CARBON CAPTURE COALITION

To: Office of Fossil Energy and Carbon Management, US Department of Energy
From: Carbon Capture Coalition
Contact: Sangeet Nepal, Technology Specialist, Carbon Capture Coalition
snepal@carboncapturecoalition.org
Date: January 6, 2025
Re: DE-FOA-0003471

Executive Summary:

The Carbon Capture Coalition appreciates the Department of Energy's (DOE) effort in initiating the process of collecting public comments to continue the mission of the CarbonSAFE initiative to rapidly develop and deploy carbon storage sites necessary to enable the decarbonization of the US economy. CarbonSAFE has been one of DOE's most significant success stories and has played a role in carbon management technologies emerging as a powerful economic driver in the US, encouraging innovation, job creation and preservation, and attracting investment in new technologies.

The US boasts some of the world's most abundant geologic storage formations for the safe and permanent storage of captured carbon dioxide (CO_2). Through private-public partnerships, DOE has been identifying and studying potential CO_2 storage sites across the country since the early 2000s, and thanks to these investments, the US is arguably the global leader in carbon storage research, development, and deployment. Moving forward, it is imperative that carbon management technologies remain at the heart of a national strategy for good jobs in clean, American industries.

However, while the US currently holds a global leadership position in the demonstration and deployment of these technologies, nations like China, Canada, the UK, and the EU are investing significantly in this expanding sector. Carbon management can improve America's strategic position in global markets and reinforce our position as the global leader in decarbonization. As global demand for low-carbon products continues to increase, leading the charge in commercializing carbon storage technologies will help the US maintain a strong, resilient economy and continue to compete in global markets. This balance between energy production and environmental stewardship is crucial for long-term leadership in the evolving global energy landscape.

DOE's work in geologic CO_2 storage research and development for more than two decades has overwhelmingly demonstrated that geologic storage of CO_2 is a safe and

permanent practice with a very low risk of CO_2 migrating outside the target formation when properly sited and carried out.

Scaling carbon storage is essential to achieving commercial liftoff and widespread deployment of carbon capture technologies across emitting sectors and removing CO_2 directly from the atmosphere. According to DOE, the country's geologic storage capacity is anywhere from 2.2 trillion to 21.2 trillion metric tons of CO_2, which can permanently store thousands of years' worth of US emissions.

Increasing demand for low-carbon products and significant federal investments in carbon management and associated infrastructure over the past few years have spurred the announcement of approximately 225 publicly announced carbon management projects, including carbon capture, CO_2 removal, transport, utilization, and storage. Over three-quarters of announced capture and removal projects plan to use Class VI wells for storage. As depicted in the figure below, many facilities where carbon capture is economically viable are located near geologic formations suitable for saline storage, further supporting large-scale deployment in the near-term.

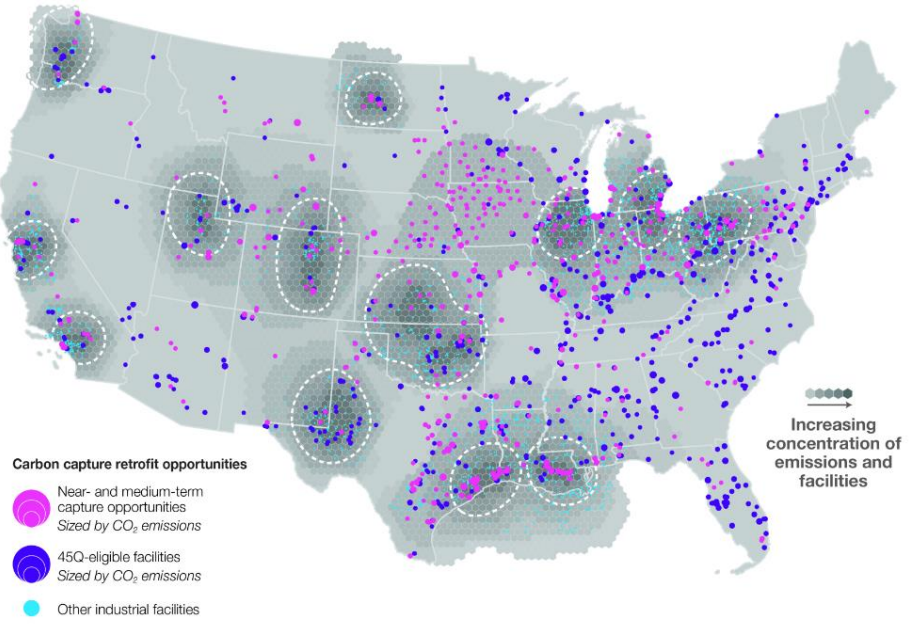

Figure authored by GPI based on Abramson, McFarlane, and Brown, *Transport Infrastructure for Carbon Capture and Storage*; EPA GHGRP 2019 data (as of August 7, 2021).

