FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

Department of Energy (DOE)
Office of Fossil Energy and Carbon Management (FECM)

Bipartisan Infrastructure Law: Regional Direct Air Capture Hubs

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002735
FOA Type: Initial
Assistance Listing Number: 81.089

FOA Issue Date:	12/13/2022
Submission Deadline for Mandatory Letters of Intent	01/24/2023 – 5:00 PM ET
Submission Deadline for Full Applications:	03/13/2023 – 5:00 PM ET
Pre-Selection Interviews (Topic Area 3 Only):	Summer 2023
Expected Date for DOE Selection Notifications:	~06/30/2023
Expected Timeframe for Award Negotiations:	~11/30/2023

- **Applicants must submit a Letter of Intent by 5:00pm ET on the due date listed above to be eligible to submit a Full Application.**

- To apply to this FOA, applicants must register with and submit application materials through Grants.gov at https://www.grants.gov.

- **Unique Entity Identifier (UEI) and System for Award Management (SAM)** - Each applicant (unless the applicant is excepted from those requirements under 2 CFR 25.110) is required to: (1) Be registered in the SAM at https://www.sam.gov before submitting its application; (2) provide a valid UEI number in its application; and (3) continue to maintain an active SAM registration with current information at all times

during which it has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, the DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

NOTE: Due to the high demand of UEI requests and SAM registrations, entity legal business name and address validations are taking longer than expected to process. Entities should start the UEI and SAM registration process as soon as possible. If entities have technical difficulties with the UEI validation or SAM registration process they should utilize the HELP feature on SAM.gov.

- Applicants must designate primary and backup points-of-contact with whom DOE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award.

Registration Requirements

There are several one-time actions that must be completed before submitting an application in response to this Funding Opportunity Announcement (FOA) (e.g., register with the System for Award Management (SAM), obtain a Unique Entity Identifier (UEI) number, register with Grants.gov, and register with FedConnect.net to submit questions). It is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA.

- **SAM** – Applicants must register with SAM at https://www.sam.gov/ prior to submitting an application in response to this FOA. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in SAM registration. Failure to register with SAM will prevent your organization from applying through Grants.gov. The applicant must maintain an active SAM registration with current information at all times during which it has an active Federal award or application under consideration. More information about SAM registration for applicants is found at: https://www.fsd.gov/gsafsd_sp?id=gsafsd_kb_articles&sys_id=650d493e1bab7c105465eaccac4bcbcb .

  NOTE: If clicking the SAM links do not work, please copy and paste the link into your browser.

- **UEI** – Applicants must obtain an UEI from the SAM to uniquely identify the entity. The UEI is available in the SAM entity registration record.

  NOTE: Subawardees/subrecipients at all tiers must also obtain an UEI from the SAM and provide the UEI to the Prime Recipient before the subaward can be issued.

- **Grants.gov** – Applicants must register with Grants.gov in order to receive automatic updates, in the event that Amendments to this FOA are posted. However, please note that applications will not be accepted through Grants.gov. You cannot submit an application through Grants.gov unless you are registered. Please read the registration requirements carefully and start the process immediately.

  1) The Authorized Organizational Representative (AOR) must register at: https://apply07.grants.gov/apply/OrcRegister
  2) An email is sent to the E-Business (E-Biz) POC listed in SAM. The E-Biz POC must approve the AOR registration using their MPIN from their SAM registration.

  More information about the registration steps for Grants.gov is provided at:
  https://www.grants.gov/web/grants/applicants/registration.html

In addition:

- Add a Profile to a Grants.gov Account: A profile in Grants.gov corresponds to a single applicant organization the user represents (i.e., an applicant) or an individual applicant. If you work for or consult with multiple organizations and have a profile for each, you may log in to one Grants.gov account to access all of your grant applications. To add an organizational profile to your Grants.gov account, enter the UEI for the organization in the UEI field while adding a profile. For more detailed instructions about creating a profile on Grants.gov, refer to: https://www.grants.gov/web/grants/applicants/registration/add-profile.html .

- *EBiz POC Authorized Profile Roles*: After you register with Grants.gov and create an Organization Applicant Profile, the organization applicant's request for Grants.gov roles and access is sent to the EBiz POC. The EBiz POC will then log in to Grants.gov and authorize the appropriate roles, which may include the AOR role, thereby giving you permission to complete and submit applications on behalf of the organization. You will be able to submit your application online any time after you have been assigned the AOR role.

  NOTE: When applications are submitted through Grants.gov, the name of the organization applicant with the AOR role that submitted the application is inserted into the signature line of the application, serving as the electronic signature. The `EBiz POC **must** authorize people who are able to make legally binding commitments on behalf of the organization as a user with the AOR role; **this step is often missed and it is crucial for valid and timely submissions**.

  For more detailed instructions about creating a profile on Grants.gov, refer to: https://www.grants.gov/web/grants/applicants/registration/authorize-roles.html .

  To track your role request, refer to: https://www.grants.gov/web/grants/applicants/registration/track-role-status.html .

Questions relating to the **registration process, system requirements, or how an application form works** must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov.

- **FedConnect.net** – Applicants must register with FedConnect to submit questions. FedConnect website: https://www.fedconnect.net/

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Executive Summary

Following the passage of the Bipartisan Infrastructure Law (BIL), DOE will invest $3.5 billion for development of four domestic Regional Direct Air Capture Hubs (the "DAC Hubs") to accelerate commercialization of, and demonstrate the processing, transport, secure geologic storage, and/or conversion of, carbon dioxide (CO_2) captured from the atmosphere.

Through this FOA, DOE makes available up to $1.236 billion of funding to begin the process of conceptualizing, designing, planning, constructing, and operating the DAC Hubs, with additional funding opportunities expected to follow in the coming years. This FOA (i.e., DE-FOA-0002735) offers potential Applicants three different options for seeking DAC Hub funding:

- **Topic Area One (TA-1)** is designed to support earlier-stage efforts to explore the feasibility of a potential DAC Hub's location, ownership structure, business model, CO_2 storage/utilization option(s), and technology partner(s) during Phase 0. For this Topic Area, this FOA provides up to $3 million per project in federal funds, for up to twelve (12) awards, at an 80 percent maximum federal cost-share.

- **Topic Area Two (TA-2)** is designed for DAC Hub projects ready to pursue a front-end engineering design (FEED) study for a Hub's initial capture capacity and supporting infrastructure during Phase 1. To be eligible for TA-2, Applicants must: (1) be ready to design a DAC Hub that captures at least 50,000 tonnes of CO_2 per year (50 KTA), (2) provide evidence from prior operations to support that scale-up, and (3) present a DAC Hub Capacity Build-Out Plan to eventually reach the goal of at least 1 million tonnes of CO_2 per year (1 MTA), among other requirements. This FOA provides up to $12.5 million per project in federal funds, for up to eight (8) awards, at a 50 percent maximum federal cost share.

- **Topic Area Three (TA-3)** is designed for DAC Hub projects that have already completed a FEED study and are seeking support for project development for a potential Hub. To be eligible for TA-3, Applicants must: (1) be ready to perform a detailed design, and build a DAC Hub that captures at least 50 KTA CO_2, (2) provide evidence from prior operations to support that scale-up, and (3) present a DAC Hub Capacity Build-Out Plan to eventually reach the goal of at least 1 MTA CO_2, among other requirements. This FOA provides up to $50 million per project in federal funds, for up to two (2) awards, at a 50 percent maximum federal cost share to complete the detailed design and permitting phase (Phase 2). Following a competitive (down)-selection process, this FOA provides up to $500 million per project in federal funds, for up to two (2) awards, at a 50 percent maximum federal cost share, to execute and complete procurement, construction, and operation phases (Phases 3-4) for the initial DAC Hub capacity, and the DAC Hub Capacity Build-out Plan, if applicable.

Due to the early technical maturity of TA-1 and TA-2, the scope of DAC Hub implementation is expected to be completed through two FOAs: this FOA (i.e., DE-FOA-0002735) and a second FOA

(i.e., FOA 2) anticipated to be released in 2024 or later. FOA 2 plans to provide funding for Phases 1 through 4 and will not limit eligibility to those Applicants receiving awards under this FOA (i.e., DE-FOA-0002735).

This FOA (i.e., DE-FOA-0002735) is designed to enable a range of entities to apply for DAC Hubs including, non-profits, state and local governments, academic institutions, civil society organizations, companies with relevant energy or CO_2 storage resources, etc.—in addition to DAC technology developers.

The DAC Hubs will also require substantial engagement of local and regional stakeholders, as well as Indian Tribes, which include Alaska Native Regional Corporations and Village Corporations, to ensure that they generate local, regional, and national benefits. DAC Hubs will be expected to carry out meaningful community and labor engagement; invest in America's workforce by creating good-paying jobs with the free and fair choice to join a union; advance diversity, equity, inclusion, and accessibility (DEIA); and contribute to the President's Justice40 Initiative goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities. Successful projects will be expected to deliver on a Community Benefits Plan that includes these activities in a way that is accountable to and reflective of community and labor priorities.

For TA-1 and TA-2, any funding for subsequent phases of DAC Hub development would be awarded separately and be subject to an additional application and review process. For example, a project that receives funding via TA-1 through this FOA (i.e., DE-FOA-0002735) to complete the feasibility stage (Phase 0) would need to reapply to a future FOA (i.e., FOA 2) to receive additional funding for activities under TA-2, the FEED stage (i.e., Phase 1).

For the purpose of the DAC Hubs, *other Carbon Dioxide Removal (CDR) technologies, such as: biochar, biomass burial, direct ocean capture, soil carbon sequestration, and afforestation/reforestation, may be included in the DAC Hub, but* ***these efforts will not be eligible for Federal funding or allowable cost share under this FOA.***

I. Funding Opportunity Description

A. Background and Context

The Department of Energy (DOE) Office of Fossil Energy and Carbon Management (FECM), in collaboration with the Office of Clean Energy Demonstrations (OCED) and the National Energy Technology Laboratory (NETL), is issuing this Funding Opportunity Announcement (FOA) for Regional Direct Air Capture (DAC) Hubs. On November 15, 2021, President Joseph R. Biden, Jr. signed the Infrastructure Investment and Jobs Act (Public Law 117-58), also known as the Bipartisan Infrastructure Law (BIL).[1] Awards made under this FOA will be funded, in whole or in part, with funds appropriated by the BIL.

The BIL is a once-in-a-generation investment in infrastructure, designed to modernize and upgrade American infrastructure to enhance U.S. competitiveness, drive the creation of good-paying jobs with free and fair choice to join a union, tackle the climate crisis, and ensure stronger access to economic and other benefits for disadvantaged communities[2]. The BIL appropriated more than $62 billion to DOE[3] to invest in American manufacturing and workers; expand access to energy efficiency and clean energy; deliver reliable, clean, and affordable power to more Americans; and demonstrate and deploy the technologies of tomorrow through clean energy demonstrations. As part of and in addition to upgrading and modernizing infrastructure, DOE's BIL investments will support efforts to build a clean and equitable energy economy that achieves a zero-carbon electricity system by 2035, and to put the United States on a path to strengthen our country's energy prosperity and achieve net-zero emissions economy-wide by no later than 2050[4] to benefit all Americans.

The BIL appropriates $3.5 billion over the five (5) year period encompassing fiscal years (FYs) 2022 through 2026 for development of four (4) domestic Regional DAC Hubs to accelerate commercialization of, and demonstrate the processing, transport, geologic storage, and conversion of, CO_2 captured from the atmosphere. *See* Section

[1] Infrastructure Investment and Jobs Act, Public L. No. 117-58, 135 Stat. 429 (2021)[hereinafter BIL], available at https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf.

[2] Pursuant to Executive Order (EO) 14008, and the Office of Management and Budget's Interim Justice40 Implementation Guidance M-21-28, DOE has developed a definition and tools to locate and identify DACs. These resources can be located at https://energyjustice.egs.anl.gov/. DOE will also recognize DACs as defined and identified by the White House Council of Environmental Quality's Climate and Economic Justice Screening Tool (CEJST), which can be located at https://screeningtool.geoplatform.gov/. DOE's Justice40 Implementation Guidance is located at https://www.energy.gov/sites/default/files/2022-07/Final%20DOE%20Justice40%20General%20Guidance%20072522.pdf .

[3] U.S. Department of Energy. November 2021. "DOE Fact Sheet: The Bipartisan Infrastructure Deal Will Deliver For American Workers, Families and Usher in the Clean Energy Future." https://www.energy.gov/articles/doe-fact-sheet-bipartisan-infrastructure-deal-will-deliver-american-workers-families-and-0

[4] Executive Order (EO) 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021.

969D of the Energy Policy Act of 2005 (EPAct 2005) (42 U.S.C. 16298d). Section 40308 of the BIL amended EPAct 2005 and added the DAC Hubs provision which is focused on providing funding for eligible projects[5] that contribute to the development of the DAC Hubs. Each of the Regional DAC Hubs:

(i) facilitates the deployment of direct air capture projects;
(ii) has the capacity *to capture and sequester, utilize, or sequester and utilize* at least 1,000,000 metric tons of carbon dioxide from the atmosphere annually from a *single unit* or *multiple interconnected units*;[6]
(iii) demonstrates the *capture*, *processing, delivery*, and *sequestration or end-use of captured carbon*; and
(iv) could be developed into a regional or interregional carbon network to facilitate *sequestration* or carbon utilization.

