U.S. Department of Energy

Office of Clean Energy Demonstrations

Request for Information: DE-FOA-0003478

Opportunities for Additional Support for Commercial Direct Air Capture (DAC) Demonstration Facilities

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PROGRAM AREA: Office of Clean Energy Demonstrations

RESPONSES DUE: December 17, 2024

Purpose

This is a Request for Information (RFI) issued by the U.S. Department of Energy's (DOE) Office of Clean Energy Demonstrations (OCED) in collaboration with the Office of Fossil Energy and Carbon Management (FECM). The intent of this RFI is to obtain public input regarding additional approaches that current and future DOE programs could implement to help direct air capture (DAC) developers address challenges in raising project investment capital and achieving sustained facility operations. The RFI seeks to understand how federal funding may complement existing DOE financial assistance mechanisms offering development, construction, and partial operations funding for first-of-a-kind (FOAK) commercial demonstrations, and supplement other government incentives (e.g., 45Q tax credit). This RFI seeks input on whether and how DOE should consider complementary programming (e.g., direct demand-pull mechanisms, other revenue support, other operational support) to enable and accelerate commercial scale-up of DAC technologies.

Background

OCED was established in December 2021 to accelerate market adoption of clean energy technologies and fill a critical innovation gap on the path to achieving our nation's climate goals of net zero emissions by 2050. OCED's mission is to deliver clean energy demonstration projects at scale in partnership with the private sector to accelerate deployment, market adoption, and the equitable transition to a decarbonized energy system.

OCED is a multi-technology office with funding for demonstrations that include advanced nuclear, clean hydrogen, carbon management, long-duration energy storage, industrial decarbonization, and more. With a clear role in commercializing critical clean energy technologies, OCED fills the gap between the research, development, and early-stage demonstration projects, including those within DOE technology offices, and initial deployments supported by the private sector and/or other DOE programs, such as the Loan Programs Office.

OCED's portfolio in the carbon management sector includes the $3.5 billion Regional Direct Air Capture (DAC) Hubs program, which it manages in partnership with FECM and the National Energy Technology Laboratory (NETL). The DAC Hubs program will develop four regional direct air capture hubs, as directed by the Bipartisan Infrastructure Law (BIL).[1] Each hub will demonstrate a DAC technology or suite of technologies with the capacity to capture at least 1 million metric tons of carbon dioxide (CO_2) annually from the atmosphere. Once captured, the CO_2 will be permanently stored in a geologic formation or utilized in new products.

DOE released the first funding opportunity under the program (DE-FOA-0002735, "FOA-1") in December 2022 and announced over $1.2 billion to eligible projects. In August 2023, DOE announced the selection of 21 projects for award negotiations across various project readiness levels spanning pre-construction planning, front-end engineering design (FEED) studies, and feasibility studies. Those 21 projects also reflect diversity in aspects of technology, geography, organizational structure, energy inputs, and CO_2 storage or utilization types, among others.

DOE also released several Requests for Information and a Notice of Intent related and relevant to the program. In January 2023, DOE released a Request for Information on the use of demand-side support for clean energy technologies (DE-FOA-0002995, the "clean energy demand RFI"). In February 2024, DOE released a Request for Information (DE-FOA-0003333, the "mid-scale RFI") focused on the role of mid-scale commercial DAC facilities. In September 2024, DOE released a Notice of Intent (DE-FOA-0003429, the "recurring program NOI") to publish a Notice of Funding Opportunity in the fourth quarter of 2024 to offer funding to mid-scale commercial DAC facilities, large-scale commercial DAC facilities, and scaling platforms for early commercial DAC facilities.

FECM, a partner with OCED in implementing the Regional DAC Hubs Program, has extensive experience supporting research and development efforts for DAC technologies. These efforts have included laboratory-scale testing of novel materials (DE-FOA-0002188); bench-scale testing of structured material systems, components,

[1] BIL § 40308(a), as codified at 42 U.S.C. § 16298d(j).

and integrated processes (DE-FOA-0002614); initial engineering design studies for commercial-scale carbon capture, utilization and storage systems from air (DE-FOA-0002402); and engineering studies for DAC combined with dedicated long-term carbon storage and coupled to existing low-carbon energy (DE-FOA-0002560). Currently, FECM implements multiple provisions for DAC technologies, including the Commercial DAC Pilot Prize and the DAC Precommercial EPIC and Technology Prizes. In addition to supporting DAC technology research, development and pilot programming, FECM is also actively implementing the Carbon Dioxide Removal (CDR) Purchase Pilot Prize to establish and inform DOE's role in building a rigorous, high-quality market for CDR credits. FECM recently announced the semifinalists for this prize, which include 9 competitors implementing DAC technologies.