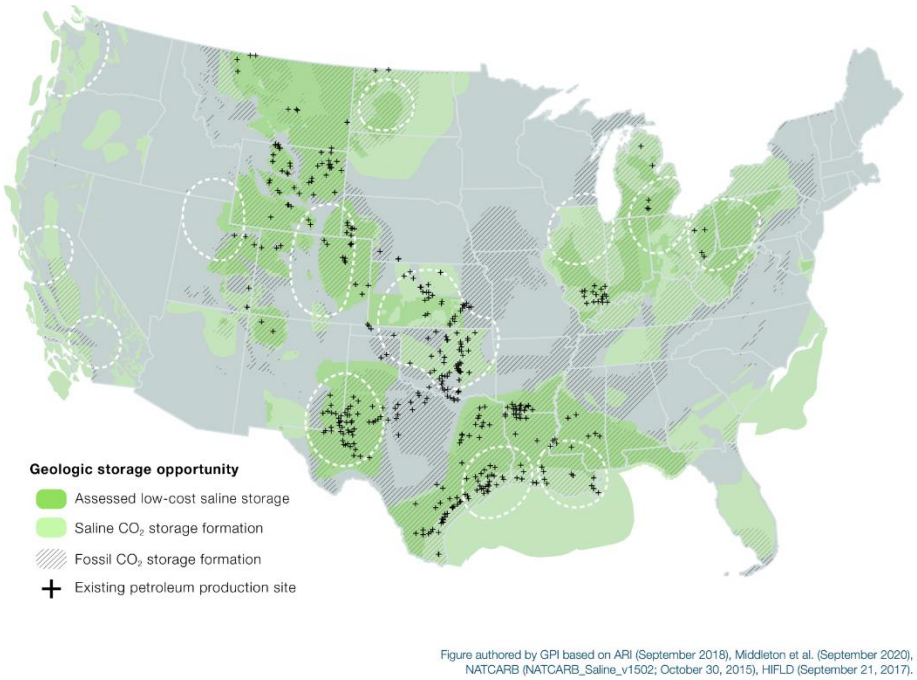

Figure 1: 45Q-eligible facilities and other near- and medium-term capture opportunities show potential carbon capture hubs (Top). Locations of saline storage formations overlain with potential carbon capture hubs (Bottom).[1]

The US build-out of the infrastructure required for carbon storage, in addition to carbon capture retrofits at industrial and power facilities, as well as the anticipated deployment of large-scale direct air capture facilities, will create a large number of high-wage jobs requiring a variety of skill sets in both construction and operations while protecting our nation's existing domestic energy, industrial, and manufacturing jobs. The development and deployment of carbon management technologies provide a unique opportunity for the US to improve its strategic position in global markets and reinforce our position as the global leader in decarbonization.. Commercially available carbon storage sites are the lynchpin to scaling the full carbon management supply chain and associated jobs and economic benefits.

Historically, robust and wide-ranging bipartisan support for carbon management technologies has played a crucial role in advancing efforts to deploy these technologies at the levels necessary to meaningfully impact rising global temperatures while safeguarding our nation's economic interests.

1. **To what extent has the CarbonSAFE initiative accelerated the deployment of carbon storage in the U.S. thus far? What factors in the program design**

[1] Fry, Matt, et al. *Carbon and Hydrogen Hubs: An Atlas for United States Decarbonization*. Great Plains Institute, February 2022. Accessed online.

have resulted in the selection and performance of projects that can achieve this objective?

The CarbonSAFE program has been fundamental in establishing US leadership in carbon storage, including early characterization of subsurface geology and research and development (R&D) on carbon storage and necessary measurement, monitoring, reporting, and verification (MMRV) requirements. As a core part of DOE's Carbon Storage R&D Program, CarbonSAFE has been one of the most successful funding initiatives of DOE. In the first six years of implementation, the CarbonSAFE Initiative completed 19 projects (13 Phase I; 6 Phase II) and initiated five Phase III projects.

