses seven specific pathways to illustrate economywide decarbonization strategies; only one excludes carbon capture and requires global energy demand to decrease by nearly 50 percent by midcentury. Among the pathways IPCC considers there is a median, or midpoint, of 665 gigatons (billion tons) of carbon dioxide cumulatively captured and stored between now and 2100,[19] or nearly 9 gigatons captured or removed and stored on average, globally, per year.[20]

The IEA's *Net Zero Emissions by 2050 Scenario* estimates that the current slate of projects under development globally will be capturing and storing about 40 million tons of CO_2 in the next five years.[21] That number must increase to 1.6 gigatons by 2030 and 7.6 gigatons by midcentury to reach net zero. Additionally, while most of this captured CO_2 is permanently stored, IEA estimates significant markets for carbon reuse, particularly for synthetic fuels. Even in scenarios that rely on high levels of renewable energy and electrification, IPCC estimates that globally, carbon management technologies will be needed to capture a total of 2 gigatons of CO_2 in the industrial sector by 2030.[22] For comparison, the United States is responsible for approximately 15 percent of global emissions, at a rate of about 4.85 gigatons in 2020.[23]

In terms of the number of facilities needed to reach these goals, a commercial-scale carbon capture and storage facility is typically considered to be storing 1 million metric tons of CO_2 per year, which would translate to multiple thousands of carbon management facilities in industry, power, and direct air capture deployed between now and 2030.

As the global leader in carbon management technology development, the United States has a unique role to play in sharing resources, technology, and knowledge of carbon management technologies worldwide, to ensure that low- and zero-carbon energy technologies are affordable and accessible as global economies set net-zero targets in motion.

Meeting ambitious carbon management deployment goals which are in-line with 2050 climate targets translates to multiple thousands of such facilities in industry, power, and direct air capture deployed between now and 2030.

While the primary objective of carbon management is to reduce and abate CO_2 emissions and mitigate the worst impacts of climate change, carbon capture and reuse at industrial facilities may also result in the significant reduction of conventional air pollutant emissions, including sulfur dioxide, nitrous oxides, and particulate matter. All of these emissions are criteria air pollutants regulated by the EPA and are recognized as harmful to human health and the environment. Carbon capture retrofits at industry and power facilities should prioritize reducing not only greenhouse gases but also these harmful criteria air pollutants to provide tangible air quality benefits to communities in close proximity to these existing facilities.

Carbon Management's Role in Preserving and Expanding a High-Wage Jobs Base

Widespread deployment of carbon management technologies at industrial, power, and large-scale direct air capture facilities economywide is an essential tool to preserving and expanding a high-wage jobs base in key sectors across almost every state in the nation. Furthermore, among the broader suite of low- and zero-carbon technologies needed to reach net-zero emissions by 2050, the full suite of carbon management technologies is especially critical to helping to decarbonize and sustain our nation's domestic energy, industrial, and manufacturing base, whose vital products and services we will continue to rely on for decades to come. This combination of climate necessity and economic and jobs benefits fosters broad, deeply bipartisan support for carbon management technologies that is unprecedented in U.S. climate and energy policy. This bipartisan support further underscores the important role these technologies must play in reaching our collective climate obligations while maintaining the robust domestic energy production and manufacturing needed for everyday life.

The combination of climate necessity and economic and jobs benefits fosters broad, deeply bipartisan support for carbon management technologies that is unprecedented in U.S. climate and energy policy. This bipartisan support further underscores the important role these technologies must play in reaching our collective climate obligations while maintaining the robust domestic energy production and manufacturing needed for everyday life.

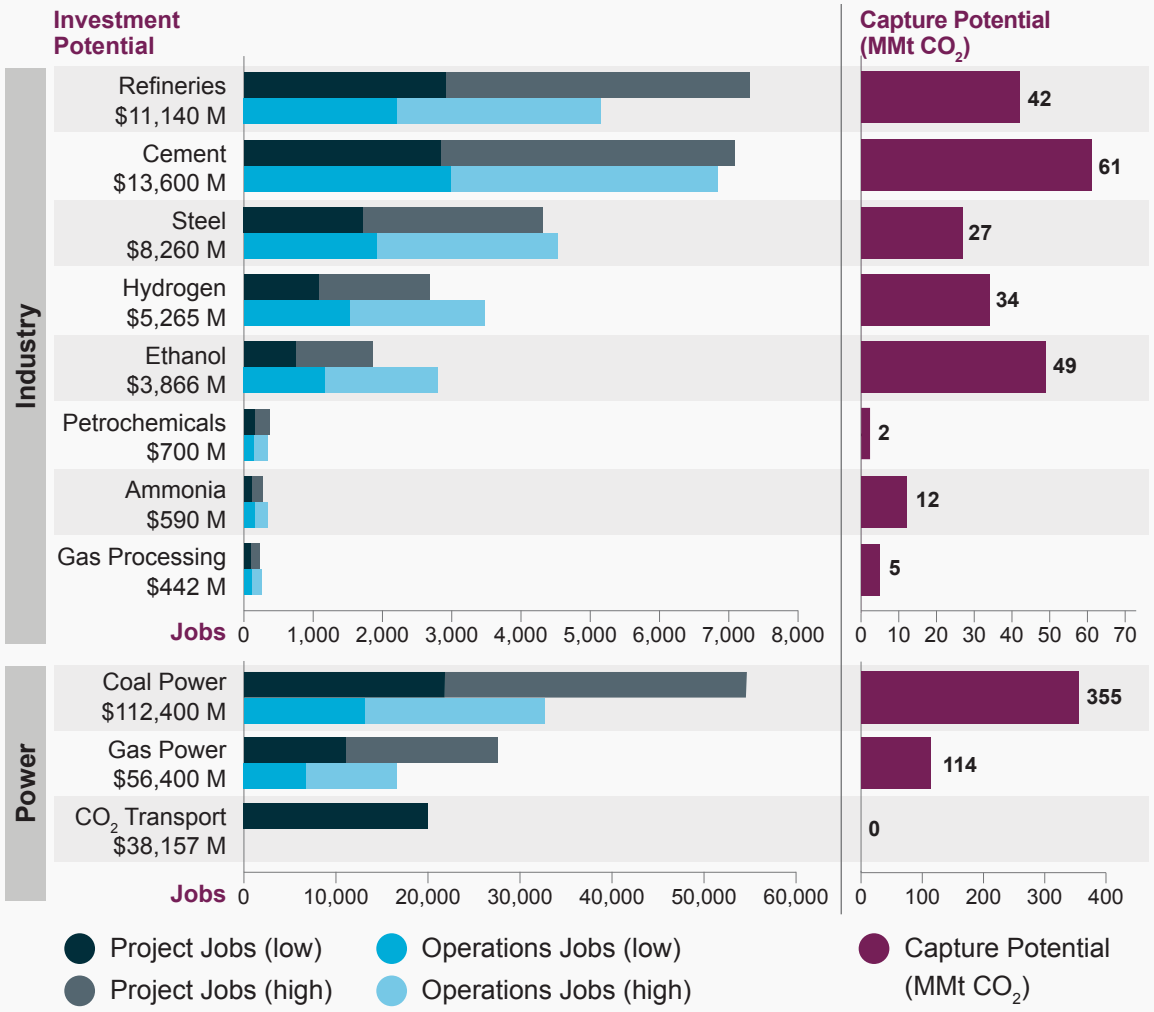
Following the historic investments in carbon management and associated infrastructure in the 117th Congress, we are now presented with the opportunity to place carbon management technologies at the heart of a national strategy for job creation and retention, workforce development and training, economic renewal, and climate stewardship.

The U.S. buildout of carbon capture retrofits at industrial and power facilities, coupled with the anticipated deployment of large-scale direct air capture facilities and associated infrastructure at levels consistent with meeting midcentury temperature targets, will provide for the creation of large numbers of skilled, high-wage jobs in both construction and operations, while supporting the retention of our nation's existing domestic energy, industrial, and manufacturing jobs.