The activities to be funded under this FOA support BIL Section 40308 and the broader government-wide effort to provide more options for the U.S. to achieve a net-zero greenhouse gas (GHG) economy by 2050 in a cost effective, reliable, and efficient manner, and to maximize the benefits of the clean energy transition as the nation works to curb the climate crisis, empower workers, and advance environmental justice.

DOE is aware of the concerns from environmental justice and climate perspectives about how DAC projects could negatively affect communities, local environmental quality, and the overall climate mitigation effort if not developed with appropriate safeguards. To ensure DAC is deployed responsibly, this FOA will include several requirements designed to: protect communities from increases in cumulative pollution, create meaningful benefits, and maintain and create good, high-wage jobs across the country as part of the Community Benefits Plan (CBP).[7] The intent is to develop community-informed Regional DAC Hubs that achieve cost-effective, efficient, equitable, and environmentally responsible development of a domestic DAC industry. Prior to beginning construction, DOE will require projects to complete an in-depth environmental pollution impact assessment (including cumulative pollution impacts) of any installation of DAC and balance of plant systems within the DAC Hub. Funding of the subsequent phases (i.e., procurement, construction, and operation) of the demonstration project will be dependent on the results of the completed pollutant assessment. During the operation phase, DOE will require projects to

[5] The term eligible project means a direct air capture project or a component project of a regional direct air capture hub. 42 U.S.C. 16298d(j)(1)(A).
[6] For multiple interconnected units (i.e., integrated DAC systems), this FOA will require each individual integrated DAC system to demonstrate capacity to capture a minimum of 50,000 metric tons (tonnes) of CO_2 from the atmosphere annually (50 KTA).
[7] Carbon Capture, Utilization, and Sequestration Guidance: https://www.federalregister.gov/documents/2022/02/16/2022-03205/carbon-capture-utilization-and-sequestration-guidance

continue to assess the net-climate benefits of the project and track and report on outcomes and outputs related to community benefits, as well as to track and report on non-CO_2 pollution to air, water, and soil.

NOTICE TO APPLICANTS: BIL Build America, Buy America requirements[8] and Davis-Bacon Wage Rate requirements[9] will be applicable to the design, construction, and operation of the Regional DAC Hubs. Applicants should take these requirements into consideration when developing an application under this FOA.

i. Program Purpose

The goal of the Regional DAC Hubs initiative is to responsibly catalyze a commercial DAC industry in the United States and establish the United States as the global leader in developing and demonstrating the commercial viability of this critical climate technology. To do so, the Regional DAC Hubs will contribute to the following sub-goals:

1. *Commercial scale-up*: validate commercial scale demonstrations for a diversity of DAC technologies and Hub concepts that builds confidence to catalyze private sector capital formation. This includes assessing technology scale-up risks, cost, performance, business models, host site, infrastructure, offtakers, markets and financing structures for the most promising technologies and Hub approaches.
2. *Infrastructure*: build out the related infrastructure to sustainably scale up DAC technologies and Hub concepts, including clean power generation, heat integration, transport, and secure geologic storage and/or CO_2 conversion pathways.
3. *Climate impact*: prove at commercial scale that DAC technologies and different Hub concepts can maximize net-emissions goals as well as address other potential environmental impacts (e.g., water availability for at-scale projects).
4. *Responsible demonstrations*: develop the business models and CBPs that provide the greatest positive Justice40 benefits to communities while minimizing negative impacts, invest in the American workforce, advance Diversity, Equity, Inclusion, and Accessibility (DEIA), and promote strong stakeholder and labor

[8] *See* BIL §§ 70901–70953For more information regarding implementation of the Buy America preference, see the Office of Management and Budget's Memorandum number M-22-11,"Initial Implementation Guidance on Application of Buy America Preference in Federal Financial Assistance Programs for Infrastructure" (Apr. 18, 2022), https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-11.pdf.

[9] The BIL includes wage requirements and directs that all laborers and mechanics employed by contractors or subcontractors in the performance of construction, alteration, or repair work on a project assisted in whole or in part by funding made available through the BIL shall be paid wages at rates not less than those prevailing on similar projects in the locality. *See* BIL§ 41101.

engagement. The DAC Hubs will make progress toward DOE's Carbon Negative Shot,[10] which is a pathway-neutral "Energy Earthshot" that aims to develop less than $100/net metric ton (tonne) CO_2-equivalent (CO_2e) removal by 2032, with costs including ongoing monitoring, reporting, and verification (MRV).

ii. Technology Space and Strategic Goals

This FOA seeks applications to develop and commercially demonstrate Regional DAC Hubs in the United States. This FOA shall provide funding for eligible projects that contribute to the development and demonstration of four (4) domestic Regional DAC Hubs to accelerate the commercialization of CO_2 removal via integrated capture from the atmosphere, processing, transport, and secure geologic storage and/or conversion.

DAC Hubs are a relatively novel concept in the industry, and while many technology companies have plans for developing projects, few organizations have started developing DAC Hubs. Owners of DAC Hubs could be a range of private and/or public-sector organizations, many of whom are just beginning to explore the role that DAC Hubs could play in the economic, environmental, and social welfare of their communities. Additionally, the business models and ownership structures for DAC Hubs could take many different configurations.

Therefore, this FOA is designed to enable a range of entities to apply for DAC Hubs, including state/local governments, academic institutions, non-profit organizations, and private corporations. It is also designed to encourage DAC developers that have thought exclusively about single-technology projects to begin exploring partnerships with other DAC technology providers to ensure a diverse set of technologies can mature to sufficiently assess scale-up risks, cost, performance, environmental and socio-economic impacts, and viable business models proven at relevant commercial scales to catalyze private-sector capital formation and market "lift-off" for DAC. This FOA is also designed to enable innovative DAC Hub ownership structures, such as a utility model, or community- or publicly owned organizations and/or models tailored to support underserved communities, to participate alongside more traditional industry models.

Definitions:
Throughout this FOA, the following terms are used:

- **DAC Hub**: Definition provided in section B.i.
- **DAC Hub Owner:** this is the organization or consortium that is the primary applicant and leader of the DAC Hub project. This owner may be a private company, state/local government, civil society

[10] https://www.energy.gov/sites/default/files/2021-11/Carbon-Negative-Shot-Infographic.pdf

organization (such as a Non-Government Organization, community group, or academic institution), or a consortium of the above actors.

- **DAC Technology Provider(s):** the developer(s) of the actual DAC technology that is built and operated at the DAC Hub. Although not required, the DAC technology provider may be the DAC Hub owner.
- **DAC Hub Team:** any other core members of the DAC Hub project, potentially including:
    - Infrastructure partners that provide power, heat, and/or other utilities to run the DAC technology
    - Engineering, Procurement, and Construction (EPC) partners
    - Storage and/or utilization partners
    - Offtake and investment partners
    - Community and workforce partners
    - Other key technical partners and consultants responsible for discrete aspects of DAC Hub design, construction, operation, and analysis

Given that DAC technology risks, costs, performance, and environmental and socio-economic impacts can vary considerably based on geography and business model, DAC Hub team members may be interested in participating in multiple DAC Hubs. Therefore, these providers and partners may apply to multiple DAC Hubs across all Topic Areas (TAs) in this FOA, *if they represent distinct projects and demonstrate novel applications of the technology relevant to commercial scale up of DAC in the future.* Although the DAC Hub team members may participate in multiple DAC Hubs, **the *DAC Hub owner* can only own one DAC Hub.**

Detailed technical descriptions of the specific TAs for this FOA are provided in the sections that follow and **Appendices A, B, and C**.

To achieve the greatest impact for all Americans with this once-in-a-generation investment in infrastructure, it is critical that BIL-funded projects invest in America's workforce, mitigate new impacts, and deliver tangible and measurable benefits to impacted communities. Projects that fail to do this may fail to gain social support and may in turn decrease support for future projects. Specifically, BIL-funded projects are expected to (1) support meaningful community and labor engagement; (2) invest in America's workforce; (3) advance diversity, equity, inclusion, and accessibility; and (4) contribute to the President's goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities (the Justice40 Initiative). DAC Hub projects will include CBP work to ensure they support these goals. Within the CBP, the Applicant is encouraged to provide specific detail on how to ensure the delivery of measurable community and jobs benefits, e.g., through milestones and the use of tools such as good neighbor agreements, local hire agreements, project labor agreements, other collective bargaining agreements, or similar agreements (collectively referred to

throughout this FOA as "Workforce and Community Agreements"). Applicants are also encouraged to submit letters of support from established labor unions and community-based organizations that demonstrate the Applicant's ability to achieve the above goals as outlined in the CBP. Due to the difference in scope, TA-1, TA-2, and TA-3 have different requirements related to community benefits. See Section I.B.iv. for the CBP content requirements.

B. Topic Areas

i. DAC Hubs Definition

Pursuant to Section 40308 of the BIL, this FOA shall provide funding for eligible projects that contribute to the development of four (4) domestic Regional DAC Hubs to accelerate the commercialization of CO_2 removal via integrated capture from the atmosphere, processing, transport, secure geologic storage and/or conversion. The term "regional direct air capture hub" means a network of direct air capture projects, potential CO_2 utilization/conversion offtakers, connective CO_2 transport infrastructure, subsurface resources, and sequestration infrastructure located within a region.

DAC Hubs will contain any connective infrastructure (e.g., pipelines or other required transport methods) needed to connect proposed atmospheric carbon capture, processing, storage, and conversion sites, if applicable. Captured CO_2 will be stored in a secure, domestic carbon storage facility and/or converted to valuable products which demonstrate a reduction in life cycle GHG emissions when compared to the equivalent incumbent product.[11] Carbon storage facilities should have sufficient capacity to store carbon from the proposed DAC Hub for at least 12 years of operation. Alternatively, an offtake agreement may be utilized.

As shown in **Figure 1**, it is envisioned that the development and demonstration of the DAC Hubs will be conducted in one or multiple stages depending on the technology readiness and number of the DAC technologies deployed in the DAC Hub.

[11] Life cycle analysis of the carbon utilization or carbon conversion pathway to determine a reduction from an appropriate counterfactual must be conducted in accordance with the latest NETL CO2U LCA Guidance Toolkit available at https://netl.doe.gov/LCA/CO2U.

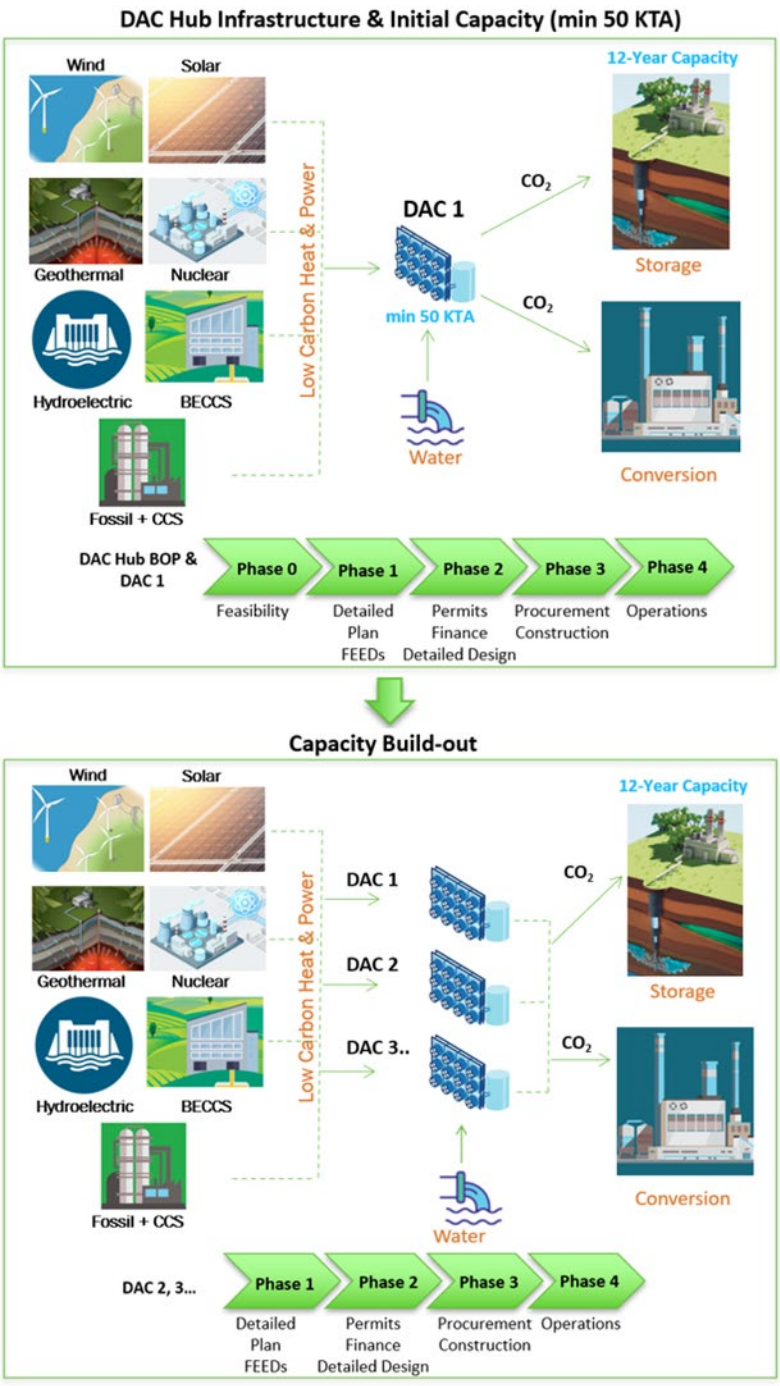

Figure 1: DAC Hub Vision, Development, and Implementation Phases. Main elements of the Hub: (i) DAC systems; (ii) methods to provide renewable and/or low carbon power and heat (e.g., wind, solar, geothermal or nuclear energy, bioenergy with Carbon Capture and Storage (BECCS), fossil fuel energy generation with Carbon Capture and Storage (CCS), and hydroelectric); and (iii) CO_2 offtake (secure geological storage and/or carbon conversion), and (iv) necessary connective infrastructure and water supply (if needed).