Table 1: Relevant information on the CarbonSAFE initiative funded under the Bipartisan Infrastructure Law (BIL)

Category	**Details**
Investment from BIL	$2.5 billion
Timeframe for Appropriations	FY 2022–FY 2026
Availability	Until expended
Funding Opportunity Announcement	DE-FOA-0002711 (FOA-2711)
Awarded Funds	~$595 million
Awarded Projects	- 8 Phase II projects - 15 Phase III projects
Ongoing Award Negotiations	~$560 million - 12 Phase II projects - 10 Phase III projects - 1 Phase III.5 project - 1 Phase IV project

Since the initiative's inception in 2016 through the third release of FOA-2711, 83 projects across the country from Phase I through Phase IV are slated to directly benefit from a combination of annual appropriations and BIL funding. This public-private partnership established through CarbonSAFE is critical in addressing challenges by collecting geologic data from US basins to close R&D knowledge gaps, thereby enabling more efficient site screening, characterization, and development of carbon storage infrastructure.

The CarbonSAFE initiative has been central to facilitating the progress of projects across the various development stages:

- Phase I: collecting, analyzing, and modeling the storage site data crucial in understanding the economic feasibility.
- Phase II: evaluating the reservoirs' feasibility to determine the suitability for geologic storage of more than 50 million metric tons of CO_2.
- Phase III: Identifying storage sites within the storage complex and prepare and submit Underground Injection Control (UIC) Class VI permits to construct each proposed injection well at the sites.
- Phase III.5: Completing National Environmental Policy Act determination and issuance of permits.
- Phase IV: Drilling and completion of the injection and monitoring wells, which completes the end goal of successful injection in the subsurface.

Overall, the step-by-step approach of these phases is critical in ensuring the technical, safety, and social aspects of the storage projects are sound and result in selecting eligible projects to achieve at least 50 million metric tons of CO_2 on each facility over a 30-year period.

2. **Do you think the CarbonSAFE initiative has been a successful component of DOE's mission to establish 65 million metric tons of CO_2 per year of commercial injectivity by 2030 and 100 million metric tons of CO_2 per year of commercial injectivity by 2035? What factors of the CarbonSAFE program have been beneficial in achieving these goals, and what changes would better position the program for success?**

The phased structure of the CarbonSAFE initiative has resulted in the selection of projects that can help achieve DOE's goal of safely and permanently storing 65 million metric tons of CO_2 per year in the United States. A clear program framework and predictable solicitation schedule of the initiative have been instrumental in enhancing project and program success by effectively helping project developers manage budgets and timelines. Overall, the initiative has elevated confidence among project developers, regulators, and the public to successfully deploy large-scale commercial storage. In 2019, carbon capture and storage projects supported by DOE and organizations worldwide injected over 25 million metric tons of CO_2, demonstrating no negative impacts on human health or the environment.

Today, in the US, out of approximately 225 carbon management (carbon capture, utilization, transport, storage, and CO_2 removal) projects that have been publicly announced, more than three-quarters of these projects intend to store captured CO_2 in Class VI wells. Class VI wells are used to inject CO_2 into deep geologic formations more

than a mile underground to solely store captured CO_2, which is often referred to as dedicated storage. EPA established this well class separately from Class II to provide specific regulations for projects whose purpose is dedicated geologic storage. EPA tailored Class VI program rules to address the permanent storage of CO_2 and ensure that wells are appropriately sited, constructed, tested, monitored, funded, and closed once injection activities are completed.

While $2.25 billion out of the $2.5 billion fund available for the CarbonSAFE initiative under the BIL has been made available under FOA 2711, thus far, DOE has only awarded about $595 million for 23 projects. An additional approximately $560 million of funding for 24 selected projects is still under negotiation with DOE. Expeditious negotiations with these selected projects are necessary to advance them.

Additionally, to address the growing need for CO_2 storage infrastructure and meet the objective of storing at least 65 million metric tons per year by 2030, the Coalition provides the below recommendations to DOE. These recommendations propose that DOE take a multi-pronged approach, prioritizing available large-scale storage opportunities through Phase III-IV in the near-term while simultaneously allowing for continually expanding the scope of the CarbonSAFE program, to build toward developing additional storage opportunities in the medium- to long-term.

1. In keeping with the program's goal of large-scale geologic storage development, DOE should prioritize regions with greater near-term storage opportunities by expeditiously facilitating the development of commercial large-scale carbon sequestration projects with substantial capacity to store CO_2 from multiple nearby carbon capture projects.
    - Focus on large-scale projects (defined by DOE as storing at least 50 million metric tons over a 30-year period) to facilitate the deployment of commercial large-scale carbon sequestration projects.
    - Prioritize Phase II, III, and III.5 projects that demonstrate commercial readiness prior to Phase IV.
2. Support more projects within Phase IV.
    - At present, the North Dakota CarbonSAFE project is the only project selected under Phase IV. It is important to have projects within the other phases facilitated as expeditiously as possible to increase the maturity of the projects and make them eligible for funding under Phase IV.
3. Facilitate interagency coordination of Class VI permit application and state primacy review process.
    - Continue to facilitate coordination between funded CarbonSAFE projects and EPA/state regulators by using subsurface data and findings from the CarbonSAFE Initiative to refine reservoir analysis, assist in evaluating injection sites, and support EPA permitting decisions.