Through a 2021 report commissioned by the Great Plains Institute, Rhodium Group found that carbon capture retrofit opportunities at industrial and electric power facilities across a 21-state region have the potential to create 70,000 to 100,000 jobs per year over the next 15 years.[24] Up to nearly 20,000 additional jobs would be created per year over this period by the buildout of a regional and national network of CO_2 transport and storage infrastructure, recently enabled by the enactment of critical policy levers included in the Bipartisan Infrastructure Law.

In another phase of the same analysis, Rhodium Group found that in the states beyond the original 21-state study, an additional 7,000 jobs per year could be created over the same 15-year period through the capital investment in retrofits and retrofit operations at industrial facilities,

Figure 9: Near- and Medium-Term Carbon Capture Jobs Potential Per Year in the United States, 2021–2035[25]



Note: Jobs figures are in average jobs each year, 2021–2035.

specifically. This translates to approximately 107,000 jobs per year nationwide in industry and electric power, plus additional jobs created through CO_2 transport operations (see Figure 9). Nationwide, additional job creation would occur in the long term, with capital investment and retrofit operations driving the creation of up to 131,000 jobs after 2035 in both capital investments and retrofit operations.[26]

Prior to negotiations around what would ultimately become the Inflation Reduction Act (which included Coalition-endorsed enhancements to the federal Section 45Q tax credit), Rhodium Group quantified the potential impact pending 45Q enhancements would have on America's job sector. The analysis found that the recommended restructuring of the 45Q tax credit would yield between $12 billion and $15 billion in total investment in carbon management deployment through 2035, translating into into 4,047–5,240* additional jobs per year during that time frame.[27] These jobs are in addition to the jobs related to carbon management deployment already underway, thanks to previously established policy.

** These numbers have been converted from job-years to jobs per year to normalize all the jobs data into the same metric.*

Ensuring That Benefits from Project Deployment Flow to Affected Communities

The challenges and realities associated with a changing climate are becoming increasingly severe and more widespread, requiring the use of every greenhouse gas mitigation tool at our disposal. According to the IPCC, deploying carbon management technologies on an economywide scale, including retrofitting industrial and power facilities with carbon capture equipment and carbon dioxide removal strategies like direct air capture to remove legacy emissions from the ambient air, is a critical piece of a broad strategy to meet midcentury global temperature targets. This requires the robust and responsible buildout of CO_2 transport infrastructure, retrofitting existing facilities and constructing new facilities, and developing commercial scale permanent storage sites.

As the U.S. prepares for this enormous and vital undertaking, community considerations must be centered in the deployment of the full value chain of carbon management technologies to ensure that benefits—in jobs, economic development, as well as potential co-benefits of project development—flow to the communities and workers that will host and build these diverse projects. As projects across the carbon management value chain will be in different geographies of the United States, project developers cannot take a one-size-fits-all approach to community engagement. At the same time, communities near areas of industrial activity that are prime candidates for deploying these technologies have historically been overburdened by both the impacts of climate change and air pollutants. One potential local benefit of carbon capture retrofits at industrial and power facilities is the reduction of other kinds of pollution in addition to CO_2 to protect communities from increases in cumulative pollution for several reasons.

First, prior to CO_2 separation and capture, emissions must undergo pretreatment to remove additional criteria air pollutants to protect the capture solvent from degrading more quickly. Criteria air pollutants are regulated by the EPA and include sulfur oxides, particulate matter, and nitrogen dioxide. Additionally, reuse of pre-combustion industrial gases removes criteria pollutants as part of the conversion process as it avoids those gases being flared or combusted. Finally, installation of carbon capture may result in facilities having to meet more current and usually stricter emissions standards. However, the specific impact of individual carbon capture retrofits on conventional pollutants will vary depending on the emissions and carbon capture technologies deployed at individual cement, refining, iron and steel, and power plants.

Carbon capture installations are inherently capital-intensive, meaning investors are incentivized to retrofit industrial and power facilities with the longest remaining lifespan compared to older, less efficient facilities that have fewer remaining years of operating life ahead of them. Younger, more efficient emission sources are precisely the ones that pose the most significant challenge to climate change; without capture, they have the potential to continue to emit CO_2 unabated for decades. In contrast, older facilities that are slated to close in the near term are unlikely to apply carbon capture.

While carbon management technologies can provide air quality benefits, further analysis is needed to quantify potential impacts on local criteria air pollutants and other pollutant emissions resulting from deployment of these technologies across sectors. Further research on carbon capture deployment resulting in the reduction of air pollutants is critical to identifying appropriate measures to optimize air quality benefits and equitably addressing cumulative impacts on affected communities.

Coalition Vision for the 118th Congress

Providing the toolkit for 2030 deployment goals

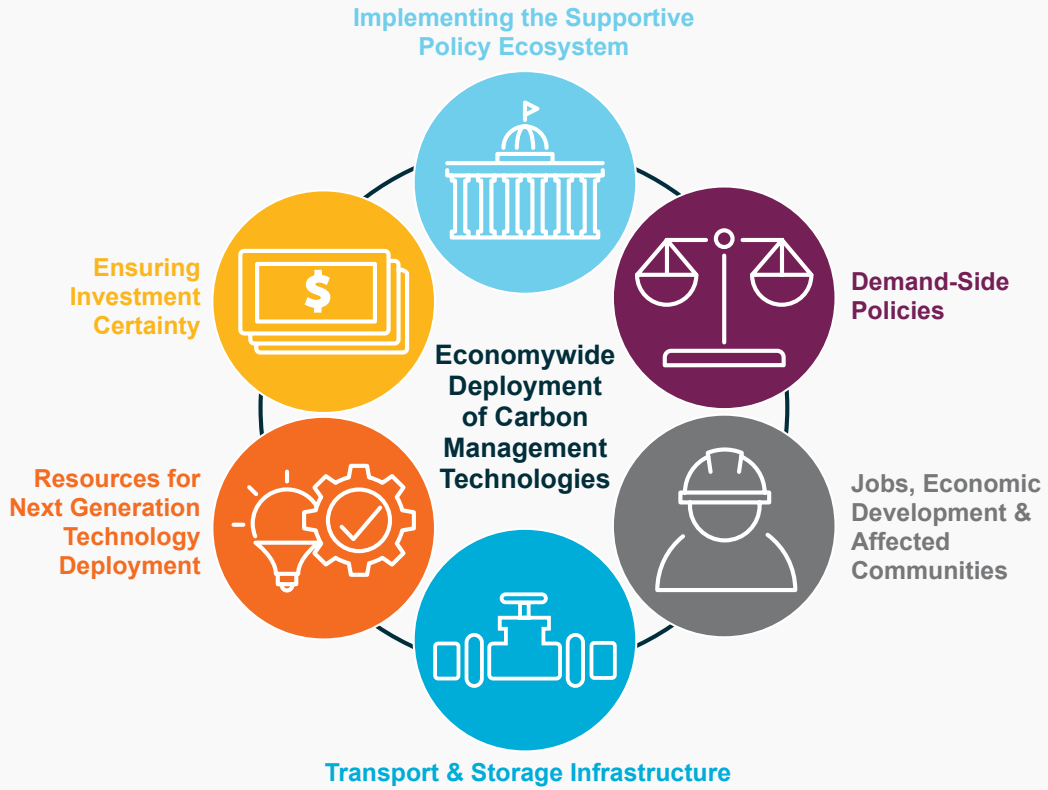
Following the enactment of all of the Coalition's top legislative priorities for the 117th Congress, the Coalition now turns its attention toward a comprehensive federal policy and regulatory agenda that will be pivotal to commercializing carbon capture, removal, transport, reuse, and storage technologies, while ensuring swift and coordinated implementation of recent policy gains.

The remainder of this Federal Policy Blueprint outlines the consensus agenda of the Carbon Capture Coalition on federal policies, regulatory actions, and implementation of enacted legislation. It will guide Coalition efforts to engage federal policymakers and stakeholders in seeking widespread adoption and deployment of carbon capture, removal, and reuse technologies and associated development of CO_2 transport and storage infrastructure.