For DAC Hubs considering single or multiple mature DAC technologies that are ready to be deployed, building the DAC Hub infrastructure and target DAC removal capacity can be conducted in one stage.

For TA-3, DAC Hubs considering currently less mature DAC technologies, it is anticipated that the initial implementation stage will include: (i) the design of the DAC Hub infrastructure (e.g., renewable and low carbon heat and power sources, water supply), (ii) the design and construction of carbon storage CO_2 storage facility that has sufficient capacity to store CO_2 from the proposed DAC Hub for at least 12 years of operation, and (iii) the design, construction, and operation of the anchoring DAC technology (i.e., the first DAC technology built into the DAC Hub), the associated connective infrastructure and balance of plant (e.g., power, water, and heat sources), and/or CO_2 conversion technology (i.e., integrated DAC system) with an initial removal capacity of *at least 50,000 tonnes* of CO_2 from the atmosphere annually (50 KTA). Following the competitive (down)-selection into Phases 3-4, it is anticipated that the DAC Hubs will build out by adding DAC and/or CO_2 conversion capacity, using new or existing technologies, as shown in the "Capacity Build-out" graphic (Bottom of **Figure 1**)**.**

For the purpose of the DAC Hubs, *other CDR technologies, such as: biochar, biomass burial, direct ocean capture, soil carbon sequestration, and afforestation/reforestation, may be included in the DAC Hub, but* ***these efforts will not be eligible for Federal funding or allowable cost share under this FOA.***

Life cycle analysis (LCA) of the entire Regional DAC Hub will be used as the basis for evaluating the net CO_2-equivalent removal potential from the atmosphere, including: all mass and energy inputs and outputs required to construct, operate, monitor, and close the facility; emissions from land use change; and long-term retention of the CO_2 (see **Appendix D**). DOE will give preference to applications that have the greatest long-term potential to maximize net CO_2 emissions reductions by incorporating energy and CO_2 storage/conversion options associated with the greatest net-climate benefit. Applicants are asked to describe plans to use and/or transition to clean energy over the life of their project. If CO_2 will be stored in conjunction with hydrocarbon extraction during any phase of the project, the Applicants should detail plans for maximizing the amount of CO_2 storage relative to associated hydrocarbon extraction over the life of the project or, where applicable, directly displacing non-anthropogenic CO_2 currently sourced from geologic domes with anthropogenic CO_2.

A summary of the DAC Hub specifications is listed in **Table 1**.

Table 1. Regional DAC Hubs Specifications

Structure	Initial Capacity	Technology Readiness of Individual Technology to Participate in DAC Hub	CO_2 Transport, Storage, and/or Conversion	Performance
Capacity to capture and store, utilize, or store and utilize at least 1,000,000 metric tons (tonnes) of CO_2 from the atmosphere annually (MTA) A single unit (i.e., integrated DAC system) with the capacity to remove at least 1 MTA of CO_2 from the atmosphere or Multiple interconnected units (i.e., integrated DAC system) with each unit (i.e., integrated DAC system) capturing a minimum of 50,000 tonnes CO_2 from the atmosphere annually (50 KTA) Preference will be given to DAC Hubs that include a diversity of DAC technologies	Minimum initial DAC Hub capacity of 50 KTA CO_2	TRL 7 and Integrated, continuous, engineering-scale DAC system test (max 10X scaling factor to initial DAC Hub Capacity) completed by commence construction TRL 7 and Integrated, continuous, engineering-scale CO_2 conversion system test (max 10X scaling factor to proposed demonstration scale) by commence construction	CO_2 pipelines (or other required transport methods) needed to connect proposed atmospheric carbon capture, processing, storage, and/or conversion sites Captured CO_2 will be stored in a secure, domestic CO_2 storage facility that has sufficient capacity to store CO_2 from the proposed DAC Hub for at least 12 years of operation. If necessary, the Recipients shall secure agreements for the offtake of CO_2 emissions captured by qualifying technologies during the project CO_2 conversion to valuable products which demonstrate a reduction in life cycle greenhouse gas emissions when compared to the equivalent incumbent product	Support Carbon Negative Shot goal ($100/net tonne CO_2e) Demonstrate the potential to reach at least 1 MTA net CO_2 removal capacity Optimize land use, water use, process carbon intensity, levelized cost per tonne of net CO_2e removed from the atmosphere Evaluate community benefits and harms in affected communities

Regional DAC Hub Applicants should discuss any coordination with activities of the Carbon Capture Technology Program established under the Energy Policy Act of 2005 (EPAct 2005) Section 962(b)(1) (*see also* BIL Section 40303), the Carbon Storage Validation and Testing Program established under EPAct 2005 Section 963(b)(1) (*see also* BIL Section 40305), and the CIFIA[12] Program established under EPAct 2005 Section 999B(a) (*see also* BIL Section 40304). Applicants that receive DOE support for related aspects of DAC Hubs pursuant to the above provisions (e.g., CO_2 transportation and/or storage) will be eligible to apply for funding for complementary but not duplicative work from this FOA.[13,14]

[12] "CIFIA" means Carbon Dioxide Transportation Infrastructure Finance and Innovation Act

[13] https://www.energy.gov/bil/bipartisan-infrastructure-law-homepage

[14] https://netl.doe.gov/bilhub

ii. General Information for All Topic Areas

DOE intends to issue *two* Regional Direct Air Capture Hubs FOAs, under Section 969D of the Energy Policy Act of 2005 (42 U.S.C. 16298d). The staging of two (2) separate FOAs to implement this provision will enable the program to have the greatest impact on catalyzing the growth of the DAC industry with a diversity of technology approaches, anchor tenants, off takers, users, and business models that develop over time.

Domestic Regional DAC Hub development and implementation will be conducted in five phases (as applicable) – **Phase 0**: Feasibility; **Phase 1**: Detailed Plan and Front-End Engineering Design (FEED) Studies; **Phase 2**: Project Development, Permitting, and Financing; **Phase 3**: Procurement, Construction, and Integration; and **Phase 4**: Ramp-Up and Sustained Operations. A high-level summary of activities and deliverables for each phase are listed in **Table 2**.

Table *2*. DAC Hubs: Phase Activities and Deliverables[(1)]

	Phase 0: Feasibility[(2)]	**Phase 1: Detailed Plan & FEEDs[(2)]**	**Phase 2: Develop, Permit, Finance[(2)]**	**Phase 3: Procure, Construct, Integrate[(2)]**	**Phase 4: Ramp-up and Operate[(2)]**
Business Development and Management	• Finalized DAC Hub Concept* • Financial Plan (FP): cost share for Phase 1 and preliminary, high-level plan for Phases 1-4 • Project Management Plan (PMP) • High-level Business Plan (BP)	• Initial DAC Hub Capacity Defined • Executed Host Site agreement for DAC Hub and storage site* • Executed DAC Hub Owner commitment letter • PMP, BP, FP for Phase 2-4	• DAC Hub Description* • Teaming, offtake & feedstock agreements • Sites access secured • Confirmed project financing, including contingency funding • PMP and FP for Phase 3-4 • BP for Phase 3-4 with refined DAC Hub Capacity Build-out Plan • Labor agreements	• Regular progress/status reporting for all agreements • Regular financial status reports • Updated BP, PMP, FP, teaming, offtake, labor agreements & feedstock agreements for final DAC Hub capacity	• Financial model updated with steady operation • Updated BP, PMP, FP, teaming, offtake, labor agreements & feedstock agreements based on final DAC Hub capacity and steady operation • Revised capacity build-out & projections

	Phase 0: Feasibility[2]	Phase 1: Detailed Plan & FEEDs[2]	Phase 2: Develop, Permit, Finance[2]	Phase 3: Procure, Construct, Integrate[2]	Phase 4: Ramp-up and Operate[2]
Engineering, Procurement, Construction & Operations	• Min Technology Readiness Level (TRL) 5 DAC & conversion technologies • DAC[3]: Engineering & design (5%)[6] and Class 4 (+/- 30%)[7] Total Project Cost (TPC) • DAC Hub BOP: Conceptual Design* • Storage: Status of Storage Field Development Plan, or offtake agreement* • Phase 1 Schedule – L2 • Integrated Program Schedule (IPS) – L1[8]; capacity build-out* – L1	• Min TRL 6 DAC & conversion technologies • DAC[3]: Engineering & design (40%)[6] and Class 3 (+/- 15%)[7] TPC • DAC Hub BOP: Engineering & design (5%)[6] and Class 4 (+/- 30%)[7] TPC* • Storage: Storage Field Development Plan or offtake agreement* • Phase 2 Schedule – L3 • IPS– L2; capacity build-out* - L2	• Min TRL 7 DAC & conversion technologies • DAC[3]: Engineering & design (90%)[6] and Class 1 (+/- 5%)[7] TPC • DAC Hub BOP: Engineering & design (15%) and Class 4 (+/- 20%)[7] TPC* • IPS – L3; capacity build-out* - L2	• Progress execution reporting • Integrated project completion testing • Updated TPC • DAC procurement, installation and commissioning • IPS – L3; capacity build-out* - L3	• Regular operation status reporting • Validated performance model • Final TPC • IPS – L3; capacity build-out* - L3
Safety, Security, Regulatory Requirements	• Permitting workflow overview • Environmental Health & Safety (EH&S) Analysis	• Environmental Information Volume (EIV) • EH&S Analysis • Cybersecurity Plan* • Underground Injection Control (UIC) Class VI permit application submitted* • Hazard and Operability (HAZOP) Study	• EIV (120 days after award) • National Environmental Policy Act (NEPA) determination • Execution ready safety plans • All permits for construction • UIC Class VI Permit to construct* • Pipeline right-of-way • Final Cybersecurity Plan* • Updated HAZOP • Pollution Impact Assessment	• All permits for execution • UIC Class VI Permit to inject* • Safety & security incident reporting & audits	• Ongoing permits, safety & security reporting
Risk Analysis & Mitigation (as Part of PMP)	• Risk Management Plan (RMP) • Risk Register	• RMP • Update Risk Register	• Quantitative RMP • Update Risk Register to inform contingency funds	• Quantitative RMP • Update Risk Register	• Tech risk updated for operations • Ongoing risk reporting • Failure root cause analysis and abatement implementation

	Phase 0: Feasibility[2]	Phase 1: Detailed Plan & FEEDs[2]	Phase 2: Develop, Permit, Finance[2]	Phase 3: Procure, Construct, Integrate[2]	Phase 4: Ramp-up and Operate[2]
Technical Data & Analysis	• DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at min 1 tonne CO_2 per year (TPY) • Preliminary LCA	• Updated DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at 1 KTA CO_2 or final commercial scale factor • LCA based on FEED study	• Updated DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at max 10X scaling factor [5] • Refined LCA based on Detailed Design • Technical Verification and Validation (V&V) plan	• V&V data collection & analysis	• Ongoing data collection • Refined LCA incorporating operation data
Community Benefits	• Develop and implement CBP Development Proposal, including: • Community & Labor Engagement • Investing in American Workforce • DEIA • Justice40 Initiative • Develop full CBP*	• Implement Phase 1 scope of CBP • Update CBP for Phases 2-4 based on Phase 1 activities*	• Implement Phase 2 scope of CBP • Update CBP for Phases 3-4 based on Phase 2 activities*	• Implement Phase 3 scope of CBP • Update CBP for Phase 4 based on Phase 3 activities*	• Implement Phase 4 scope of CBP • Update CBP based on steady state operations

[1] Unless otherwise specified, all activities included in **Table 2** apply to the proposed initial DAC Hub capacity. Activities applicable to final DAC Hub capacity are marked with **(*)**; [2] Phase Deliverables; [3] DAC: Integrated Direct Air Capture System, including related balance-of-plant (BOP), CO_2 transport, and CO_2 conversion (if applicable); [4] CO_2 conversion technologies are also included but cases should demonstrate maximum climate impacts; [5] Scaling factor is referenced to initial DAC Hub capacity; [6] Maturity level of project definition; [7] Cost estimate accuracy; [8] Integrated Program Schedule (IPS) level as defined in **Appendix Z**.