Description

OCED is evaluating the rationale for and design features of a potential future program, or modification to existing programs, to catalyze the DAC industry's growth using methods other than providing funding primarily for the capital expenditure ("capex") for facility construction. These non-capex measures could include demand support for DAC facilities' products and services, such as carbon removal credits deriving from a DAC facility ("DAC credits") or other non-capex support to fund the ongoing operation of the facility. Such alternative support may help a new project secure financing and improve revenue and profitability for a new or existing project's sustained operation.

In responses to the clean energy demand RFI and the mid-scale RFI, OCED has already received a variety of perspectives related to additional support for DAC. Some of these responses emphasized that DOE should explore ways to support demand. Some of these responses elaborated on the overall rationale and implementation details that will be explored further in this RFI. This RFI is dedicated solely to questions about non-capex support for DAC to help consolidate and update those previously shared viewpoints and to inform program design decisions, especially given opportunity cost tradeoffs.[2]

How and why additional non-capex support could serve a role in advancing the DAC industry must be informed by current OCED programming that already supports these objectives. A demonstration project funded by OCED would typically apply for funding either at the beginning of the Detailed Design (e.g., FEED study) phase or the pre-construction Project Development phase.[3] In either case, a successful project that

[2] Respondents are welcome to reference any past RFI submissions that may be relevant in response to this RFI
[3] https://www.energy.gov/oced/project-management-oversight-excellence

meets established milestones would continue to be awarded federal funding through the construction phase and into the initial operations phase.[4]

DOE funding for the planning, design, construction and initial operations of a DAC project already indirectly incentivizes demand for DAC projects. The introduction of federal funding at any phase represents a subsidization of the facility's levelized cost of capture, which may allow for a lower selling price for a carbon removal credit or physical ton of CO_2. The project can attract more demand than if the project had no federal funding through improved overall project economics.

However, even if existing approaches to federal funding and tax credits *indirectly* stimulate demand, there are reasons to explore how more direct demand support or other non-capex funding mechanisms could be valuable to DAC project developers. These programs could help unlock project investment by securing committed DAC credit buyers. Additional support mechanisms may help to bridge the gap between the market's willingness to pay and the cost of DAC credits or tons of CO_2, de-risk offtake mechanisms and contracting for DAC credits through direct procurement or provide other targeted support for the facility's operational phase.

Demand Support Mechanisms

DOE's direct purchase of credits could allow a developer to supplement a facility's order book with contract terms that complement the terms of the private sector credit buyers (e.g., by buying longer-dated credits for future delivery, if private sector buyers prefer shorter-dated credits). DOE's purchase activities could serve to promote standardized contracts that may facilitate more transactions in the broader market. There may also be a crowding-in effect that motivates voluntary corporate buyers to purchase credits who would not otherwise buy but for an explicit DOE demand program. DOE has seen early indications of this effect through the CDR Purchase Pilot Prize, under which other private entities have committed to purchasing high-quality CDR credits alongside DOE, leveraging similar criteria and DOE's diligence processes.

Direct purchase of DAC credits could be implemented in a variety of ways. A non-exhaustive list of examples includes pricing alternatives such as favoring lowest price bidders (i.e., a reverse auction), buying at a fixed price, or buying at different prices based on the specific DAC credit supplier (e.g., paying more for earlier technologies and/or technologies with better future cost prospects). Contract terms could specify that suppliers are required to deliver the credits, or that they have the option to deliver at their discretion (i.e., a "put option"). These program design choices, and others, have

[4] Subject to various progress milestones and other potential restrictions

the potential to create different incentives for suppliers and buyers, and lead to different outcomes for the DAC credit market and individual project development approaches.

In addition to direct purchase of credits, there are other demand support mechanisms that could partially offset the cost of a given credit for a third-party buyer, such as contracts-for-difference or flat subsidies tied to credit purchases. Whether a direct purchase of a credit, a partial offset for a third-party purchase, or another demand-side intervention, these mechanisms could allow project developers to reduce revenue risks or cost risks for investors and make investment in DAC facilities more attractive for the private sector in ways that a traditional capex-focused funding approach may not.

Looking beyond the next wave of DAC projects, there may be ways in which a demand program could more effectively bridge today's voluntary and "pre-compliance" credit demand with the compliance markets and larger, longer-term government procurement programs of the future. The design choices for a program with those objectives may look similar to a program designed around near-term, FOAK demonstration project needs, but not necessarily.

Other Non-Capex Mechanisms

Funding vehicles designed to support the operations phase of a DAC facility, other than through demand support, may also be valuable to developers and investors. An example in this category is an annual subsidy to offset the costs of operations and maintenance (O&M) for a period of time. A more targeted approach could be to subsidize the facility's energy costs, perhaps with a flat subsidy or with a mechanism that reduces any remaining price volatility. Other examples include a subsidy designed to supplement or complement the 45Q tax credit, a minimum volume commitment for key non-energy components of a DAC facility (e.g., a transport and storage servicer), and others. These funding approaches have the potential to either subsize or stabilize the revenue and profitability of a DAC facility during some or all of its operational life. Any additional subsidization would need to be evaluated in the context of existing subsidies (e.g., capex support, tax credits) to ensure that Federal resources are enabling a commercial market for direct air capture without the need for ongoing DOE subsidization.