The Coalition's strategic vision for future policy action is to:

- Ensure that the recently enacted supportive policy ecosystem for carbon management is properly implemented at the federal level;
- Ensure benefits from the deployment of carbon capture projects flow to affected communities and workers;
- Create demand side policies for products and services sourced from carbon management;
- Provide resources for the next generation of federal research, development, deployment and demonstration activities, to enable the carbon management sector;
- Strengthen the available portfolio of tax credits to ensure investment certainty and business model flexibility, as intended by Congress;
- Enable the appropriate transport and storage of CO_2 by swift and coordinated federal action

Figure 10: Coalition Vision for Economywide Deployment of Carbon Management Technologies



2023 Policy Blueprint Recommendations

Implementing the Supportive Policy Ecosystem

- Support swift and effective implementation of 45Q tax enhancements
- Ensure federal funding is timely, transparent, and in keeping with congressional intent
- Promulgate CO_2 storage regulations for federal lands

Demand-Side Policies

- Develop a federal role in standardizing the marketplace
- Support purchasing of innovative carbon management products and services

Jobs, Economic Development, and Affected Communities

- Leverage existing policy levers to expand support for jobs training
- Collect and disseminate information on air and environmental quality
- Provide technical assistance for community engagement

Transport and Storage Infrastructure

- Support supplemental safety measures for CO_2 pipelines
- Provide clarity for CO_2 storage projects on federal lands
- Support implementation of Title 41 of the FAST Act
- Provide appropriate regulatory clarity for interstate construction

Resources for Next Generation Technology Deployment

- Build upon momentum provided by federal demonstration programs
- Continue to scale federal funding for core carbon management activities
- Ensure the rapid scale-up of the carbon management industry

Ensuring Investment Certainty

- Increase credit levels for carbon reuse for commercial products
- Index 45Q to inflation immediately to ensure carbon management's progress
- Provide clarity and certainty to the 45Q reuse pathway
- Catalyze the growth of a diverse carbon management industry
- Ensure the intended impact of the direct pay mechanism

Implementing the Supportive Policy Ecosystem

Implementing the Supportive Policy Ecosystem

- Support swift and effective implementation of 45Q tax enhancements
- Ensure federal funding is timely, transparent, and in keeping with congressional intent
- Promulgate CO_2 storage regulations for federal lands

In the same way that other low- and zero-carbon energy technologies such as wind and solar were largely developed and commercialized through public-private partnerships, the federal government has played a key role in the development of some of the first carbon capture and storage projects, where the cost and risk of deploying these technologies at commercial scale remained prohibitive for private industry to shoulder alone.

The Department of Energy's investments in commercial demonstration of carbon management technologies at industrial facilities have been successful. Investments include carbon capture deployment at hydrogen and ethanol facilities, respectively, both of which were funded through the American Recovery and Reinvestment Act and continue to operate effectively today. However, much more investment is needed in the deployment of less commercially available technologies, to ensure that the U.S. remains not only a global leader in the development and deployment of these technologies, but that we can meet both net-zero emissions targets and midcentury climate goals. Congress and the administration have since made a significant course correction with the enactment of the Bipartisan Infrastructure Law, the Inflation Reduction Act, and the CHIPS and Science Act to bolster federal investment in carbon management technologies and realize economies of scale.

Support swift and effective implementation of 45Q tax enhancements

Carbon management projects are complex and capital-intensive and can have lead times of five years or more, when adding up the time that it takes to secure project financing, conduct front-end engineering and design studies, as well as complete any relevant permitting processes and environmental reviews. Although recent enhancements to the 45Q tax credit provide a much longer runway for project developers to commence construction—until the end of 2032—project developers must still be in advanced development stages in the next few years to take advantage of the tax credit.

Now with the necessary enhancements to the 45Q tax credit in statute, cost gaps for carbon management project deployment can be closed in key sectors such as heavy industry, power, and direct air capture. The U.S. Department of Treasury and the Internal Revenue Service must work to swiftly and effectively implement these changes to allow for project deployment to make significant progress in the next several years and put the carbon management industries on a pathway to achieve 2030 deployment goals.

In particular, it is vital to ensure that the direct pay and transferability provisions provide the necessary flexibility to credit claimants, as intended by Congress. Many project developers lack the ability to monetize the 45Q tax credit themselves. Additionally, the option for a project developer to effectively transfer the tax credit to investors or project partners with the ability to fully monetize the tax credit under certain conditions will be essential to attracting investment and financing many carbon capture projects.

Ensure federal funding is timely, transparent, and in keeping with congressional intent

Following the enactment of the Bipartisan Infrastructure Law, DOE and EPA now have a robust set of federal policy tools to advance the RDD&D of carbon management technologies to achieve economywide decarbonization. Now, the DOE is tasked with the rollout of more than $12 billion in federal funding over the next five years for commercial deployment including large-scale demonstrations and activities to incentivize deployment of carbon capture, removal, transport, reuse, and storage technologies, as well as direct air capture and hydrogen hubs.

While these are unparalleled increases to federal investments in carbon management technologies, this framework mirrors the type of support provided to help de-risk and commercialize other zero- and low-emissions energy technologies over the l ast several decades, ultimately enabling successful private sector investment and development. The increased investment and ambition provided by the Bipartisan Infrastructure Law is central to ensure that carbon management technologies fulfill their key and complementary role in helping to reach midcentury climate goals. The Coalition looks forward to continuing to work with DOE and EPA to ensure that implementation of these programs is timely, transparent, and consistent with legislative intent, and that agencies have appropriate capacity to properly staff these programs.

Promulgate CO_2 storage regulations for federal lands

Safe and permanent storage of CO_2 in deep geologic formations represents a well- understood and commercial practice, with both onshore and offshore CO_2 storage already occurring around the globe. There is an abundance of appropriate geologic storage sites on federal lands, especially where there is existing infrastructure and environmental impacts can be avoided or minimized. Federal agencies, however, lack the proper procedures to authorize storage of CO_2 on federally managed lands.

EPA regulates and permits geologic storage projects using the Underground Injection Control Programs' Class II and Class VI injection wells. Through these programs, EPA and established state primacy programs maintain a robust system of monitoring, reporting, and verification (MRV) to validate secure geologic storage to claim the 45Q tax credit. Furthermore, 45Q is performance-based, meaning that projects must demonstrate that the captured carbon oxide (CO_2 or its precursor, CO) is permanently stored or otherwise utilized or reused to receive the credit.

The Bipartisan Infrastructure Law gave the Secretary of the Interior the authority to grant a lease, easement, or right-of-way on the Outer Continental Shelf for long-term storage of CO_2 and tasked the relevant agencies with promulgating regulations within one year. Agencies should ensure these policies and processes are aligned to allow for a clear and workable pathway to realize CO_2 storage on public lands. The Coalition urges the Department of Interior to finalize draft regulations for the Outer Continental Shelf.

The Coalition also supports transparent and rigorous regulations governing storage of CO_2 on federal lands. While there are marked differences between offshore and onshore environments, relevant federal agencies should support the same rigor of MRV for secure, permanent storage of CO_2 when promulgating rules governing the offshore environment. These agencies should also ensure the same level of transparency and reporting measures required by EPA. Ensuring measurement, transparency, and accountability mechanisms for offshore geologic storage of CO_2 is integral to maintaining public confidence in the integrity of the 45Q tax credit.

Demand-Side Policies

Demand-Side Policies

- Develop a federal role in standardizing the marketplace
- Support purchasing of innovative carbon management products and services

Now with the most significant policy support for the development of the carbon management supply chain in the world made law, U.S. policymakers must turn their attention to identifying the role the federal government must play to support building the marketplace for products (electricity, materials, and products) and services (net-negative emissions) sourced from carbon capture, removal, reuse, and storage.