DOE understands that some DAC technologies and Hub concepts are more mature while others are more nascent, but it is DOE's intent to further both near-term and longer-term DAC technologies and Hub concepts through this BIL provision FOA. Thus, in this FOA, there will be three (3) Topic Areas (TAs) that will cover work only in the project phases shown in **Figure 2**.

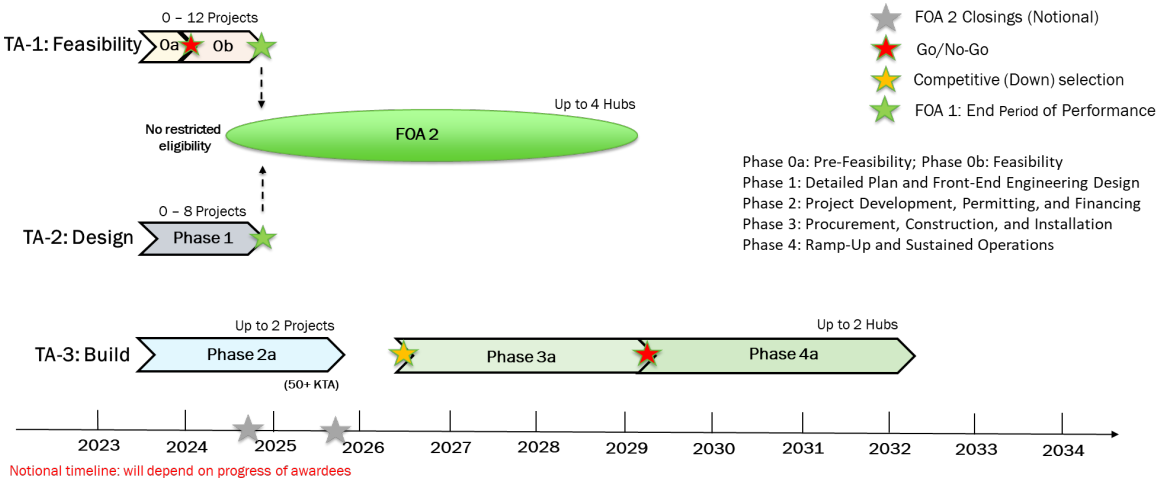

Figure 2. DAC Hubs Implementation: Notional Timeline

Specifically, the Topic Areas are:

(a) **Topic Area 1 (TA-1)** – **Feasibility (Phase 0)**, enables projects that are still formulating their Regional DAC Hub concept to conduct relevant analysis, networking and stakeholder engagement necessary to advance projects from a concept stage,

(b) **Topic Area 2 (TA-2)** – **Design (Phase 1)**, allows for projects that have already completed some of the necessary activities at the feasibility stage but require time to execute FEED studies and to advance permitting, and

(c) **Topic Area 3 (TA-3)** – **Build (Phases 2-4)**, enables projects that have completed a significant amount of work (e.g., DAC FEED and DAC Hub BOP pre-FEED) but require time for permitting, National Environmental Policy Act (NEPA) compliance, and detailed design before commencing procurement, DAC Hub construction, operation, and capacity build out, if applicable.

Due to the early technical maturity of **TA-1** and **TA-2**, the scope of DAC Hub implementation is expected to be completed through two FOAs: DE-FOA-0002735 and a second FOA (i.e., FOA 2) anticipated to be released in 2024 or later. FOA 2 plans to provide funding for Phases 1 through 4 and will NOT limit eligibility to those Applicants receiving awards under this FOA (i.e., DE-FOA-0002735). Details are provided in **Figure 2**. FOA 2 has not yet been developed and these requirements will likely evolve. DOE reserves the right to restructure FOA 2 as needed.

Table 3. Topic Area Description

Topic Area	Title	Phase(s) to be completed in FOA 1	Duration
BIL Section 40308: Regional Direct Air Capture Hubs			
TA-1	Feasibility	Phase 0a and 0b	Up to 24 months
TA-2	Design	Phase 1	Up to 24 months
TA-3	Build	Phases 2-4 and Capacity Build-Out	Up to 10 years

Phase 0: Feasibility; **Phase 1**: Detailed Plan and Front-End Engineering Design (FEED) Studies; and **Phase 2**: Project Development, Permitting, and Financing; **Phase 3**: Procurement, Construction, and Integration; and **Phase 4**: Ramp-Up and Sustained Operations.

TA-1 will provide funding for up to twelve (12) *feasibility studies* for Regional DAC Hub concepts including initial CBP activities and analysis.

TA-2 will provide funding for up to eight (8) *FEED studies* for Regional DAC Hubs, preparation of an Environmental Information Volume (EIV), and the CBP activities and analysis to complete **Phase 1** of the DAC Hub projects.

TA-3 will provide funding for up to two (2) *Regional DAC Hubs* to complete Phases 2 through 4 including CBP and NEPA work as the project progresses toward construction and operation for the initial capacity (min 50 KTA CO_2). Following the competitive (down)-selection into Phases 3-4, additional capacity build-out may be achieved by conducting Phases 1 through 4 for the new DAC technology(ies) added to the established DAC Hub.

Due to the numerous requirements of DAC Hubs generally, and the technical maturity of DAC technologies specifically, DOE believes the **majority** of proposals should target TA-1 with **fewer** proposals at TA-2 and **even less** at TA-3. In addition, DOE believes that a range of organizations beyond DAC technology developers can be DAC Hub *owners*, and DOE has designed TA-1 to support entities that have not yet finalized DAC technology selections to still apply for funding and advance their concepts for Hubs in their regions.

iii. Technical Requirements for Each Topic Area

TA-1: *Feasibility* - Regional DAC Hubs

The main objective of a project awarded under **TA-1** (Phase 0) is to complete feasibility studies for Regional DAC Hub concepts meeting technical specifications provided in **Table 1** and encompassing initial CBP activities and analysis. **TA-1** is tailored to enable projects that are still formulating their Regional DAC Hub concept and require time for pre-feasibility and feasibility studies. **TA-1** will be carried out in

two budget periods (i.e., *Phase 0a – Pre-Feasibility* and *Phase 0b – Feasibility)*, as shown in **Table 4**. TA-1, Phase 0a Recipients are allotted a 9-month technical period of performance to complete preliminary studies during the first budget period (Phase 0a), followed by a 15-month technical period of performance to complete Feasibility studies in the second budget period (Phase 0b).

Key technical application requirements **for TA-1** are provided in **Table 4**. Full Application requirements for applying to **TA-1** of the current FOA, are in Section IV, **Appendix A** and associated appendices. If the Applicant has already conducted, or is currently conducting, activities required under this FOA, the status of such activities should be clearly described in the application. DOE will not fund redundant, previously, or currently sponsored work. Applicants should propose a scope and budget covering only those additional activities that are necessary to complete the requirements of this FOA (i.e., DE-FOA-0002735).

By the completion of Phase 0, DOE expects that the proposed anchoring DAC or conversion system has already achieved at least TRL 5 and has been validated in an integrated bench-scale project capturing at least 1 tonne of CO_2 removed from the atmosphere annually (1 TPA). Bench-scale testing to achieve TRL 5 is not allowed under **TA-1** scope but could continue in parallel if selected for award. DOE intends to leverage ongoing work in DAC technology development from other DOE programs or private sector investment.

By the completion of Phase 0, DOE expects that significant progress has been achieved to characterize the selected carbon storage site. Carbon storage site characterization is not allowed under **TA-1** but could continue in parallel if selected for award. DOE intends to leverage ongoing work in secure geological storage technology development from other DOE programs or private sector investment. If the Applicant has already conducted or is currently conducting activities meeting the Phase 0 requirements under a different DOE award (e.g., DE-FOA-0001999) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed under this FOA. If the Applicant has a current application into DOE (DE-FOA-0002711 or DE-FOA-0002730), but DOE has not made selections yet, duplicate scope is appropriate in this FOA.

For the purpose of **TA-1**, "site selection" refers to the site chosen for the purpose of the Feasibility studies and other work within the proposed project. Project siting decisions cannot be finalized prior to successful completion of NEPA reviews, as well as any other applicable processes such as satisfactory progress of CBP work.

At a minimum, by the conclusion of the project (i.e., end of Phase 0b), TA-1 Recipients should have completed or accomplished the following which are described in detail in Appendix A and references therein.

- DAC Hub Concept.
- DAC Technology Description(s) and Data Tables (i.e., Initial DAC Hub Capacity).
- CO_2 Conversion Technology Description(s) and Data Tables (if applicable, Initial DAC Hub Capacity).
- DAC Hub Data Table.
- Technology Maturation Plan(s).
- Preliminary Life Cycle Analysis (LCA) (i.e., Both Initial and Final DAC Hub Capacity).
- Integrated DAC and/or Conversion System Pre-FEED Study (i.e., Initial DAC Hub Capacity).
- DAC Hub Balance-of-Plant (BOP) Conceptual Design (i.e., Final DAC Hub Capacity).
- Status of Storage Field Development Plan (i.e., storage capacity for at least 12 years of DAC Hub operations), if needed, or status of the offtake agreement.
- Environmental Health and Safety (EH&S) Risk Analysis.
- Safety, Security, and Regulatory Requirements.
- Business Plan.
- Financial Plan.
- Full Community Benefits Plan.

Table 4. TA-1: Key Technical Application Requirements and Deliverables[1]

	Phase 0 Application Requirements	**Phase 0a Deliverables: Pre-Feasibility[2]** (Up to 9 months)	**Phase 0b Deliverables: Feasibility[2]** (Up to 15 months)
Business Development and Management	• DAC Hub Summary:* Identify potential DAC hub owner & Team, preliminary site location, identify CO_2 storage sites or conversion sites • Secured cost share for Phase 0 • Project Management Plan (PMP)	• DAC Hub Description:* Select DAC Hub owner, Team, Site location for Phase 0b	• Finalized DAC Hub Concept* • Financial Plan (FP): cost share for Phase 1 and preliminary, high-level plan for Phases 1-4 • PMP • High-level Business Plan (BP)
Engineering, Procurement, Construction & Operations	• Identify potential DAC technologies and/or CO_2 conversion technologies[4] • DAC Hub Balance of Plant (BOP): concept* • Discuss CO_2 storage site or offtake options* • Phase 0 Schedule – L2[7]	• Select anchoring DAC technology(ies); discuss technology readiness • Initial DAC Hub BOP Design*	• Min TRL 5 DAC & conversion technologies • DAC[3]: Engineering & design (5%)[5] and Class 4 (+/- 30%)[6] TPC • DAC Hub BOP: Conceptual Design* • Storage: Status of Storage Field Development Plan or offtake agreement* • Phase 1 Schedule – L2 • Integrated Program Schedule (IPS) – L1; capacity build-out* – L1
Safety, Security, Regulatory Requirements		• Safety history/culture description • Permitting workflow overview	• Permitting workflow overview • EH&S Analysis
Risk Analysis & Mitigation (as Part of PMP)	• Initial Risk Management Plan (RMP)	• Refined RMP	• RMP • Risk Register
Technical Data & Analysis	• Data Tables for DAC and CO_2 conversion[4] (if available)	• DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] • Preliminary LCA	• DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at min 1 TPY CO_2 • Preliminary LCA
Community Benefits	• N/A	• Develop CBP Development Proposal (CBPDP)	• Implement CBP Development Proposal • Develop full CBP*

[1] Unless otherwise specified, all activities included in **Table 4** apply to the proposed initial DAC Hub capacity. Activities applicable to final DAC Hub capacity are marked with **(*)**; [2] Phase Deliverables; [3] DAC: Integrated Direct Air Capture System, including related balance-of-plant (BOP), CO_2 transport, and CO_2 conversion (if applicable); [4] CO_2 conversion technologies are included but cases should demonstrate maximum climate impacts; [5] Maturity level of project definition; [6] Cost estimate accuracy. [7] Integrated Program Schedule (IPS) level as defined in **Appendix Z**. Complete descriptions of the **TA-1** activities, and deliverables are provided in **Appendix A** and references therein.

TA-2: *Design* - Regional DAC Hubs

TA-2 aims to support Regional DAC Hub projects that have already formulated their Hub concept and have performed a pre-FEED study for the initial DAC Hub anchoring technology. The main objectives of a project awarded under **TA-2** are to: (i) execute planning activities for a DAC Hub that meets the technical specifications provided in **Table 1**; (ii) execute and complete FEED studies for the initial anchoring DAC system (i.e., min 50 KTA CO_2 capacity with CO_2 conversion, if applicable, related BOP, and other supportive infrastructure such as pipelines) , and (iii) execute and complete the Storage Field Development Plan for the proposed carbon storage facility to support at least 12 years of DAC Hub operation, if needed. For **TA-2**, while only detailed Phase 1 applications are being solicited at this time, information relating to initial plans to carry out Phases 2 through 4 will be required to assess the potential viability of the overall Regional DAC Hub project.