This RFI approaches these topics by asking two broad categories of questions. First, it focuses on the tradeoffs and obstacles at the level of an individual commercial demonstration project. At this individual project level, OCED seeks to explore the relationship between raising project investment capital and securing advanced customer agreements, and the dynamics in the current markets for voluntary carbon removal credits, to inform how federal funding could most effectively be offered to facilitate the commercial deployment of DAC projects.

The second category looks beyond the project level to the questions of how any explicit demand support interventions offered in the near term could catalyze broader and deeper demand for DAC deployment in the longer term.

> *Unless otherwise specified, questions concerning potential new programs are intended to solicit input broadly regarding possible uses of existing or new DOE funding that may be currently available or may become available in the future.*
>
> *The funding offered in the first FOA (up to $1.4B) is committed to selected projects, pending DOE's determination of successful completion of required project milestones.* ***The funding contemplated in the Notice of Intent (up to $1.8B), if awarded, represents the entirety of the funding available for new programs.*** *All funding is subject to the availability of appropriated funds.*

Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to *DAC-RFI-OCED@hq.doe.gov* no later than **5:00pm (ET) on December 17, 2024**. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Responses must be provided as a Portable Document Format (.pdf) attachment to the email, and no more than 20 pages in length, 12-point font, 1-inch margins. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if applicable. OCED will not respond to individual submissions. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

OCED may publicly share a summary of the responses in written, webinar, or other formats. Any information that OCED chooses to share publicly will be aggregated and/or anonymized to the greatest extent possible. DOE takes very seriously the confidentiality of third-party information and will treat information submitted/received as confidential to the fullest extent permissible under Federal law, including the Freedom of Information Act (FOIA). **Please refer to the Proprietary Information section below for instructions on marking of any proprietary or confidential information.**

Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name and type of organization
- Indication if company / institution is:

  - A DAC technology and/or DAC project developer,
  - A current or potential buyer of carbon removal credits,
  - A current or potential investor in DAC projects or companies
- Company / institution point of contact
- Contact's address, phone number, and e-mail address

Request for Information Categories and Questions

Category 1: Questions related to supporting individual DAC projects

(Note: all questions are optional)

1. Does the Description section above accurately characterize the situation facing DAC developers, credit buyers, and investors, and reflect the potential options and tradeoffs related to a demand-side or non-capex support program? If not, why not?

2. To what extent is financing for DAC projects contingent on, and currently held back by the lack of demand for DAC carbon removal credits, and what are the reasons?

3. To what extent do 45Q tax credits enable the continued operation of DAC projects post-construction? What are the pros and cons of subsidization via 45Q tax credits for prospective DAC projects?

4. What other obstacles may hinder investment in DAC projects?

5. When comparing DAC facilities at small-scale (500–2,000 tons per annum, TPA), mid-scale (2,000–25,000 TPA) and large-scale (25,000+ TPA), are there unique aspects to the relationship between raising investment capital and pre-committed demand? Are the investor or credit buyer requirements different across those scales (beyond what an increase in size would imply for total volumes and amounts)?

6. What would lead to more voluntary purchases of DAC credits?

7. What terms and conditions should be standardized to facilitate a broader marketplace for DAC credits?

8. Are uncertainties about credit eligibility in current or future compliance regimes or voluntary commitment frameworks holding back corporate credit purchases? What clarifications or changes would be required to address these uncertainties?

9. How would a DAC project developer prefer to allocate federal award funding to either: 1) offset construction costs, 2) offset operating costs, and/or, 3) a demand support mechanism or program, if given the choice to propose any allocation?

10. How valuable would developers find the option described in the previous question, and why?

11. What potential forms of demand-side support or other non-capex support would be most valuable in stimulating DAC deployments, and why? What overall program characteristics (e.g., total program funding amount, program duration) would give these forms of support the most impact? For purposes of this question, when responding please assume that any funds for a new program would come from remaining funds available under the Regional DAC Hubs provision.[5] Feel free to comment on any of the examples below or describe others not mentioned.

    a. Federal government (or affiliate) direct purchase of credits (e.g., advanced market commitment)

    b. Subsidy of third-party credit purchase (e.g., 45Q top-up or extension, contract for difference, flat subsidy)

    c. Minimum throughput guarantees for key DAC hub infrastructure (e.g. transport and storage)

    d. Subsidy of ongoing operations and maintenance (O&M) costs to lower the facility's effective cost of capture