Consumer and private sector demand for the wide variety of materials and products derived from carbon management technologies will be a critical driver of the growth of carbon management technologies needed to reach net-zero emissions and actively remove legacy emissions from the atmosphere. These mechanisms include purchase agreements for low-, zero- and negative-carbon electricity, liquid fuels, low-carbon intensity hydrogen, and various products and services sourced through carbon capture, removal, reuse, and storage.

In the past two years, the private sector has shown tremendous interest in providing demand-side support for goods and services produced from carbon management technologies. This includes a range of activities from the procurement of low- and zero-carbon embodied materials such as steel and concrete to significant investment in advanced market commitments for the purchase of carbon removal from direct air capture. However, without additional incentives to produce and purchase these products and services, it is unlikely that they will be able to compete against existing commodities and supply chains and unable to scale within the time frame required by climate ambition. Moving forward, robust, verifiable demand-side policies and mechanisms must play a complementary role to tax credits and other financial incentives on the supply side to help drive private investment in commercial technology deployment.

Develop a federal role in standardizing the marketplace

Purchasers of these products and services sourced from carbon management need confidence that what they're purchasing provides real greenhouse gas emissions reductions as compared to business as usual. The federal government has a central role to play in developing standards for what is needed to track, account for, and verify the carbon reductions from goods and services produced from carbon management. There are two primary measurement and reporting aspects for carbon management projects which are necessary to create durable, verifiable purchasing standards for these goods and services: life cycle assessment (LCA) and monitoring, reporting and verification (MRV).

An LCA is the measurement and analysis of greenhouse gas emissions associated with a particular process or product. It helps purchasers and stakeholders understand the greenhouse gas impacts of a particular process or products and can be used to compare the climate impacts of different products and technologies.[28] The federal government has invested significant time and expertise in establishing LCAs for more mature technology pathways, including for transportation fuels and other energy technologies.

Establishing common LCAs for less commercially mature technologies, including carbon dioxide removal and conversion pathways, can be more challenging as these technologies are not yet demonstrated on a commercial scale and limited data may be available on the various inputs needed for these technology pathways. Additionally, common LCA approaches have proven to be insufficient for many of these technologies. Developing LCA approaches and standards is an area where the federal government will play an important complementary role in the rapidly developing voluntary markets for products and services sourced from carbon management.

MRV involves the measurement of carbon captured, stored, or converted (through LCA or other established protocols at EPA), and then the reporting and independent verification of this information. While MRV processes have been established for qualifying for the 45Q tax credit by the U.S. Department of the Treasury and IRS, federal agencies should assist in establishing MRV for less commercially mature technology pathways, such as emerging CDR technologies. The DOE itself has identified that there is currently a lack of robust and standardized MRV processes to compare carbon management solutions.

Congress can provide additional resources to support the development of both LCA and MRV standards for different carbon management technology pathways, as well as the cross-collaboration between federal agencies and across sectors on such tools. These efforts would complement existing efforts, such as the DOE Carbon Negative Shot, which aims to bring the cost of carbon dioxide removal below $100 per metric ton by the end of the current decade.[29]

Support purchasing of innovative carbon management products and services

The federal government can take novel steps to incentivize the development of the marketplace for products and services from carbon management. Congress can harness the purchasing power of the federal government to establish markets for earlier stage carbon management technologies, including commercially available but nascent products as well as net-negative emissions and fuels sourced from direct air capture. Already, smaller purchasing programs for materials and services sourced from carbon oxides are in statute. This includes the carbon conversion grant program for states and localities, authorized and appropriated by the Bipartisan Infrastructure Law, and a competitive purchasing pilot program for the purchase of carbon dioxide removed from the atmosphere that was included in the fiscal year 2023 Omnibus Appropriations Act. Additionally, bipartisan members of Congress are actively exploring reverse auctions and other federal purchasing programs for carbon dioxide removal as policy mechanisms to establish advanced commitments and begin building markets for these technologies.

Congress can harness the purchasing power of the federal government to establish markets for earlier stage carbon management technologies, including commercially available but nascent products as well as net-negative emissions and fuels sourced from direct air capture.

Piloting such purchasing programs through the federal government allows industry, agencies, and stakeholders to coordinate on establishing standards and MRV protocols while allowing supply chains to scale to capture, abate, and remove gigatons of greenhouse gases. The need for these types of incentives presents Congress with a ripe opportunity to further incentivize large-scale, private purchasing programs.

Jobs, Economic Development, and Affected Communities

Jobs, Economic Development, and Affected Communities

- Leverage existing policy levers to expand support for jobs training
- Collect and disseminate information on air and environmental quality
- Provide technical assistance for community engagement

In addition to reducing or removing carbon emissions and helping to reduce other air pollutants, the widescale deployment of carbon management technologies has the potential to safeguard and create highly skilled jobs that sustain local economies and the families that depend upon them. As the U.S. works to implement a portfolio of federal policy support to ensure that carbon management technologies can deploy at the pace and scale necessary to fulfill their full climate potential, successful and responsible deployment relies on the early and meaningful engagement with potential host communities and local workforces to guarantee that the co-benefits from deployment of these technologies, including carbon capture, direct air capture, CO_2 transport, carbon reuse, and storage, flow directly to affected communities and workers.

...the widescale deployment of carbon management technologies has the potential to safeguard and create highly skilled jobs that sustain local economies and the families that depend upon them.

Leverage existing policy levers to expand support for jobs training

Carbon management is an especially important piece of the larger puzzle to decarbonize heavy industrial, manufacturing, and energy facilities, where high temperatures are required to drive industrial activity and where process emissions from chemical reactions are more difficult to address. Retrofitting these facilities with carbon capture equipment allows for continued operation, avoiding plant closures and preventing the offshoring of jobs and livelihoods which would otherwise increase economic challenges within communities. Traditionally, the jobs associated with installing existing facilities with carbon capture retrofits or constructing direct air capture facilities, in conjunction with accompanying CO_2 transport, reuse and storage projects, rely upon existing labor forces, trades, and skill sets present in oil and gas, mining, and key industrial and manufacturing sectors. In addition to the jobs associated with carbon management projects, there are jobs associated with the equipment, materials (e.g., cement and steel), engineering, and labor required to install the technology, as well as ongoing jobs to operate and maintain the retrofits.

These jobs can bring significant benefits to communities and regions through high wages that have long been a traditional pathway to the middle class for many American families. However, the skilled, high-paying jobs that carbon capture and CO_2 transport infrastructure projects help to safeguard may not be readily available to disadvantaged communities living in close proximity to industrial, power, or direct air capture facilities, and whose residents may not have access to the education or training required for such employment.

High-quality apprenticeship and workforce training programs have traditionally been a path to a career and financial stability. Congress and the administration should take steps to ensure the benefits of the jobs created and protected as a result of deployment of carbon management projects

are reaped by those living in host communities. They include finalizing clear and workable guidance for prevailing wage and apprenticeship requirements for project developers wishing to access the full value of the 45Q tax credit. Additionally, project developers should look to leverage existing federal apprenticeship and skill-training programs to expand support for jobs training undertaken in partnership with community colleges, trade unions, and other local institutions so that the pipeline for the workforce is in place as carbon management industries scale.

Collect and disseminate information on air and environmental quality

Communities that are most vulnerable to climate change also typically suffer the greatest impacts from criteria air and other pollutants generated by nearby industrial and power facilities; carbon management technologies have the potential to play a pivotal role in addressing cumulative pollution in overburdened communities. Common air pollutants that can be removed or significantly reduced using carbon capture and reuse include sulfur dioxide, nitrous oxides, and particulate matter,[30] all of which are criteria air pollutants regulated by the EPA and recognized as harmful to human health and the environment.[31] Carbon capture is a flexible emissions control technology that works on a wide range of industrial facilities and power plants, and in many instances carbon capture retrofits or reuse applications reduce these conventional air pollutant emissions.

Communities that are most vulnerable to climate change also typically suffer the greatest impacts from criteria air and other pollutants generated by nearby industrial and power facilities; carbon management technologies have the potential to play a pivotal role in addressing cumulative pollution in overburdened communities.