To apply for **TA-2**, the proposed anchoring DAC technology must have already achieved a minimum TRL 5 and have been validated in an integrated bench scale project removing at least 1 tonne of CO_2 removed from the atmosphere annually (1 TPA). Key technical application requirements **for TA-2** are provided in **Table 5**. Full Application requirements for applying to the current FOA, **TA-2** are located in Section IV, **Appendix B** and associated appendices. If the Applicant has already conducted, or is currently conducting, activities required under **TA-2** of this FOA, the status of such activities should be clearly described in the application. DOE will not fund redundant, previously, or currently sponsored work. Applicants should propose a scope and budget covering only those additional activities that are necessary to complete the requirements of this FOA. TA-2 does not fund the design, build, and operation of integrated pilot scale operations or any R&D related to the FEED studies for the initial capacity of a DAC Hub, including CO_2 conversion to products and/or secure geological storage.

For the purpose of TA-2, "site selection" refers to the site chosen for the purpose of the Feasibility studies and other work within the proposed project; project siting decisions cannot be finalized prior to successful completion of reviews (e.g., NEPA), as well as any other applicable processes such as satisfactory progress of CBP work.

By the completion of TA-2 (Phase 1), DOE expects that the proposed anchoring DAC and CO_2 conversion system (if applicable) have already achieved at least TRL 6 and have been validated in an integrated, continuous, engineering-scale system test at a scale of (i) a minimum 1000 tonne of CO_2 per year (1 KPA), or (ii) the final commercial form factor. Engineering-scale testing to achieve TRL 6 is not allowed under **TA-2** scope but could continue in parallel if selected for award. DOE intends to leverage ongoing work in DAC technology and CO_2 conversion (if applicable) development(s) from other DOE programs or private sector investment.

By the completion of Phase 1, **TA-2** Recipients should have completed the characterization of the proposed carbon storage site to support at least twelve (12) years of DAC Hub operation. Carbon storage site characterization is not allowed under **TA-2** but could continue in parallel if selected for award. DOE intends to leverage ongoing work in secure geological storage technology development from other DOE programs or private sector investment. If the Applicant has already conducted or is currently conducting activities meeting the Phase 1 requirements under a different DOE award (e.g., DE-FOA-0001999) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed under this FOA. If the Applicant has a current application into DOE (DE-FOA-0002711 or DE-FOA-0002730), but DOE has not made selections yet, duplicate scope is appropriate in this FOA.

At a minimum, by the conclusion of the project (i.e., end of Phase 1), TA-2 Recipients should have completed or accomplished the following which are described in detail in Appendix B and references therein.

- Initial DAC Hub Capacity Defined.
- DAC Technology Description(s) and Data Tables (i.e., Initial DAC Hub Capacity).
- CO_2 Conversion Technology Description(s) and Data Tables (if applicable, Initial DAC Hub Capacity).
- DAC Hub Data Table.
- Technology Maturation Plan(s) (TMP).
- Life Cycle Analysis (LCA) (i.e., both Initial and Final DAC Hub Capacity).
- Integrated DAC and/or Conversion System FEED Study (i.e., Initial DAC Hub capacity).
- DAC Hub Balance-of-Plant (BOP) pre-FEED Study (i.e., Final DAC Hub Capacity).
- Storage Field Development Plan (i.e., storage capacity for at least 12 years of DAC Hub operations), if needed, or status of the offtake agreement.
- UIC Class VI Permit Application Materials, if needed (i.e., storage capacity for at least 12 years of DAC Hub operations).
- Environmental Health and Safety (EH&S) Risk Analysis.
- Safety, Security, and Regulatory Requirements.
- Business Plan.
- Financial Plan.
- Environmental Information Volume.
- Implement Community Benefits Plan (Phase 1 scope).

Table 5. TA-2: Key Technical Application Requirements and Deliverables[1]

	Phase 1 Application Requirements	Phase 1 Deliverables: Detailed Plan & FEEDs[2] (Up to 24 months)
Business Development and Management	• Finalized DAC Hub Concept* • Financial Plan (FP): cost share for Phase 1 and preliminary, high-level plan for Phases 1-4 • High-level Business Plan (BP)	• Initial DAC Hub Capacity Defined • Executed Host Site agreement for DAC HUB and storage site* • Executed Hub Owner commitment letter • PMP, BP, FP for Phase 2-4
Engineering, Procurement, Construction & Operations	• Min TRL 5 DAC & conversion technologies • DAC[3]: Engineering & design (5%)[5] and Class 4 (+/- 30%)[6] TPC • DAC Hub BOP: Conceptual Design* • Storage: Status of Storage Field Development Plan or offtake agreement* • Phase 1 Schedule – L2 [7] • Integrated Program Schedule (IPS) – L1; capacity build-out* – L1	• Min TRL 6 DAC & conversion technologies • DAC[3]: Engineering & design (40%)[5] and Class 3 (+/- 15%)[6] TPC • DAC Hub BOP: Engineering & design (5%) and Class 4 (+/- 30%)[6] TPC* • Storage: Storage Field Development Plan or status offtake agreement* • Phase 2 Schedule – L3 • IPS– L2; capacity build-out* - L2
Safety, Security, Regulatory Requirements	• Permitting workflow overview • EH&S Analysis	• EIV • EH&S Analysis • Cybersecurity Plan* • UIC Class VI permits submitted* • HAZOP
Risk Analysis & Mitigation	• RMP • Risk Register	• RMP • Update Risk register
Technical Data & Analysis	• DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at min 1 TPY CO_2 • Preliminary LCA	• Updated DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion technologies validated at 1 KTA CO_2 or final commercial form factor • LCA based on FEED study
Community Benefits	Plans* include: • Community & Labor Engagement • Investing in American Workforce • DEIA • Justice40 Initiative	• Implement Phase 1 scope of CBP • Update CBP for Phases 2-4 based on Phase 1 activities*

[1] Otherwise specified, all activities included in **Table 5** apply to the proposed initial DAC Hub capacity. Activities applicable to final DAC Hub capacity are marked with **(*)**; [2] Phase Deliverables; [3] DAC: Integrated Direct Air Capture System, including balance-of-plant (BOP), CO_2 transport, and CO_2 conversion (if applicable); [4] CO_2 conversion technologies are included but cases should demonstrate maximum climate impacts; [5] Maturity level of project definition; [6] Cost estimate accuracy. [7] Integrated Program Schedule (IPS) level as defined in **Appendix Z**. Complete descriptions of the **TA-2** activities, and deliverables are provided in **Appendix B** and references therein.

TA-3: ***Build*** - **Regional DAC Hubs**

TA-3 is intended for applicants who have already completed all Phase 1 activities, as described in **Table 6**. The main objectives of a project awarded under **TA-3** are to: (i) finalize planning and permitting activities for a DAC Hub that meets the technical specifications provided in **Table 1**; (ii) execute and complete Phases 2-4 for the initial DAC Hub capacity (i.e., minimum 50 KTA CO_2), and (iii) execute and complete Phases 2-4 for the proposed carbon storage and/or conversion facility to support at least 12 years of DAC Hub operation, if needed. While only detailed Phase 2 applications will be solicited under the current TA-3, information relating to initial plans to carry out Phases 3-4 will be required to assess the potential viability of the overall DAC Hub project. If applicable, following the competitive (down)-selection for Phases 3-4 (see Section VI.C), additional capacity build-out will be achieved by conducting Phases 1 through 4 for the new DAC technology added to the existing DAC Hub. A complete list of activities to be completed during **TA-3** is provided in **Appendix C**.

TA-3 Phase 2 encompasses advanced planning activities for: (i) a Regional DAC Hub, (ii) the initial DAC capacity (i.e., min 50 KTA CO_2 capacity with CO_2 conversion, if applicable, related BOP, and other supportive infrastructure such as pipelines), and (iii) the carbon storage and/or conversion facility to support at least 12 years of DAC Hub operation, if needed. DAC Hub projects should finalize their project development plans, commercial agreements, TEA and LCA assessments, offtake agreement's financial structure, and complete the necessary permitting and approval activities required to begin construction for the initial DAC Hub capacity and the carbon storage facility to support at least 12 years of DAC Hub operation, if needed.

To apply to **TA-3**, the proposed anchoring DAC technology and CO_2 conversion system (if applicable) must have already achieved a minimum TRL 6 and have been validated in an integrated, continuous, engineering-scale system test at a scale of (i) a minimum 1000 tonne of CO_2 per year (1 KPA), or (ii) the final commercial form factor. Key technical application requirements for **TA-3** Phase 2 are provided in **Table 6**. Full Application requirements for applying to the current FOA, TA-3 Phase 2 are in Section IV, **Appendix C** and associated appendices. If the Applicant has already conducted, or is currently conducting, activities required under **TA-3** of this FOA, the status of such activities should be clearly described in the application. DOE will not fund redundant, previously, or currently sponsored work. Applicants should propose a scope and budget covering only those additional activities that are necessary to complete the requirements of this FOA.

For the purpose of **TA-3** Phase 2 activities, “site selection” refers to the site chosen for the purpose of the Detailed Design studies and other work within the proposed project; project siting decisions cannot be finalized prior to successful completion of NEPA

reviews, as well as any other applicable processes such as satisfactory progress of CBP work.

By the end of **TA-3** Phase 2, engineering designs should be sufficiently mature to support completion and execution of relevant procurement or construction contracts and overall commencement of major project execution tasks for the initial DAC Hub capacity. Long-lead procurement activities may be started in Phase 2 following NEPA compliance with prior DOE approval. Third-party financing and contingency agreements should be completed and relevant offtake or feedstock agreements be in place. Risk management plans should be revised and updated to reflect progress made and risks mitigated, as well as new or emerging risks, and corresponding management plans. Data Management and Intellectual Property Management Plans should also be finalized. Evidence of a contingency reserve will be required prior to beginning Phase 3 activities.

By the completion of Phase 2, DOE expects that the proposed anchoring DAC and CO_2 conversion system (if applicable) have already achieved at least TRL 7 and have been validated in an integrated, continuous, engineering-scale system test **at maximum ten (10) times** scaling factor to the proposed initial DAC Hub capacity.[15] Engineering-scale testing to achieve TRL 7 is not allowed under TA-3 scope but could continue in parallel if selected for award. If the Applicant has already conducted or is currently conducting activities meeting the Phase 2 requirements under a different DOE award (e.g., DE-FOA-0001999) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed under this FOA. If the Applicant has a current application into DOE (DE-FOA-0002711 or DE-FOA-0002730), <u>but DOE has not made selections yet</u>, duplicate scope is appropriate in this FOA.

By the completion of Phase 2, TA-3 Recipients must complete a task for an in-depth environmental pollution impact assessment (including cumulative pollution impacts) of any installation of DAC and balance of plant systems within the DAC Hub. Funding of any future Phases of the work will be dependent on the results of the completed pollutant assessment.

At a minimum, by the conclusion of the project (i.e., end of Phase 2), TA-3 Recipients should have completed or accomplished the following which are described in detail along with TA-3 Phase 2 activities in Appendix C and references therein.

- DAC Hub Description.

[15] For example, if the proposed initial Hub capacity is 300 KTA CO_2 and is achieved by a single DAC technology, the anchoring DAC technology should be validated in an integrated, continuous, engineering system at a minimum 30 KTA CO_2 scale. If the DAC Hub capacity is achieved by multiple DAC technologies, each individual technology must be validated separately at a maximum ten (10) times scaling factor to its proposed capacity in the DAC Hub.

- DAC Technology Description(s) and Data Tables. (i.e., Initial DAC Hub Capacity)
- CO_2 Conversion Technology Description(s) and Data Tables (if applicable, Initial DAC Hub Capacity).
- DAC Hub Data Table.
- Technology Maturation Plan(s) (TMP).
- Refined Life Cycle Analysis (LCA). (i.e., both Initial and Final DAC Hub Capacity).
- Integrated DAC and/or Conversion System Detailed Design (i.e., Initial DAC Hub Capacity).
- DAC Hub Balance-of-Plant (BOP) pre-FEED Study (i.e., Final DAC Hub Capacity).
- All Permits Secured, including UIC Class VI permits to construct, if needed (i.e., storage capacity for at least 12 years of DAC Hub operations).
- Environmental Health and Safety (EH&S) Risk Analysis.
- Pollution Impact Assessment.
- Safety, Security, and Regulatory Requirements.
- Business Plan.
- Financial Plan.
- National Environmental Policy Act (NEPA) Compliance.
- Implement Community Benefits Plan (Phase 2 scope).

High level description of Phases 2-4 can be found in **Table 6**.

The comprehensive list of application requirements for Phases 3–4, including Merit Review Criteria to evaluate the application for Phases 3–4, will be contained in Phase 2 awards. Note that only TA-3 Recipients that have successfully completed all Phase 2 activities and requirements (see **Appendix C**) will be afforded the opportunity to submit a Phase 3-4 application for consideration under the competitive (down)-selection process outlined in this FOA.