4. Address research gaps in basalt formations (for in-situ mineralization) by characterizing and estimating the storage potential to explore and expand the injection practices.
    - Currently, the CarbonSAFE initiative supports relatively few projects related to basalt formations. DOE should leverage the know-how from projects such as the HERO Basalt CarbonSAFE project to target its support to projects focused on basalt formations.

3. Has the CarbonSAFE initiative addressed all the geographic locations and geologic settings it needs to address in order to accelerate CCUS deployment? If not, what additional geographic locations or geologic settings would be required to meet the goals stated above, and how would they further accelerate the deployment of carbon storage in the US?

The CarbonSAFE initiative has supported a diverse portfolio of projects across the country. Still, some opportunities to expand the geographic locations of the initiative across the country remain, as detailed below:

- Prioritize Phase III, Phase III.5 and Phase IV Projects in near-term high-potential regions:
    - Focus on funding Phase III, Phase III.5 and, specifically, Phase IV projects in regions with the greatest potential for near-term carbon storage deployment.
    - Priority should be given to areas with demonstrated CO_2 storage capacity, clusters of emissions sources, and advanced carbon capture projects. Some examples may include, but are not limited to, the Gulf Coast, the Appalachia Basin, Permian Basin, and Illinois Basin regions.
- Support additional projects related to the outer continental shelf to expand the initiative's footprint offshore:
    - With joint Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE) rules to allow for carbon storge projects on the outer continental shelf being drafted, DOE should look to continually expand its geographic locations offshore to accommodate the growing need to identify safe, secure geologic storage.
- Support additional projects tied to basalt formations to broaden the initiative's footprint across the country, particularly in the Pacific Northwest and Southeast region.

4. **Do you believe the CarbonSAFE initiative requirement that a storage complex be capable of storing a minimum of 50 million metric tons of CO_2 over 30 years is overly restrictive? If so, what size (in metric tons and injection duration) would constitute a "commercial large-scale" CO_2 storage complex?**

The CarbonSAFE initiative's requirement of storing a minimum of 50 million metric tons of CO_2 over 30 years is not overly restrictive. It should continue per the statutory requirement laid out in 42 USC §16293(a)(1)(B). A storage complex capable of storing 50 million metric tons of CO_2 over 30 years would mean that such a complex would store a minimum of 1.7 million metric tons per year, representing a moderately sized commercial project. A site of this size would be unable to accommodate a large multi-hub capture and storage project necessary to reach economywide deployment of carbon capture and removal technologies.

DOE's carbon storage program and CarbonSAFE's scope should focus on those Phase III, III.5, and IV projects that can accommodate larger volumes of CO_2. For example, if all 83 projects supported under the CarbonSAFE initiative achieve the minimum program requirements of 50 million metric tons stored over 30 years, the storage capacity of the complex from all of these projects would be less than 150 million metric tons per year. However, to meet the United States' capture and storage targets, a commercial large-scale CO_2 project would need to capture around 8.5 million metric tons annually or at least 250 million metric tons over the 30-year period. Meeting these targets will also help to keep US industries and products competitive in the global market which is increasingly low-carbon.

5. **Are the allocation of funding amounts and cost-sharing requirements on the various Phases of CarbonSAFE initiative specified in DE-FOA-0002711 appropriate?**

The funding levels and cost-sharing requirements have been well-suited to the different phases of the CarbonSAFE initiative. To meet the program's goal of enabling the injection of at least 65 million metric tons of CO_2 annually by 2030, it is essential to expeditiously award and execute multiple Phase IV construction projects within the next two years as well as continue to make program funding available for all phases, to build toward availability of carbon storage sites across the nation. More broadly, sustained government support and investment in the CarbonSAFE initiative will be vital for the widespread deployment of carbon management technologies economywide.

6. **Are there any other requirements or restrictions of the CarbonSAFE initiative that may have discouraged potential applicants from submitting an application to DE-FOA-0002711? If so, how can these requirements/restrictions be modified to increase the applicant pool?**

Uncertainty and delays in award timelines and funding negotiations may discourage applicants, particularly in later stages focused on commercialization, since these projects are focused on reaching a final investment decision, a critical project development milestone. Providing all selectees with a specific timeline for the award negotiation can provide certainty and help project developers with any unforeseen circumstances and contingencies with the project. Additionally, DOE should expeditiously complete the award negotiations of the previously 24 selected projects, totaling approximately $560 million in federal cost share for selected projects.