Despite the overall promising potential for carbon management projects to help improve local air quality, more detailed data is needed to quantify expected air quality benefits and impacts on criteria air pollutants, as well as on water quality and other environmental factors. Already, the DOE is now requiring projects receiving federal funding to support carbon capture, direct air capture demonstration and deployment to track and report the cumulative climate benefits of projects, as well as non-CO_2 pollutants.

As the DOE collects responses to funding opportunity announcements for carbon management project proposals, the department should make publicly available collected information on available air and environmental quality data associated with proposals. Types of information funded projects may be asked to provide include: the net CO_2 reduction for carbon capture, removal, or reuse systems, and changes to both criteria air pollutants and air toxics (hazardous air pollutants such as lead and mercury) from these systems.[32] In many cases, this information will already be measured, as carbon capture retrofits may result in facilities having to meet more current and usually stricter emissions standards.[33]

DOE collecting and publicly sharing data will accomplish two things. First, it will help communities hosting these projects to better understand the local benefits and impacts of carbon capture retrofits, associated carbon reuse projects, and direct air capture facilities. This information will help to inform decision-making at the local level and determine the need for any additional measures to ensure continued improvement in local environmental quality for

communities. Second, it will help the industry build a standardized approach to collecting and disseminating this crucial information as a routine part of community engagement as the industry scales.

Provide technical assistance for community engagement

As commercial deployment of carbon management technologies matures, so does the potential to spur regional economic growth, improve air quality, and create high-paying job opportunities for communities nationwide. At the same time, it is critical to understand community values and address the societal impacts of these projects. Community engagement is a fundamental part of successful project management and development and must be a part of the decision-making process at every level.

Bridging the gap between carbon management project developers and residents of the host communities who have interest in or skepticism and concerns surrounding carbon management project development and other climate solutions involves engaging with communities early. Prior to siting projects, stakeholders should work alongside community advocates to effectively understand their interests and concerns including potential impacts to land use, habitats, and local communities. Information sharing between communities and project developers can be mutually beneficial, as the best solutions can be implemented when community expertise is treated with the same value as technical expertise. If carbon management technologies are to fulfill their potential as part of a broader solution set for economywide decarbonization, responsible and effective deployment relies upon meaningful and continued public engagement.

As commercial deployment of carbon management technologies matures, so does the potential to spur regional economic growth, improve air quality, and create high-paying job opportunities for communities nationwide.

With a supportive policy framework for carbon management now law, it is anticipated that there will be significant project development and deployment over the next several decades. Already, there have been more than 120 carbon management projects announced across the nation since the significant restructuring and expansion of the federal Section 45Q tax credit in the 2018 FUTURE Act.[34] Additionally, with the transformative enhancements to the foundational 45Q tax credit and the deployment dollars needed to scale these projects now law, it is expected that more projects will be announced in reaction to these enhancements. Carbon management projects already in development are proof that productive, two-way engagement between project developers and communities is a central pillar to successful project deployment. As the industry continues to scale, DOE should continue to provide guidance to project developers on how to best establish robust and meaningful community engagement plans at the outset of project development and throughout the funding process. A portfolio of best practices for community engagement developed and disseminated by relevant DOE offices through federal funding opportunities will be broadly beneficial to the entire carbon management industry.

If carbon management technologies are to fulfill their potential as part of a broader solution set for economywide decarbonization, responsible and effective deployment relies upon meaningful and continued public engagement.

Transport and Storage Infrastructure

Transport and Storage Infrastructure

- Support supplemental safety measures for CO_2 pipelines
- Provide clarity for CO_2 storage projects on federal lands
- Support implementation of Title 41 of the FAST Act
- Provide appropriate regulatory clarity for interstate construction

Commercial-scale deployment of carbon management technologies requires a robust and responsible buildout of an interconnected, nationwide network of carbon dioxide transport and storage infrastructure. This buildout is multifaceted and requires policy mechanisms for CO_2 transport, geologic storage, and carbon reuse. Through the enactment of critical policy tools such as the bipartisan Utilizing Significant Emissions with Innovative Technologies (USE IT) Act, Title 41 of the Fixing America's Surface Transportation (FAST) Act, and most recently the Bipartisan Infrastructure Law, CO_2 transport infrastructure is poised to expand to support the vital decarbonization of key industries and regions. It is estimated that this infrastructure in the U.S. will need to expand up to 25,000–65,000 miles to meet net-zero and midcentury climate targets and incorporate the use of trucks to transport CO_2 from sites that are not economic to connect to pipeline systems. In contrast, nearly 385,000 miles of operational pipelines in the U.S. currently carry petroleum, natural gas, oil, and other products.[35]

As federal funding for both low-interest loans to build common-carrier pipelines and grants to oversize such systems are announced and dispersed, it is essential to instill confidence in both the public and policymakers of the safety of CO_2 infrastructure systems. This includes providing assurance that appropriate federal agencies have appropriate regulatory frameworks and safety protocols in place as these systems scale to meet the anticipated expansion of carbon management projects.

Planning and investing in this infrastructure today will reduce costs and land-use impacts, while realizing necessary economies of scale. As the U.S. works to meet the demand for CO_2 transport and storage infrastructure at the scale imagined, to the extent possible, pipeline siting and construction should use, or be adjacent to, existing utility and transportation rights-of-way and employ high-quality environmental and social data when new rights-of-way are required so as to minimize potential impacts to wildlife and people.

Support supplemental safety measures for CO_2 pipelines

CO_2 pipelines have been operating safely in the United States for more than 50 years. Currently, 50 operating pipelines span over 5,000 miles with individual pipelines safely transporting millions of tons of CO_2 annually over hundreds of miles and across entire regions of the country.[36]

CO_2 pipelines in the U.S. have an excellent safety record. Safety data reported by the Pipeline and Hazardous Materials Safety Administration (PHMSA), the agency charged with overseeing CO_2 pipeline safety in the U.S., shows that CO_2 pipelines have been and can be operated at the highest level of safety by best-practice operators. Since reporting began, CO_2 pipelines have had only one reported injury and no fatalities. However, it is important to recognize that like all infrastructure, there are associated risks from CO_2 pipelines. As such, there are several steps Congress and the administration can take to ensure these transport and storage networks are designed, constructed, and maintained at

rigorous standards delivering the highest levels of reliability and safety while enabling the deployment of these technologies at levels sufficient to meet decarbonization goals:

- **Expand first responder training for CO_2 pipeline safety incidents.** As PHMSA prepares to revisit and potentially enhance safety standards relating to CO_2 pipeline infrastructure, the agency should update training programs for first responders of potential CO_2 pipeline safety incidents. Additionally, this training should be expanded to include local hospital employees and 9-1-1 operators.
- **Require that project proponents more rigorously consider potential geohazard impacts on CO_2 pipelines during design, siting, construction, and maintenance.** Geohazards are geological events that may cause loss of life or significant damage to property, including land subsidence from flooding, landslides, earthquakes, and other events. Additional considerations of these potential impacts would ensure that pipeline networks are resilient and continue to operate safely over time in a changing climate with more extreme weather patterns.
- **Request that PHMSA conduct additional reporting on the public safety record of CO_2 pipelines.** Additional information from PHMSA with regard to the CO_2 transport and storage infrastructure safety and regulatory environment would be helpful for policymakers and stakeholders to make informed decisions during project deployment. Congress should require PHMSA to provide a report containing further public information on the safety record of CO_2 pipelines, an update on the current status of the CO_2 pipeline regulatory regime including annual agency funding levels, and considerations for additional funding necessary for agency staffing as CO_2 pipeline infrastructure projects are deployed. PHMSA has also identified areas of research needed on CO_2 pipelines that may require additional agency funding, including the study of controlled releases on CO_2 pipelines, which should also be included in this report. Additional areas of study may include assessment of the potential role existing or retired natural gas pipeline infrastructure could play in CO_2 transport.
- **Carry out a national assessment of the CO_2 network necessary to meet net-zero emissions.** Building off research conducted by stakeholder groups, the federal government should carry out a national assessment to quantify the capacity and miles of CO_2 pipelines that may be required to meet net-zero emission goals.