Table 6. Key Technical Application Requirements and Deliverables[1]

	Phase 2 Application Requirements	**Phase 2 Deliverables: Develop, Permit, Finance[2]** (30 months)[9]	**Phase 3 Deliverables: Procure, Construct, Integrate[2]** (36 months)[9]	**Phase 4 Deliverables: Ramp-up and Operate[2]** (36 months)[9]
Business Development and Management	• Initial DAC Hub Capacity Defined • Cost Share, DAC Hub owner, Storage Site*, and Team Commitment Letters • PMP, BP, FP for Phase 2-4	• DAC Hub Description* • Teaming, offtake & feedstock agreements • Sites access secured • Confirmed project financing • PMP and FP for Phases 3-4 and DAC Hub Capacity Build-out • BP for Phases 3-4 with refined DAC Hub Capacity Build-out Plan • Labor agreements	• Regular progress/status reporting for all agreements • Regular financial status reports • Updated BP, PMP, FP, teaming, offtake, labor agreements & feedstock agreements for final DAC Hub capacity	• Financial model updated with steady operation • Updated BP, PMP, FP, teaming, offtake, labor agreements & feedstock agreements based on final DAC Hub capacity and steady operation • Revised final DAC Hub capacity & projections
Engineering, Procurement, Construction & Operations	• Min TRL 6 DAC & conversion technologies • DAC[3]: Engineering & design (40%)[6] and Class 3 (+/- 15%)[7] TPC • DAC Hub BOP: Engineering & design (5%) and Class 4 (+/- 30%)[7] TPC* • Storage: Storage Field Development Plan or offtake agreement* • Phase 2 Schedule – L3 • IPS– L2; capacity build-out* - L2[8]	• Min TRL 7 DAC & conversion technologies • DAC[3]: Engineering & design (90%)[6] and Class 1 (+/- 5%)[7] TPC • DAC Hub BOP: Engineering & design (15%) and Class 4 (+/- 20%)[7] TPC* • IPS – L3; capacity build-out* - L2	• Progress execution reporting • Integrated project completion testing • Updated TPC • DAC procurement, installation and commissioning • IPS – L3; capacity build-out* - L3	• Regular operation status reporting • Validated performance model • Final TPC • IPS – L3; capacity build-out* - L3
Safety, Security, Regulatory Requirements	• EH&S Analysis • UIC Class VI permits submitted* • HAZOP	• EIV (120 days after award) • NEPA determination • Execution ready safety plans Analysis • All permits for construction • UIC Class VI Permit to construct* • Pipeline right-a-way • Final Cybersecurity Plan* • Updated HAZOP • Pollution Impact Assessment	• All permits for execution • UIC Class VI Permit (operation) or executed offtake agreement* • Safety & security incident reporting & audits	• Ongoing permits, safety & security reporting

	Phase 2 Application Requirements	Phase 2 Deliverables: Develop, Permit, Finance[2] (30 months)[9]	Phase 3 Deliverables: Procure, Construct, Integrate[2] (36 months)[9]	Phase 4 Deliverables: Ramp-up and Operate[2] (36 months)[9]
Risk Analysis & Mitigation (as Part of PMP)	• Risk Management Plan (RMP) • Risk Register	• Quantitative RMP • Update Risk register	• Quantitative RMP • Update Risk register	• Tech risk updated for operations • Ongoing risk reporting • Failure root cause analysis and abatement implementation
Technical Data & Analysis	• DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at min 1 KTA CO_2, or final commercial form factor • LCA	• Updated DAC Hub Data Table* • Data Tables for DAC and CO_2 conversion[4] technologies validated at max 10X scaling factor[5] • Refined LCA based on Detailed Design • Technical Verification and Validation (V&V) plan	• V&V data collection & analysis	• Ongoing data collection • Refined LCA incorporating operation data
Community Benefits	• Plans* include: • Community & Labor engagement • Investing in American Workforce • DEIA • Justice40 Initiative	• Implement Phase 2 scope of CBP • Update CBP for Phases 3-4 based on Phase 2 activities*	• Implement Phase 3 scope of CBP • Update CBP for Phase 4 based on Phase 3 activities*	• Implement Phase 4 scope of CBP • Update CBP based on steady state operations

[1] Otherwise specified, all activities included in **Table 6** apply to the proposed initial DAC Hub capacity. Activities applicable to final DAC Hub capacity are marked with **(*)**; [2] Phase Deliverables; [3] DAC: Integrated Direct Air Capture System, including related balance-of-plant (BOP), CO_2 transport, and CO_2 conversion (if applicable); [4] CO_2 conversion technologies are included but cases should demonstrate maximum climate impacts; [5] Scaling factor is referenced to initial DAC Hub capacity; [6] Maturity level of project definition; [7] Cost estimate accuracy. [8] Integrated Program Schedule (IPS) level as defined in **Appendix Z**. [9] Initial DAC Hub Capacity only; additional capacity build-out could be conducted in parallel by completing Phases 1 through 4 which may increase the technical period of performance. Complete descriptions of the **TA-3** activities, and deliverables are provided in **Appendix C** and references therein.

iv. Community Benefits Plan

Development and deployment of carbon management technology will be more successful if community engagement and partnership development, including equity,

justice, and quality job principles, are integrated into funding opportunities. For example, failing to meaningfully engage with communities and stakeholders has been a contributing factor to delays or cancellations of energy and carbon management projects in the past. However, with meaningful engagement, communities and stakeholders can be project partners whose questions and concerns can improve overall project outcomes. This is clear from feedback obtained from stakeholders of the Office of Fossil Energy and Carbon Management,[16,17] requests for information,[18] published research, and Office learnings from project work.

To support the goals of building a clean and equitable energy economy (including maximizing benefits and minimizing negative impacts), projects funded under this FOA are expected to include a CBP to:

- Support meaningful community and labor engagement;
- Invest in America's workforce;
- Advance diversity, equity, inclusion, and accessibility; and
- Contribute to the President's goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities (the Justice40 Initiative).[19]

Due to the difference in scope, TA-1, TA-2, and TA-3 have different requirements related to community benefits as described below and in **Appendices E and F**.

Detailed guidance and examples on creating each section of the CBP are provided as an attachment to the FOA. Applicants are encouraged to read these resources prior to writing their CBP.

DOE reserves the right to share non-procurement sensitive (or otherwise non-confidential / non-privileged) portions of information contained in CBPs publicly after awards are announced. However, during project selection and negotiations, which can take more than one year, the content in CBPs submitted in FOA applications is considered procurement sensitive and cannot be shared by DOE with the public. Applicants may share details of their CBP with stakeholders and other parties at their own discretion. For example, applicants may create a slide deck, factsheet, or other communication tool to communicate their plans and get feedback.

TA-1: *Feasibility* - Regional DAC Hubs

[16] https://usea.org/event/department-energy-public-community-listening-session-regarding-carbon-management
[17] https://usea.org/event/virtual-carbon-management-applicant-education-workshop
[18] https://www.fedconnect.net/FedConnect/default.aspx?ReturnUrl=%2ffedconnect%2f%3fdoc%3dDE-FOA-0002660%26agency%3dDOE&doc=DE-FOA-0002660&agency=DOE
[19] https://www.energy.gov/diversity/justice40-initiative

Applicants to TA-1 are not required to submit a CBP at application, however, during TA-1 Phase 0a, awardees will be required to develop a CBP Development Proposal (CBPDP), which will be required as a deliverable at the end of Phase 0a and considered as part of the go/no-go decision between Phase 0a and Phase 0b. The requirements for the CBPDP Phase 0a deliverable are outlined in **Appendix E**.

During Phase 0b, Recipients will be required to implement the CBPDP during that performance period. A full CBP will be required as a deliverable at the end of Phase 0b.

Applicants to TA-1 are encouraged to familiarize themselves with the CBP requirements under TA-2 and TA-3.

TA-2: *Design* - Regional DAC Hubs and **TA-3: *Build*** - **Regional DAC Hubs**

Applicants to TA-2 and TA-3 must submit a Community Benefits Plan (CBP or Plan) as a separate part of their application package. The CBP elements should be incorporated into the overall DAC Hub scope, schedule, and budget. Full Application requirements for the CBP are in **Appendix F.**

For each CBP section, Applicants should propose metrics to measure the success of the CBP. Major milestones and work descriptions relevant to the plan should be included within the IPS and Workplan. Applicants are encouraged to use SMART (Specific, Measurable, Achievable, Relevant and Timely) milestones whenever possible.

Each of the four sections should include information about the resources intended to implement the CBP, including staff time and budget to convene public meetings to engage and negotiate agreements with relevant labor unions, communities and other stakeholders.

Applicants are also encouraged to submit documentation (e.g., letters of support) to demonstrate existing or planned partnerships with community entities, such as organizations that work with local stakeholders (e.g., residents and businesses), organizations that carry out workforce development programs, trade associations, worker organizations including labor unions, and community-based organizations that work with disadvantaged communities. These letters of support should be submitted under the Community Partnership Documentation (see Section IV.D.xxviii) and do not count toward the CBP page limit.

DOE will provide feedback to awardees and require that they update their CBP during award negotiations. During Phases 1-4, DOE will also provide additional guidance to awardees on requirements for updating the CBP for future phases which may include new impacts, metrics, ways of measuring the information, or reporting guidance for

a specific subset of metrics related to community and workforce benefits, particularly as project impacts change with capacity maturation. In addition to providing guidance, DOE or its representative(s) expect to independently verify plan implementation status and effectiveness. Independent findings may be incorporated into Go/No-Go and down-select reviews. DOE will also require accomplishments and findings related to the CBP to be included as part of the final report.

Applicants are encouraged to leverage information generated in other portions of this FOA to support CBP development, including the Environmental Questionnaire, Environmental Health & Safety Risk Analysis, engineering and design documents, Health & Safety Risk Analysis and the LCA. For sections of the Plan that require an assessment of project impacts, including assessments done as part of the Investing in the American Workforce and the Justice40 Initiative sections, applicants should assess impacts across the project's initial (minimum 50,000 tonnes CO_2) and mature (minimum 1,000,000 tonnes CO_2) capacity levels, as impacts are likely to change as capacity increases.

DOE recognizes that each project and applicant is unique and requires a range of approaches to ensuring community benefits and minimization of harms, and that some of these approaches may be new to applicants. If the applicant has prior or ongoing efforts to advance energy and environmental justice, DEIA, community and labor engagement, or quality jobs, the application should discuss how they are incorporating lessons learned and building on these prior/ongoing efforts.

Due to the differences in project scope for TA-2 and TA-3, CBPs for each TA should reflect the maturity and scope of the proposal:

- **For TA-2**: Applicants should complete each portion of the CBP to the greatest extent possible. In cases where information is incomplete, Applicants should clearly explain the reason for missing information and provide plans to address those gaps during the project. At this stage of the application process, the CBP should indicate the applicant's intention to engage meaningfully with community and labor stakeholders on these goals, including the potential of entering into formal Workforce and Community Agreements. The CBP should provide the most details regarding actions the Applicant would take during TA-2, but can also describe in a higher-level summary what goals, deliverables, outcomes, and implementation strategies the Applicant would pursue in later phases. If selected for award, DOE will work with awardees during the first 90 days of award to update the CBP.
- **For TA-3**: If selected for award, DOE expects the information contained in the CBP to deepen and evolve during each phase. The CBP must be implemented and updated during each project phase. For example, in each phase, awardees would 1) implement the CBP activities corresponding to that phase and 2)

create an end-of-phase report that includes status summary, lessons learned, and an updated CBP for future phases/activities. The CBP should provide the most details regarding actions the Applicant would take during Phase 2, but can also describe in a higher-level summary what goals, deliverables, outcomes, and implementation strategies the applicant would pursue in Phases 2-4. The CBP will be part of Go/No-Go and down-select decision criteria.

v. Carbon Matchmaker

Applicants have access to Carbon Matchmaker, which may be utilized to facilitate the formation of new project teams for this FOA. Carbon Matchmaker is an online information resource to connect users across the carbon capture, utilization, and storage (CCUS) and carbon dioxide removal (CDR) supply chains. Carbon matchmaker will:

- Enable a teaming mechanism to support geographically diverse CCUS/CDR projects across the United States.
- Increase awareness and facilitate development of regional carbon management hubs, including alongside hydrogen hub development where relevant.
- Provide domestic and international community, industry, and technology development stakeholders with carbon dioxide supply and demand maps for current and planned projects.
- Highlight past and currently funded DOE carbon management projects in a geospatial map.

Carbon Matchmaker is intended to help facilitate regional carbon management team formation by allowing carbon management producers, end-users, and other stakeholders to self-identify and align potential needs in specific geographic areas within the United States. Carbon Matchmaker allows organizations who may wish to participate on an application to express their interest to other applicants and to explore potential partnerships.

Participation by underrepresented partners and suppliers and labor unions is encouraged. Teams that include representation from diverse entities such as, but not limited to: Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities (HBCUs)/Other Minority Institutions (OMIs), or through linkages with Opportunity Zones, are encouraged.

- Minority Serving Institutions (MSIs), including HBCUs/OMIs as educational entities recognized by the Office of Civil Rights (OCR), U.S. Department of Education, and identified on the OCR's Department of Education U.S. accredited postsecondary minorities' institution list. See https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

- Opportunity Zones were added to the Internal Revenue Code by Section 13823 of the Tax Cuts and Jobs Act of 2017, codified at 26 U.S.C. 1400Z-1. The list of designated Qualified Opportunity Zones can be found in IRS Notices 2018-48 (PDF) and 2019-42 (PDF). Further, a visual map of the census tracts designated as Qualified Opportunity Zones may also be found at Opportunity Zones Resources. Also see, frequently asked questions about Qualified Opportunity Zones.