12. Which program design features for demand-side support or other non-capex support would be most likely to result in the greatest impact, and why? What overall program characteristics (e.g., total program funding amount, program duration) would give these features of support the most impact? For purposes of this question, when responding please assume that any funds for a new program would come from remaining funds available under the Regional DAC Hubs provision.[5] Feel free to comment on any of the examples below or describe others not mentioned.

    a. Establish flexible credit price for different DAC credit suppliers, a single fixed-price, or a lowest-cost approach

    b. Require matching credit purchases from voluntary buyers

[5] Please refer to the Description section for a statement regarding remaining funds

c. Reward suppliers for reaching sales milestones

d. Give project developers the option to request funding for construction, operations, demand support, and/or other non-capex support programs according to fit the needs of that specific project.

e. Allow DOE to be purchaser of credits, or require DOE be one of many purchasers of equal or greater volume

13. If not addressed above, please describe the overall program characteristics or other considerations not mentioned that would allow a demand program or non-capex support program to have the greatest impact, and why? For purposes of this question, when responding please assume that any funds for a new program would come from remaining funds available under the Regional DAC Hubs provision. [5]

14. What other considerations and tradeoffs should OCED be aware of when evaluating a potential demand-side program or other non-capex program to support commercial DAC facilities? How should OCED incorporate those tradeoffs when evaluating how much, if any, funding from existing DOE authorizations and appropriations to use for DAC demand support or non-capex program?[5]

15. Are there unique equity, environmental, and energy justice[6] considerations and tradeoffs OCED should be aware of when evaluating a potential demand-side program or other non-capex program to support commercial DAC facilities?

Category 2: Questions related to future DAC market development
(Note: all questions are optional)

16. To what extent are today's buyers of DAC credits purchasing voluntarily in anticipation of coming compliance requirements? Which compliance regimes are DAC suppliers and buyers expecting will create demand soonest? What uncertainties and barriers remain to those regimes driving demand for DAC?

17. In what ways could a DAC demand program most effectively bridge today's voluntary and "pre-compliance" demand with demand from future compliance-based or long-term government procurement programs? Would tradeoffs exist

[6] Energy justice refers to the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those historically harmed by the energy system ("frontline communities").

between a demand program designed to achieve those goals versus a program designed around the needs of the current and next DAC projects?

18. To what extent would a demand program based on a limited duration of funding (i.e., not a permanent or ongoing program) be effective or ineffective in signaling to investors and prospective DAC credit purchasers the potential for long-term demand for DAC? What would success look like, given there are limited resources currently available?

19. How could demand support deployed today for the next round of DAC projects more effectively lead to subsequent deployments and reductions in the cost of DAC?

20. What selling price for credits or cost reductions in generating credits would allow the US-based DAC industry to no longer need project-level funding to subsidize construction and operations?

21. How does the selling price for credits or total subsidy (including tax benefits, grants/cooperative agreements for upfront capital cost, and any potential demand-side subsidy) per unit of emissions captured compare to the social cost of carbon?[7] Are there any barriers to data collection or analysis for this comparison?

Disclaimer and Important Notes

This RFI is not a Notice of Funding Opportunity (NOFO); therefore, OCED is not accepting applications at this time. OCED may issue a funding opportunity in the future based on or related to the content and responses to this RFI; however, OCED may also elect not to issue funding opportunity. There is no guarantee that a funding opportunity will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if OCED chooses to issue a funding opportunity regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of OCED funded awards, would be subject to Congressional appropriations and direction.

Any information obtained because of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. OCED will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. OCED will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that OCED is under no obligation to

[7] Social cost of greenhouse gases estimates, including social cost of carbon estimates, such as those developed by the Environmental Protection Agency, can be found at https://www.epa.gov/environmental-economics/scghg.

acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind OCED to any further actions related to this topic.

Evaluation and Administration by Federal and Non-Federal Personnel

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to OCED providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

Proprietary Information

When submitting proprietary and confidential information to OCED, regardless of purpose, respondents must clearly identify and mark any information they treat as confidential/proprietary in the proper manner as outlined below. DOE takes very seriously the confidentiality of third-party information and will treat information submitted/received as confidential to the fullest extent permissible under Federal law. DOE will not be able to protect information that is in the public domain or that a respondent has previously released publicly. For additional information on DOE's FOIA regulations, see 10 CFR Part 1004.

If a respondent includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for the intended reasons for submission. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act (FOIA). Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to others only when necessary for a prior identified specific purpose or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Responses/submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

Respondents should use a cover sheet or otherwise include on the first page of their response submission the following notice, including identifying the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:
Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for its intended purposes, for evaluation purposes, or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting. To the greatest extent possible, submitters should refrain from marking entire pages/documents as confidential as FOIA Exemption 4 may only be used on truly confidential/proprietary information and excessive unnecessary markings will result in additional disclosures where appropriate.