Provide clarity for CO_2 storage projects on federal lands

Federal lands are an important national resource and agencies must carefully balance often competing demands placed on these resources. Public benefits provided by federally managed lands include culturally important sites for Tribal Nations, sites for recreation, biodiversity and natural habitats, sources of renewable and non-renewable resources, agriculture, and other public benefits. If properly cited and done in a manner that protects public access and benefit and minimizes surface disturbance, the geologic storage of CO_2 beneath federal lands offers a significant opportunity to catalyze a domestic carbon management industry that will reduce greenhouse gas emissions and create and maintain high-paying jobs. The U.S. federal government owns and manages approximately 30 percent of the total surface area of U.S. land,[37] with the United States Geologic Survey estimating that roughly 130 million acres of potentially suitable storage capacity are overlayed by federal lands.[38] With historic levels of funding and policy support provided for carbon management projects in the 117th Congress, an expected uptick in project deployment is increasing interest in the development of CO_2 storage projects on federal lands.

While the Bureau of Land Management (BLM) has authorized mineral extraction projects that impact the subsurface of federal lands for nearly a century, there has yet to be a Class VI well authorized for permanent CO_2 storage on federal lands. In June 2022, BLM, under the U.S. Department of the Interior, took a step forward in unlocking the CO_2 storage potential by issuing a new policy authorizing the use of federal lands for the geologic storage of CO_2. However, uncertainty remains for CO_2 storage developers, including questions surrounding pore space ownership, land use plans, and interaction with other regulatory agency authorizations for CO_2 storage. Additionally, until the agency has the capacity to implement this new policy and address uncertainties, it is unlikely that the United States will meet CO_2 storage volumes that are in line with 2050 climate goals.

As project developers take advantage of the restructured 45Q tax credit and other federal incentives for the deployment of carbon management technologies, Congress should work with the BLM and other relevant agencies to provide further clarity for CO_2 storage activities on federal lands in ways that are consistent with the agency's multiple-use mandate to manage for wildlife, natural habitats, recreation areas, cultural and historic features, grazing leases and other resources.

Support implementation of Title 41 of the FAST Act

As part of the bipartisan Utilizing Significant Emissions with Innovative Technologies (USE IT) Act, carbon transport and storage infrastructure is eligible for the permitting review process created under Title 41 of the Fixing America's Surface Transportation Act, also referred to as FAST-41. This program is designed to improve the timelines, predictability and transparency of the federal environmental review and authorization process for significant infrastructure projects. This includes construction of any facility, technology, or system that captures, reuses, or stores carbon emissions, including those capturing legacy emissions from the ambient air.

Efficient and effective permitting timelines along with transparency of the federal environmental review process will be critical in scaling the carbon management industry at the pace necessary to keep up with anticipated project deployment incentivized by recent policy successes. Therefore, the administration should require federal agencies to implement the authority established under FAST-41 to ensure that project development can move forward within time frames that ensure successful project deployment.

Provide appropriate regulatory clarity for interstate construction

While there is clear regulatory authority given to PHMSA over the safety of CO_2 pipelines, the authority to regulate siting, construction, and operation activities is currently handled on a state-by-state basis. In contrast, natural gas pipelines that cross state lines are considered interstate commerce and are overseen by the Federal Energy Regulatory Commission under the Natural Gas Act. Carbon dioxide differs from natural gas in its consumption and industrial use, making certain components of the Natural Gas Act inappropriate if applied to CO_2.

However, clarity surrounding the interstate construction process for CO_2 pipelines could provide additional certainty to project developers. First and foremost, any such clarifications should "do no harm" and not hinder existing processes and timelines for the buildout of CO_2 transport infrastructure. Congress and the administration should continue to engage with developers and communities to identify any potential long-term solutions for regulatory authority over interstate CO_2 transport that can support the carbon management industry as it continues to grow in the decade ahead.

Resources for Next Generation Technology Deployment

Resources for Next Generation Technology Deployment

- Build upon momentum provided by federal demonstration programs
- Continue to scale federal funding for core carbon management activities
- Ensure the rapid scale-up of the carbon management industry

Carbon capture, removal, reuse, transport, and storage projects and associated infrastructure must be deployed quickly to reach ambitious 2030 deployment goals. Doing so will establish new benchmarks in technical maturity, ease of construction, affordability, and effective and timely permitting processes. Meeting these benchmarks will enable the industrial, power, and CO_2 transport and storage sectors to make the massive carbon capture investments necessary for achieving net-zero emissions economywide by 2050.

Meeting these midcentury targets, however, requires sustained and increased investment and information sharing to scale up carbon management technologies and enable deployment in a coordinated fashion. Recent historic bipartisan investments in carbon management technologies have begun a course-correction of federal investments in carbon management technologies relative to other low- and zero-emissions technologies, with the Bipartisan Infrastructure Law providing just over $12 billion for carbon management RDD&D, or 20 percent of the law's overall funding, dedicated to energy technologies. These investments ensure that federal funding and incentives for carbon management technologies more closely align with funding levels other emissions reducing technologies have benefitted from historically.

While these monies will provide crucial investments in commercial-scale demonstrations across the carbon management supply chain, the U.S. will need to continue to make increased RDD&D investments across carbon management technologies to see the levels of commercial deployment necessary to fully decarbonize the U.S. economy and

Recent historic bipartisan investments in carbon management technologies have begun a course-correction of federal investments in carbon management technologies relative to other low- and zero-emissions technologies.

meet global temperature targets. Through long-term investments in carbon management technology innovation, the United States also has a once-in-a-generation opportunity to further establish domestic leadership in low- and zero-emissions technology development that is affordable, reliable, and exportable.

Build upon momentum provided by federal demonstration programs

Now, for the first time thanks to the Bipartisan Infrastructure Law, the federal government has a stand-alone office that will oversee clean energy demonstrations across technology categories through the newly established Office of Clean Energy Demonstrations (OCED). Demonstration is

a key stage on the road to commercial availability of any technology, but demonstrating capital-intensive energy technologies, including carbon management, is time intensive and expensive, giving the private sector little appetite to commercially demonstrate these less mature technologies.

The establishment of OCED was long championed by a diverse group of clean energy advocates and stakeholders who recognized the role that public investment must play in energy technology demonstration. The newly minted office is charged with the independent oversight of large-scale energy demonstration projects that cuts across DOE offices and programs.

Currently, OCED has a five-year authorization provided by the BIL; however, continued support from the federal government will be an integral part of demonstrating less commercially mature carbon management technologies. OCED is building the expertise to manage these projects at the scale necessary for economywide deployment which will be a critical DOE function over the course of the next several years. To maintain the initial momentum for the pivotal activities provided by the Bipartisan Infrastructure Law, Congress should provide sustained investments in OCED for the office to fulfill its intended purpose.

For carbon management specifically, nearly $3.5 billion is provided for large-scale pilots and commercial demonstrations, and the law specifies that two projects must be in the industrial sector and four demonstration projects must be in the power sector. While these funds will support important first-of-a-kind demonstrations, it is important to note that many sectors that emit significant amounts of greenhouse gases will still struggle to make carbon management retrofits pencil out due in large part to the erosion of the value of the 45Q tax credit by inflationary pressures.

First-of-a-kind demonstration of large, complex technologies requires significant investment and is an important step in the process of reducing costs enough to incentivize investment by the private sector at levels currently provided by the 45Q tax credit.[39] There will be additional needs beyond initial investments provided by the Bipartisan Infrastructure Law, particularly to demonstrate carbon capture technologies in heavy industry sectors including cement, steel, refining, and others.