Interested applicants can follow the submission instructions (https://www.energy.gov/fecm/carbon-matchmaker) on the Carbon Matchmaker website. Please indicate if DOE's Carbon Matchmaker enabled or connected partnerships of participants in the application. If so, please describe. This is merely to evaluate the effectiveness and to continually improve the matchmaker tool.

Note: Participation in the Carbon Matchmaker online resource is voluntary. Participation, or lack thereof, will not have any impact on an organization being selected for award. All provided data is self-reported by interested stakeholders and is not furnished by DOE. DOE does not recommend, endorse, or otherwise evaluate the qualifications or validity of any entities or data that were self-reported on this platform. DOE will not fund the provision of any information, nor will it compensate any applicants or requesting organizations for the development of such information.

C. Applications Specifically Not of Interest

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (See Section III.D. of the FOA):

- Applications that fall outside the technical parameters specified in Section I.A. and I.B. of the FOA;
- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics);
- DAC Hub(s) not located entirely in the United States;
- R&D to advance the maturation of point source post-combustion and pre-combustion carbon capture technologies;
- R&D on CO_2 storage technologies, apart from engineering analysis to support the required design of the DAC Hub;
- R&D on DAC technologies, apart from engineering analysis to support the required design of the DAC Hub;
- R&D on CO_2 conversion/utilization technologies, apart from engineering analysis to support the required design of the DAC Hub;
- Applications to perform detailed site and subsurface characterization for the proposed carbon storage site;
- Applications proposing bench- and engineering-scale testing;

- Applications that do not submit a complete DAC Hub Data Table, and DAC and CO_2 conversion (if applicable) Data Tables (for **TA-2** and **TA-3** only);
- R&D on advanced power cycles (e.g., supercritical CO_2 cycle, oxy-combustion, and chemical looping configurations);
- R&D on CO_2 compression technologies, apart from engineering analysis to support the required design of the DAC Hub; and
- Applications proposing non-DAC CDR approaches, such as biochar, biomass burial, direct ocean capture, soil carbon sequestration, and afforestation/reforestation.

D. Authorizing Statutes

The programmatic authorizing statutes are:

- Public Law (PL) 95-91, DOE Organization Act, as amended
- PL 109-58, Energy Policy Act of 2005, Section 969D, as amended, including by PL 117-58, Infrastructure Investment and Jobs Act (IIJA), Section 40308, codified at 42 U.S.C. 16298d.

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulation (CFR) Part 200 as amended by 2 CFR Part 910.

E. Notice of Bipartisan Infrastructure Law-Specific Requirements

Be advised that special terms and conditions apply to projects funded by the BIL relating to:

- Reporting, tracking and segregation of incurred costs;
- Reporting on job creation and preservation;
- Publication of information on the Internet;
- Access to records by Inspectors General and the Government Accountability Office;
- Requiring all the iron, steel, manufactured goods, and construction materials used in the infrastructure activities of applicable projects are produced in the United States;
- Ensuring laborers and mechanics employed by contractors or subcontractors on BIL-funded projects are paid wages equivalent to prevailing wages on similar projects in the area;
- Protecting whistleblowers and requiring prompt referral of evidence of a false claim to an appropriate inspector general; and
- Certification and Registration.

Recipients of funding appropriated by the BIL must comply with requirements of all applicable Federal, State, and local laws, regulations, DOE policy and guidance, and instructions in this FOA. Recipients must flow down the requirements to

subrecipients to ensure the recipient's compliance with the requirements. DOE will post guidance and instructions at https://www.energy.gov/bil/bipartisan-infrastructure-law-homepage.

II. Award Information

A. Award Overview

The FOA will be carried out in three topic areas (i.e., TA-1, TA-2, and TA-3). Only detailed Phase 0 (TA-1), Phase 1 (TA-2) and Phase 2 (TA-3) applications are being solicited at this time. For **TA-2** and **TA-3**, information relating to initial plans to carry out subsequent phases will be required to assess the potential viability of the proposed DAC Hub. For **TA-3**, only Phase 2 Recipients that have successfully completed all TA-specific activities and requirements will be afforded the opportunity to submit a renewal application for consideration under the competitive (down)-selection process.

If the Applicant has already conducted or is currently conducting activities meeting the above description of Phase 0 (TA-1), Phase 1 (TA-2) or Phase 2 (TA-3) under a different award (BIL or appropriated programs) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed.

i. Estimated Funding

As shown in **Table 7**, DOE expects to make a total of approximately $1,236,000,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. DOE anticipates making approximately up to 22 awards under this FOA. However, DOE may issue one, multiple, or no awards. Individual awards may vary between $3,000,000 and $500,000,000 of federal funds, or less if a significant amount of work has already been completed either at private expense or on another DOE award.

DOE may issue awards in one, multiple, or none of the following Topic Areas:

Table *7***.** Anticipated Award Sizes

Topic Area	Phase	Anticipated Total Value			Anticipated No. of Awards	Anticipated Individual Award Size		
		Maximum DOE Share $K/%	Cost Share $K/%	Total $K		Maximum DOE Share** $K/%	Cost Share*** $K/%	Total $K
1	0	36,000 / 80%	9,000 / 20%	45,000	0-12	3,000 / 80%	750 / 20%	3,750
2	1	100,000 / 50%	100,000 / 50%	200,000	0-8	12,500 / 50%	12,500 / 50%	25,000
3	2	100,000 / 50%	100,000 / 50%	200,000	0-2	50,000 / 50%	50,000 / 50%	100,000

3*	**3 + 4**	**1,000,000 / 50%**	**1,000,000 / 50%**	**2,000,000**	**0-2**	**500,000 / 50%**	**500,000 / 50%**	**1,000,000**
Total		**1,236,000**	**1,209,000**	**2,445,000**	**Up to 24**			

*Applications are NOT being accepted under Topic Area 3 Phase 3+4. Values are included in this table to represent later phases for the potential project selected to continue to Phase 3+4 under the competitive (down)-selection.

***The DOE share listed under the anticipated individual award size is the maximum amount of DOE funding that can be proposed for each Topic Area. Applications that propose a DOE share in excess of these limits will not be evaluated and will be considered non-compliant to the FOA.*

**** **TA-1** Applicants may propose cost share in excess of 20% which could result in higher total award values than those stated above. **TA-2 and TA-3** Applicants may propose cost share in excess of 50% which could result in higher total award values than those stated above.*

DOE may establish more than one budget period for each award and fund only the initial budget period(s). Funding for all budget periods, including the initial budget period, is not guaranteed.

ii. Period of Performance

TA	Technical Period of Performance	Administrative Period of Performance	Budget Periods
1	Up to 24 months	None	Two budget periods (i.e., Phase 0a {up to 9 months} and Phase 0b {up to 15 months})
2	Up to 24 months	None	One budget period
3	102 months*	Up to 6 months	Three budget periods (i.e., Phase 2 {30 months}; Phase 3 {36 months}; Phase 4 {36 months})

* Initial DAC Hub Capacity only; additional capacity build-out could be conducted in parallel by completing Phases 1 through 4 which may increase the technical period of performance.

Typically, budget periods are established on an annual basis. In some cases, shorter or longer budget periods may be established for compelling programmatic or administrative reasons, such as to allow for project phases not evenly divisible with 12-month increments or to provide program personnel with logical decision points to evaluate whether the project should proceed. At the end of each budget period, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the project because of insufficient progress, change in

strategic direction, or lack of funding. Project continuation will be contingent upon several elements, including satisfactory performance and Go/No-Go decision review. For a complete list, see Section VI.B.xv.

iii. New Applications Only

DOE will accept only new applications under this FOA. DOE will not consider applications for renewals of existing DOE-funded awards through this FOA.

B. DOE Funding Agreements

Through cooperative agreements and other similar agreements, DOE provides financial and other support to projects that have the potential to realize the FOA objectives. DOE does not use such agreements to acquire property or services for the direct benefit or use of the United States government.

i. Cooperative Agreements

DOE generally uses cooperative agreements to provide financial and other support to prime recipients.

Through cooperative agreements, DOE provides financial or other support to accomplish a public purpose of support or stimulation authorized by federal statute. Under cooperative agreements, the government and prime recipients share responsibility for the direction of projects.

DOE has substantial involvement in all projects funded via cooperative agreement. See Section VI.B.x of the FOA for more information on what substantial involvement may involve.

ii. Funding Agreements with Federally Funded Research and Development Center (FFRDCs)

If an FFRDC is part of the project team, the FFRDCs will be funded through the prime recipient as a member of the project team.

III. Eligibility Information

To be considered for substantive evaluation, an applicant's submission must meet the criteria set forth below. If the application does not meet these eligibility requirements, it will be considered ineligible and removed from further evaluation.

A. Eligible Applicants

i. Domestic Entities

The proposed prime recipient and subrecipient(s) must be domestic entities. The following types of domestic entities are eligible to participate as a prime recipient or subrecipient of this FOA:

1. Institutions of higher education;
2. For-profit entities;
3. Non-profit entities; and,
4. State and local governmental entities, and Tribal Nations.

To qualify as a domestic entity, the entity must be organized, chartered, or incorporated (or otherwise formed) under the laws of a particular state or territory of the United States; have majority domestic ownership and control; and have a physical place of business in the United States.

DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient but are not eligible to apply as a prime recipient. **NETL is not eligible for award under this announcement and may not be proposed as a subrecipient on another entity's application. An application that includes NETL as a prime recipient or subrecipient will be considered non-responsive.**

Non-DOE/NNSA FFRDCs are eligible to participate as a subrecipient but are not eligible to apply as a prime recipient.

Federal agencies and instrumentalities (other than DOE) are eligible to participates a subrecipient but are not eligible to apply as a prime recipient.

Entities banned from doing business with the U.S. government such as entities debarred, suspended, or otherwise excluded from or ineligible for participating in Federal programs are not eligible.

Entities identified on a Department of Homeland Security, Binding Operational Directives as an entity publicly banned from doing business with the Unites States government are not eligible. See https://cyber.dhs.gov/directives/.

ii. Foreign Entities

In limited circumstances, DOE may approve a waiver to allow a foreign entity to participate as a prime recipient or subrecipient. A foreign entity may submit an Full Application to this FOA, but the Full Application must be accompanied by an explicit written waiver request. Likewise, if the applicant seeks to include a foreign entity as a subrecipient, the applicant must submit a separate explicit written waiver request in the Full Application for each proposed foreign subrecipient.

Appendix G lists the information that must be included in a foreign entity waiver request. The applicant does not have the right to appeal DOE's decision concerning a waiver request.

iii. Incorporated Consortia

Domestic incorporated consortia are eligible to participate as a prime recipient or subrecipient. For consortia incorporated (or otherwise formed) under the laws of a state or territory of the United States, please refer to "Domestic Entities" above. For consortia incorporated (or otherwise formed) in a foreign country, please refer to the requirements in "Foreign Entities" above.

Each consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium must provide a written description of its internal governance structure and its internal rules to the DOE Contracting Officer.

If the consortium includes foreign members, the applicant must submit a separate explicit written waiver request in the Full Application for each foreign member. See **Appendix G**.

iv. Unincorporated Consortia

Unincorporated Consortia must designate one member of the consortium to serve as the prime recipient/consortium representative. The prime recipient/consortium representative must qualify as a domestic entity. The eligibility of the consortium will be determined by the eligibility of the prime recipient/consortium representative under Section III.A. of the FOA.

Upon request, unincorporated consortia must provide the DOE Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should include the consortium's:

- Management structure;
- Method of making payments to consortium members;

- Means of ensuring and overseeing members' efforts on the project;
- Provisions for members' cost sharing contributions; and
- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

If the consortium includes foreign members, the applicant must submit a separate explicit written waiver request in the Full Application for each foreign member. See **Appendix G**.

B. Cost Sharing

Applicants are bound by the cost share proposed in their Full Applications if selected for award negotiations.

TA-1: Cost share must be at least 20% of the total project costs[20] for research and development projects.
TA-2 and TA-3: Cost share must be at least 50% of the total project costs for demonstration and commercial application projects.[21]

The cost share must come from non-federal sources unless otherwise allowed by law. Federal financing, such as DOE Loan Guarantees, cannot be leveraged by applicants to provide the required cost share or to otherwise cover the same scope that is proposed in response to this FOA. Tax credits may be considered in the overall project business case but cannot be counted towards the cost share requirements.

DOE expects that projects selected under this FOA may require the use of existing data. For purposes of this FOA, DOE will consider data that is commercially available at an established market price to be an allowable cost under the project (either as DOE share or non-federal cost share) but DOE will not consider in-kind data (e.g., data, owned by an entity, that is not routinely sold commercially but is instead donated to the project and assigned a value) to be an allowable cost under the project, including as Recipient cost share. Estimation methods used by the Recipient to assign a value to in-kind data cannot be objectively verified by DOE and therefore will not be accepted by DOE as an allowable cost under any project selected from this FOA. Consequently, DOE will not recognize in-kind data costs in any resulting approved DOE budget.