7. **How has the CarbonSAFE initiative led to a better understanding of the risks (i.e., public health and safety) and benefits (i.e., environmental and emissions reductions) of CCUS for host communities, including through tools such as two-way community engagement, community benefits agreements, workforce agreements, and incorporation of community input into siting and planning decisions? How has the CarbonSAFE initiative led to a better understanding of community concerns with CCUS, a better understanding on how to engage communities that may be impacted by CCUS projects, and a better understanding of actions or project design that may address common concerns with CCUS projects? To what extent have these efforts succeeded in achieving CCUS projects that better work for local communities and long-term support for CCUS? Is there more the CarbonSAFE initiative can do to accelerate the safely deployment of CCUS and address public concerns by prioritizing economic, environmental, and other societal benefits?**

The CarbonSAFE initiative's support has explored aspects of geologic storage to ensure that CO_2 can be safely and permanently contained in appropriate geologic formations by accumulating information and learnings to help the industry develop monitoring, reporting, and verification (MRV) protocols. Specifically, the program has enriched the understanding of secure geologic storage, provided accurate information on flows of CO_2 injection into storage reservoirs, and facilitated comprehensive monitoring of the subsurface, to ensure the geology provides permanent and secure containment of injected CO_2.

Additionally, the projects funded under DOE's work in transport and storage, in addition to CarbonSAFE, have successfully conducted real-world MRV protocol

tests. DOE has supported project developers' community engagement efforts through the implementation of the BIL. To further community understanding and engage communities in productive two-way dialogues, DOE can provide technical assistance for community engagement and specifically work with trusted local stakeholders, including universities or state agencies (e.g., geological surveys) to engage communities that CarbonSAFE projects may impact. These organizations are closely located in the host communities and have the depth of knowledge of the region and the area to build trust, engage effectively, and understand the site-specific concerns and opportunities for collaboration.

8. **How can the data acquired during the CarbonSAFE initiative be used to promote the long-term viability of CCUS infrastructure? Are there any R&D needs that would complement the goals of the CarbonSAFE initiative?**

CarbonSAFE has already delivered significant learnings to the long-term viability of CCUS infrastructure. Moving forward, data acquired from the CarbonSAFE initiative can help understand questions that will help lower project costs by leading to the adoption of new and emerging technologies, as well as increasing public confidence in carbon storage. Potential areas for expanded research and development may include:

- Developing cutting-edge tools informed by CarbonSAFE projects to enhance data collection, streamline injection processes, and improve monitoring and verification for carbon storage projects. This could include but is not limited to techniques such as radar satellite data and other remote sensing options.
- Developing state-of-the-art systems to monitor the plume in the subsurface and conduct early leakage detection.
- Further exploration of the physical and chemical properties of potential materials for wellbores and casing to provide lower-cost, durable materials that are able to withstand potential corrosion in different saline conditions and enable permanent storage of the injected CO_2.

Conclusion:

The Carbon Capture Coalition commends DOE's efforts in advancing the Carbon Storage Assurance Facility Enterprise (CarbonSAFE) initiative to continue developing the technologies needed to nationally deploy commercial large-scale (50+ million metric tons) CO_2 storage sites. The advancement of the CarbonSAFE initiative, along with the broader support from DOE's Transport and Storage program, will drive innovation,

economic growth, and job creation while maintaining US leadership in carbon management technologies.

Overall, there is a critical need for large-scale storage infrastructure, which could be achieved by prioritizing Phase III, Phase III.5, and Phase IV CarbonSAFE projects in the highest potential regions that have well-characterized geology and nearby emissions sources. As global competitors expand their carbon management efforts, America must maintain its leadership by commercializing storage technologies and leveraging its vast geologic capacity to store CO_2 safely and permanently. The Coalition looks forward to engaging with DOE on the specifics of the program design or related aspects of the CarbonSAFE initiative in the future to continue to advance carbon storage infrastructure in the US.

About Us:

The Carbon Capture Coalition is a nonpartisan collaboration of more than 100 companies, unions, conservation and environmental policy organizations, building federal policy support to enable economywide, commercial-scale deployment of carbon management technologies. This includes carbon capture, removal, transport, reuse, and storage from industrial facilities, power plants, and ambient air. Coalition members recognize that economywide adoption of carbon management technologies is critical to achieving net zero emissions to meet midcentury climate goals, strengthening and decarbonizing domestic energy, industrial production and manufacturing, and retaining and expanding a high-wage jobs base. Successful commercial deployment of these technologies requires prioritizing meaningful engagement and consultation with local communities and associated workforce development.