Continue to scale federal funding for core carbon management activities

The 2021 historic investments for carbon management contained within the Bipartisan Infrastructure Law, coupled with regular year-over-year increases to annual RDD&D funding for relevant activities at DOE, have laid the groundwork for the commercialization and deployment of carbon management technologies. However, these investments should not be viewed as a high-water mark for funding for these technologies but instead be seen as providing the building blocks for establishing an even more ambitious level of federal support that is necessary to commercialize a sufficiently broad portfolio of emission reduction technologies.

Sustained federal investment in less commercially mature and transformational carbon capture, removal, reuse, and storage technologies and processes will provide needed continuity in federal programming and remains a critical component of driving down costs. Recent analyses indicate that without further cost reductions, the cost of deploying carbon capture technologies will still exceed the current value of 45Q in certain

applications.[40] Examples of these types of investments include:

- Increased funding for demonstration of industrial carbon capture activities authorized by the 2020 Energy Act;
- Appropriations for relevant carbon management authorizations enacted by the CHIPS and Science Act;
- Further buildout of federal funding and support for earlier scale carbon dioxide removal technologies;
- Increased federal support for the development of robust monitoring, reporting, and verification protocols for the full suite of carbon management and carbon dioxide removal technology pathways.

Ensure the rapid scale-up of the carbon management industry

Commercial deployment of carbon management technologies should reduce costs through "learning by doing"; but this is only achieved when knowledge is shared between project proponents. While there has been successful commercial demonstration of carbon management technologies at power plants and in certain industrial sectors, the proprietary nature of capture technologies has limited the knowledge transfer between project operators and external stakeholders. This lack of information sharing means that lessons learned cannot be broadly shared from taxpayer-funded project demonstrations. To scale the industry at the rate required by 2030, DOE should require that project developers use common specifications and generic technology solutions for capture retrofits for federally cost-shared pilots and demonstrations. Public sharing of certain information related to taxpayer-funded demonstration projects does not preclude project developers from making continual improvements to proprietary technologies.[41]

Additionally, Congress placed funding restrictions on carbon management project developers that receive federal funding in the 2009 Omnibus Appropriations Act. Currently, project developers are restricted from receiving both a federal grant and a loan from the DOE-administered Loan Program Office and this restriction ultimately hinders the rapid development and deployment of carbon management technologies. In practice, this means that an earlier stage technology that receives a grant and proves commercially viable cannot then later apply for a loan from the Loan Program Office. Congress should remove this restriction so that DOE can support the rapid development of the full value chain of carbon management technologies.

Ensuring Investment Certainty

Ensuring Investment Certainty

- Increase credit levels for carbon reuse for commercial products
- Index 45Q to inflation immediately to ensure carbon management's progress
- Provide clarity and certainty to the 45Q reuse pathway
- Catalyze the growth of a diverse carbon management industry
- Ensure the intended impact of the direct pay mechanism

With crucial enhancements to the 45Q tax credit now enshrined in law, along with the portfolio of complementary policies enacted throughout the course of the 117th Congress, project proponents have a strong foundation to bolster the widespread deployment of carbon capture, removal, reuse, and transport and storage technologies in central sectors including heavy industry, power, and direct air capture.

Recent enhancements to the 45Q tax credit will help to close the cost gap between levels of financing available for project deployment and necessary financing needed to develop first-of-a-kind projects or less commercially mature technologies in several sectors. However, further small-scale adjustments to the tax credit will be necessary to ensure investment certainty and business model flexibility. Combined with additional guidance from the U.S. Department of Treasury and the Internal Revenue Service expected in 2023 on the updates made to the 45Q program, the further adjustments outlined below would serve to maximize the number of sectors able to access the credit and provide greenhouse gas emissions reductions, as Congress intended.

These complex and capital-intensive projects can have lead times of five years or more before beginning construction. This is especially true for those projects pursuing CO_2 storage in appropriate geologic formations due to longer permitting timelines, or those deploying technology in certain industrial sectors with little or no prior experience with commercial-scale carbon capture. Therefore, it is paramount that Treasury and IRS work to implement these provisions in a timely manner.

Further adjustments to the section 45Q tax credit include providing increased value to the nascent and diverse carbon reuse sectors and adjusting the inflation indexing of the tax credit to begin immediately rather than in 2026, so that inflation does not impact the value provided by the tax credit. As the U.S. Department of Treasury and IRS provide guidance and regulations on implementing the enhancements to the 45Q tax credit, the agency should consider several clarifications or modifications to existing regulations that will ensure the maximum number of eligible facilities can claim the tax credit and achieve the full climate, economic, and jobs benefits of carbon management.

Increase credit levels for carbon reuse for commercial products

Increasing credit levels for the nascent carbon reuse sector, which is the conversion of carbon oxides to produce commercial products, is necessary to realize commercial viability for this portfolio of technologies. While legislative action by the 117th Congress increased 45Q credit values across the board, the credit is bifurcated between permanent storage of captured CO_2 and the utilization of CO_2 for the reuse for commercially valuable products or to produce additional oil in depleted oil and

gas wells. Relative to using CO_2 for the purposes of producing additional oil, reusing carbon to produce valuable products is not yet cost competitive with incumbent technologies. Creating parity for carbon reuse with the geologic storage credit is a necessary and important step to provide commercial certainty to this nascent but growing sector and to support full decarbonization of the economy.

To claim the 45Q tax credit, taxpayers must successfully demonstrate secure geologic storage of captured or reused CO_2. This information is then publicly available via the EPA.

Increasing the CO_2 reuse pathway to $180/ton for products sourced from direct air capture and $85/ton for those products sourced from industry and power will further incentivize the deployment and innovation of carbon conversion for low- and zero-carbon products, including fuels, chemicals, and building materials. Additionally, carbon reuse can address sources of emissions that are too small to be economically captured and transported, or too far removed from appropriate storage sites. Reusing captured carbon to produce useful products is just one component of the carbon management sector and estimates of the volume of CO_2 reused in a net-zero economy depend on the available market for these products and value of CO_2. Despite the need to store CO_2 permanently at gigaton scale, available markets for carbon reuse are significant. Current estimates on the potential uptake of CO_2 reuse to make valuable products range from 5 to 10 percent of global emissions,[42] or several gigatons per year.[43]

Index 45Q to inflation immediately to ensure carbon management's progress

Increased credit values provided to projects developed in the industry, power, and direct air capture sectors are the cornerstone of the recent enhancements made to the 45Q program through the Inflation Reduction Act. 45Q credit values must keep pace with inflation so as to not erode the value of the credit; however, unlike other low- and zero-emissions technology tax credits recently reformed under the 117th Congress, the 45Q tax credit value is not adjusted for inflation until 2026.

As one example, $85 per metric ton provided for industrial and power sources storing captured CO_2 in appropriate geologic formations is within the cost range for capture, transport and storage of CO_2 from numerous industrial and power sources that are crucial to decarbonize. Modeling predicts that the $85 per ton credit for industrial and power sectors could allow the U.S. to capture and store 48 million metric tons of CO_2 by 2031 in the industrial sector alone.[44] However, $85 per ton only meets the basic financing needs of many carbon capture projects and will not make every project feasible. While it's true that further technology deployment will reduce the costs of project deployment through "learning by doing," the effects of persistent inflation could significantly erode the ability of the 45Q tax credit to meet its full emissions reduction and jobs creation potential.

Without further adjustment to the 45Q tax credit to begin inflation adjustment immediately, the real value of the non-inflation-adjusted 45Q tax credit has already been significantly diminished, and if inflation rates continue to rise, further erosion of the tax credit's value will curtail project development in the industrial, direct air capture, and power sectors. Already, much of the value increase realized in recent 45Q enhancements have been eroded due to significant inflation in both capital goods costs and energy price increases.[45] To prevent erosion of the tax credit's value, and by proxy, the ability to develop these

projects, the 45Q tax credit must be indexed for inflation much sooner than current statute allows. Not only will this ensure meeting the sector's contribution to climate goals, moving the inflation indexing start-date up is consistent with the inflation adjustments currently enacted for other clean energy tax credits.

Provide clarity and certainty to the 45Q reuse pathway

The Section 45Q tax credit, in its significant expansion in the 2018 FUTURE Act, established a federal incentive for the important but nascent carbon reuse sector. However, when the U.S. Department of Treasury and IRS finalized regulations for the 45Q tax credit in 2021, they inadvertently created a much higher barrier for project developers in this diverse sector wishing to monetize the 45Q tax credit relative to other eligible technologies. The LCA process outlined in final regulations is onerous and creates a significant barrier for reuse project developers wanting to access the tax credit. In particular, the U.S. Department of Treasury and the IRS require pre-approval of each LCA by the DOE, prior to claiming the 45Q tax credits for any taxable year. Additionally, final guidance from Treasury and IRS provides no specific timeline for this preapproval process. Life cycle analysis is an important component of the carbon reuse pathway in the 45Q program; however, preapproval is not a requirement for any other pathway under 45Q. A preapproval process that requires developers to commence construction before a project can be determined to be eligible for 45Q creates significant financial uncertainty for project developers.

As the Treasury and the IRS work to implement the 45Q enhancements now in statute, the Coalition will seek to work with relevant federal agencies to find a workable solution to this issue that maintains public and policymaker confidence in the emissions reduction potential of technologies wishing to qualify for the 45Q tax credit, while ensuring that carbon reuse projects can secure project financing.

Catalyze the growth of a diverse carbon management industry

The dramatic reduction in annual capture thresholds for industry, power, and direct air capture facilities included as part of the IRA is expected to greatly increase the number of eligible carbon management projects and significantly expand the program and its emissions reduction and economic development potential. Reflective of its sectoral and member diversity, the Coalition is committed to ensuring that the greatest number of industry sectors can qualify for the 45Q tax credit that may not have been originally imagined when the 45Q statute was first envisioned.

So long as eligible facilities are capturing qualified carbon oxides and subsequently meeting monitoring, verification and reporting standards for carbon storage, or LCA processes for carbon reuse, the Coalition maintains that ultimately, these innovative technologies should be able to monetize the 45Q tax credit as Congress intended in the 2018 FUTURE Act.

However, there are still a number of cases where projects or industry sectors broadly meet the definition of a 45Q-eligible facility and intend to meet established regulations required to claim the tax credit, but may not be able to ultimately claim the tax credit for a number of reasons, which may include:

- The definition of industrial facilities contained in 2021 regulations promulgated in response to the 2018 FUTURE Act may unnecessarily preclude certain technologies that otherwise capture qualified carbon emissions. One such example is a facility used to flare biogas and capture the resultant CO_2 which would otherwise be released into the atmosphere.

- Final regulations issued in 2021 allow taxpayers to aggregate multiple qualifying facilities capturing carbon emissions. Providing additional clarity to the factors IRS uses to determine the ability to aggregate multiple qualified facilities so they are considered part of a single project will allow additional facilities to be eligible for the tax credit. This is particularly significant for smaller scale capture and direct air capture technology applications which have the potential to provide emissions reductions in critical but challenging to decarbonize sectors, including fossil fuel intensive processes at small industrial facilities and mobile sources.
- Providing clarity on the interaction of 45Q with other newly enacted clean energy tax credits in the Inflation Reduction Act. While the statute is clear that a taxpayer cannot claim both 45Q and 45V (the clean hydrogen tax credit) at any given "facility," facilities can contain multiple, entirely separate processes. One example is a facility that produces hydrogen from renewable sources at the same site (but from different processes) from a carbon capture facility.

As the Treasury and IRS work to implement the further enhancements to the 45Q tax credit made by the 117th Congress, the Coalition will seek to ensure that any final guidance from the agencies provides flexibility and allows the maximum number of eligible facilities to claim the tax credit. Doing so will enable the greatest amount of emissions reductions, while also creating the greatest potential positive economic impact and jobs creation potential.

Ensure the intended impact of the direct pay mechanism

The recently enacted direct pay mechanism for carbon management project developers is poised to deliver the significant jobs, economic and greenhouse gas reduction benefits initially sought by Congress in the landmark, bipartisan reform and expansion of the 45Q tax credit in 2018, and subsequent enhancement of the program in the 117th Congress. Since the Coalition's 2021 Policy Blueprint, which touted the importance of providing a direct pay option to carbon management project developers to provide the full value of the tax credit, a growing chorus of support for a permanent direct pay mechanism has since emerged from technology proponents and other clean energy industries and advocates, including members of Congress across the political spectrum.

Providing a permanent direct pay mechanism will unlock broader financial markets and leverage greater private capital for investment in projects, thereby accelerating the deployment of existing technologies. The certainty provided by this policy will also allow new business models to become profitable, since tax equity markets demand a significant portion of the tax credit, thus reducing the real value of 45Q in financing innovative technologies. The current direct pay mechanism enacted through the Inflation Reduction Act allows for-profit entities to receive the full value of the tax credit at no extra cost to the American taxpayer for the first five years of the credit and nonprofit entities to receive direct pay for the full 12 years.

However, for-profit entities utilizing the financing mechanism for the first five years of the credit would create tremendous fiscal uncertainty to finance the remaining years of the credit. As Congress weighs targeted measures to address greenhouse gas emissions while bolstering the American economy, extending the impact of the existing voluntary direct pay mechanism to cover the lifetime of the credit would provide greater investment certainty to project developers and deliver the jobs, economic, and emissions reduction benefits of the 45Q program in a more cost-effective manner. Importantly, this change can be implemented at a low budgetary score.

Conclusion

The Coalition's 2023 Federal Policy Blueprint outlines a comprehensive federal policy and regulatory agenda that will be pivotal to commercializing carbon capture, removal, transport, reuse, and storage technologies to meet 2030 deployment goals. Paired with the swift and coordinated implementation of supportive federal policies for carbon management, realizing this agenda will ensure that carbon management technologies can aid in fully decarbonizing the American energy economy while preserving and expanding a high-wage jobs base in key sectors in nearly every state in the nation and providing reliable, affordable domestic energy.

The last two years have shown the tremendous momentum behind the full suite of technologies in the carbon management value chain, as evidenced by the now more than 120 publicly announced carbon capture, direct air capture, CO_2 transport, reuse, and storage projects. Building on these recent successes, the 118th Congress now has the opportunity and responsibility to reinforce the role of American leadership in the development and deployment of these technologies to meet 2050 climate targets while ensuring that benefits from project deployment flow to affected communities in the form of economic development, high-wage jobs, and environmental co-benefits.

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Glossary

BIL – Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act of 2021)

BLM – Bureau of Land Management

CDR – carbon dioxide removal

CHIPS – Creating Helpful Incentives to Produce Semiconductors (CHIPS and Science Act of 2022)

CIFIA – Carbon Dioxide Transportation Infrastructure Finance and Innovation Act

CO – carbon monoxide

CO_2 – carbon dioxide

DAC – direct air capture

DOE – U.S. Department of Energy

EPA – U.S. Environmental Protection Agency

45Q – Section 45Q of U.S. Internal Revenue Code – tax credit for CO_2 storage or reuse from CO_2 or CO which is captured from industrial sources, power generation or through direct air capture

FAST-41 – Fixing America's Surface Transportation Act, Title 41

FUTURE – Furthering carbon capture, Utilization, Technology, Underground storage, and Reduced Emissions (2018 FUTURE Act)

IEA – International Energy Agency

IPCC – Intergovernmental Panel on Climate Change (United Nations)

IRA – Inflation Reduction Act

LCA – life cycle assessment

MMt – million metric tons

MRV – monitoring, reporting, and verification

OCED – Office of Clean Energy Demonstrations, U.S. Department of Energy

PHMSA – Pipeline and Hazardous Materials Safety Administration

RDD&D – research, development, demonstration, and deployment

UIC – Underground Injection Control [Program] (EPA regulations)

USE IT Act – Utilizing Significant Emissions with Innovative Technologies Act

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