Cost share may come from project participants, state or local governments or other third-party financing. Federal financing, such as DOE Loan Guarantees, cannot be

[20] Total allowable costs is the sum of the government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project.
[21] Energy Policy Act of 2005, Pub.L. 109-58, sec. 988. Also see 2 CFR 200.306 and 2 CFR 910.130 for additional cost sharing requirements.

leveraged by applicants to provide the required cost share. Also, in general deferred or avoided costs such as tax credits may not be used as cost share. However, non-federal cost share can include Tennessee Valley Authority power sales revenue, which is specifically allowed under the Energy Policy Act of 2005. *See* 42 U.S.C § 16352(d) and 2 CFR 910.130(d)(2)(v).

To assist applicants in calculating proper cost share amounts, DOE has included a cost share information sheet and sample cost share calculation in Appendices H and I.

i. Legal Responsibility

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the prime recipient, the prime recipient is legally responsible for paying the entire cost share. If the funding agreement is terminated prior to the end of the project period, the prime recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The prime recipient is solely responsible for managing cost share contributions by the project team and enforcing cost share obligation assumed by project team members in subawards or related agreements.

ii. Cost Share Allocation

Each project team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual project team members may vary, as long as the cost share requirement for the project as a whole is met.

iii. Cost Share Types and Allowability

Every cost share contribution must be allowable under the applicable federal cost principles, as described in Section IV.I.i. of the FOA. In addition, cost share must be verifiable upon submission of the Full Application.

Project teams may provide cost share in the form of cash or in-kind contributions. Cost share may be provided by the prime recipient, subrecipients, or third parties (entities that do not have a role in performing the scope of work). Vendors/contractors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

Cash contributions include, but are not limited to: personnel costs, fringe costs, supply and equipment costs, indirect costs and other direct costs.

In-kind contributions are those where a value of the contribution can be readily determined, verified, and justified but where no actual cash is transacted in securing the good or service comprising the contribution. Allowable in-kind contributions include but are not limited to: the donation of volunteer time or the donation of space or use of equipment.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the funding was not provided to the state or local government by the federal government (unless otherwise authorized by law).

The prime recipient may not use the following sources to meet its cost share obligations including, but not limited to:

- Revenues or royalties from the prospective operation of an activity beyond the project period;
- Proceeds from the prospective sale of an asset of an activity;
- Federal funding or property (e.g., federal grants, equipment owned by the federal government); or
- Expenditures that were reimbursed under a separate federal program.

Project teams may not use the same cash or in-kind contributions to meet cost share requirements for more than one project or program.

Cost share contributions must be specified in the project budget, verifiable from the prime recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same federal regulations as federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants are encouraged to refer to 2 CFR 200.306 and 2 CFR 910.130 for additional cost sharing requirements.

iv. Cost Share Contributions by FFRDCs

Because FFRDCs are funded by the federal government, costs incurred by FFRDCs generally may not be used to meet the cost share requirement. FFRDCs may contribute cost share only if the contributions are paid directly from the contractor's Management Fee or another non-federal source.

v. Cost Share Verification

Applicants are required to provide written assurance of their proposed cost share contributions in their Full Applications.

Upon selection for award negotiations, applicants are required to provide additional information and documentation regarding their cost share contributions. Please refer to **Appendix H** of the FOA.

vi. Cost Share Payment

DOE requires prime recipients to contribute the cost share amount incrementally over the life of the award. Specifically, the prime recipient's cost share for each billing period must always reflect the overall cost share ratio negotiated by the parties (i.e., the total amount of cost sharing on each invoice when considered cumulatively with previous invoices must reflect, at a minimum, the cost sharing percentage negotiated).

In limited circumstances, and where it is in the government's interest, the DOE Contracting Officer may approve a request by the prime recipient to meet its cost share requirements on a less frequent basis, such as monthly or quarterly. Regardless of the interval requested, the prime recipient must be up-to-date on cost share at each interval. Such requests must be sent to the Contracting Officer during award negotiations and include the following information: (1) a detailed justification for the request; (2) a proposed schedule of payments, including amounts and dates; (3) a written commitment to meet that schedule; and (4) such evidence as necessary to demonstrate that the prime recipient has complied with its cost share obligations to date. The Contracting Officer must approve all such requests before they go into effect.

C. Compliance Criteria

Full Applications must meet all compliance criteria listed below or they will be considered noncompliant. DOE will not review or consider noncompliant submissions, including Letters of Intent or Full Applications that were: submitted through means other than specifically stated in the FOA; submitted after the applicable deadline; and/or submitted incomplete. DOE will not extend the submission deadline for applicants that fail to submit required information by the applicable deadline due to server/connection congestion. **Applicants are strongly encouraged to submit their Letters of Intent and Full Applications at least 48 hours in advance of the submission deadline.**

i. Compliance Criteria

All applicant submissions must:

- Submit a compliant Letter of Intent;

- Comply with the maximum DOE share of the individual award size in Section II.A of the FOA;
- Comply with the applicable content and form requirements listed in Section IV of the FOA;
- Include all required documents;
- Be successfully uploaded and with all required documents and submitted in Grants.gov; and
- Be submitted by the deadline stated in the FOA.

DOE will not review or consider submissions submitted through means other than Grants.gov, submissions submitted after the applicable deadline, or incomplete submissions.

D. Responsiveness Criteria

A review of all submitted documents and information is performed to determine if the submissions are responsive to the FOA requirements. **All submitted information and documents must meet all of the Responsiveness Criteria listed below to be eligible for review or the submission will be considered non-responsive. DOE will NOT review or consider non-responsive submissions.**

Full Applications are deemed responsive if:

- The application meets the technical requirements as described in the "Objectives/Topic Areas" contained in Section I.B. of the FOA; and
- The Applicant/application meets the Eligibility Criteria in Section III.A. of the FOA.

All "Applications Specifically Not of Interest," as described in Section I.C. of the FOA, are deemed nonresponsive and will not be reviewed or considered.

E. Other Eligibility Requirements

i. Requirements for DOE/NNSA and non-DOE/NNSA FFRDCs Included as a Subrecipient

DOE/NNSA and non-DOE/NNSA FFRDCs may be proposed as a subrecipient on another entity's application subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

Authorization for DOE/NNSA FFRDCs

The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

> Authorization is granted for the Laboratory to participate in the proposed project. The work proposed for the Laboratory is consistent with or complementary to the missions of the Laboratory, and will not adversely impact execution of the DOE assigned programs at the Laboratory.

Value/Funding

DOE will NOT fund DOE/NNSA FFRDCs participating as a subrecipient through the DOE field work authorization process. DOE will NOT fund non-DOE/NNSA FFRDCs through an interagency agreement with the sponsoring agency. Therefore, the prime recipient and FFRDC are responsible for entering into an appropriate subaward that will govern, among other things, the funding of the FFRDC portion of the work from the prime recipient under its DOE award. Such an agreement must be entered into before any project work begins.

The applicant should prepare the budgets utilizing rates appropriate for funding the FFRDCs through subawards. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's, the subrecipient's, and the FFRDC's portions of the project.

Cost Share

The applicant's cost share requirement will be based on the total cost of the project, including the applicant's, the subrecipient's, and the FFRDC's portions of the project.

Responsibility

The prime recipient will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues including, but not limited to disputes and claims arising out of any agreement between the prime recipient and the FFRDC.

Limit on FFRDC Effort

The FFRDC effort, in aggregate, **shall not exceed 25%** of the total estimated cost of the project, including the applicant's and the FFRDC's portions of the effort.

NETL is not eligible for award under this announcement and may not be proposed as a sub-recipient on another entity's application. An application that includes NETL as a prime recipient or sub-recipient will be considered non-responsive

ii. DOE/NNSA FFRDCs Using a Cooperative Research and Development Agreement (CRADA) with the Prime Recipient

DOE/NNSA FFRDC/National Laboratories (NLs) participating as a subrecipient on a project are strongly encouraged to establish a Cooperative Research and Development Agreement (CRADA) or, if the role of the DOE/NNSA FFRDC/NL is limited to technical assistance and intellectual property is not anticipated to be generated from the DOE/NNSA FFRDC/NL's work, a Technical Assistance Agreement (TAA), with at least the prime recipient before any project work begins.

The CRADA or TAA is used to ensure accountability for project work and provide the appropriate management of intellectual property (IP), e.g., data protection and background IP. The CRADA or TAA must be agreed upon by all parties and submitted to DOE or other sponsoring agency, when applicable, for approval, or submitted to DOE for notice under the Master Scope of Work process, when applicable, using any DOE or other sponsoring agency approved CRADA or TAA template without substantive changes by the time the award is made to the prime recipient.

F. Limitation on Number of Full Applications Eligible for Review

Applicants must submit a Letter of Intent by the specified due date and time to be eligible to submit a Full Application. An entity may submit more than one Full Application to this FOA provided that each describes a unique, scientifically distinct project. If an entity intends to submit multiple Full Application to this FOA, an individual Letter of Intent is required for each Full Application intended for submission.

G. Questions Regarding Eligibility

DOE will not make eligibility determinations for potential applicants prior to the date on which applications to this FOA must be submitted. The decision whether to submit an application in response to this FOA lies solely with the applicant.

IV. Application and Submission Information

A. Application Process

The application process includes multiple phases: a Letter of Intent phase and a Full Application phase. **Only applicants who have submitted an eligible Letter of Intent will be eligible to submit a Full Application**.

At each phase, DOE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III of the FOA. DOE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths (described below) and must be submitted via Grants.gov at https://www.grants.gov/, unless specifically stated otherwise in the FOA. **DOE will not review or consider submissions submitted through means other than specifically stated in the FOA, submissions submitted after the applicable deadline, or incomplete submissions**. DOE will not extend deadlines for applicants who fail to submit required information and documents due to server/connection congestion.

All submissions must conform to the following requirements:

- Each must be submitted in Adobe PDF format unless stated otherwise;
- Each must be written in English;
- All pages must be formatted to fit on 8.5 x 11 inch paper with margins not less than one inch on every side. Use Calibri typeface, a black font color, and a font size of 12 point or larger (except in figures or tables, which may be 10 point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies. References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement; and
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If applicants exceed the maximum page lengths indicated below, DOE will review only the authorized number of pages and disregard any additional pages.

Applicants are responsible for meeting each submission deadline. **Applicants are strongly encouraged to submit their Full Applications at least 48 hours in advance of the submission deadline**. Under normal conditions (i.e., at least 48

hours in advance of the submission deadline), applicants should allow at least 1 hour to submit a Full Application. Once the Full Application is submitted as specifically stated in the FOA, applicants may revise or update that submission until the expiration of the applicable deadline. If changes are made, the Applicant must resubmit the Full Application before the applicable deadline.

DOE urges applicants to carefully review their Full Applications to allow sufficient time for the submission of required information and documents. All Full Applications that pass the initial eligibility review will undergo comprehensive technical merit review according to the criteria identified in Section V. of the FOA.

B. Application Forms

The application forms and instructions are available on Grants.gov at https://www.grants.gov/.

Note: The maximum file size that can be uploaded to the Grants.gov website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA, it must be broken into parts and denoted to that effect. For example:

TechnicalVolume_Part_1
TechnicalVolume_Part_2

DOE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 10MB.

C. Content and Form of the Letter of Intent

Applicants must submit a Letter of Intent by **email to DirectAirCaptureHubs@netl.doe.gov** by the specified due date and time to be eligible to submit a Full Application. If an entity intends to submit multiple Full Applications to this FOA, an individual Letter of Intent is required for each Full Application intended for submission.

Letters of Intent will be used by DOE to plan for the merit review process. The letters should not contain any proprietary or sensitive business information and may be subject to the Freedom of Information Act (FOIA). The letters will not be used for down-selection purposes, and do not commit an applicant to submit an application. Applicants are not bound to the statements made in the Letter of Intent; it is reasonable for project partners, locations, or other factors to change during the application development process. DOE will not provide feedback on the Letters of Intent. DOE will not review or consider ineligible Letters of Intent (see Section III. of the FOA).

Each Applicant must provide the following information as part of the Letter of Intent:

- Project Title;
- Lead Organization;
- Organization Type (Business < 500 Employees; Business > 1000 Employees; Business 500-1000 Employees; FFRDC; Government-Owned, Government Operated; Non-Profit; University);
- Whether the application has been previously submitted to DOE;
- % of effort contributed by the Lead Organization;
- The Project Team, including:
  - The Project Manager for the prime recipient;
  - Team Members (i.e., subrecipients); and
  - Senior/Key Personnel (i.e., individuals who contribute in a substantive, measurable way to the execution of the proposed project);
- Technical Topic Area; and
- Abstract – The abstract provided should be not more than 4,000 words in length, and should provide a truncated explanation of the proposed project.

D. Content and Form of the Full Application

Applicants must submit a Full Application by the specified due date and time to be considered for funding under this FOA. Applicants must complete the following application forms found on the Grants.gov website at https://www.grants.gov/ in accordance with the instructions.

i. Full Application Content Requirements

Each Full Application must be limited to a single topic area. Do not consolidate unrelated concepts and technologies in a single Full Application. Full Applications must conform to the following content and form requirements and must not exceed the stated page limits. If Applicants exceed the maximum page lengths indicated below, DOE will review only the authorized number of pages and disregard any additional pages.

Component	File Format	Page Limit	File Name
SF-424	Form	N/A	N/A
Project/Performance Site Location(s)	Form	N/A	N/A
Technical Volume	PDF	40	TechnicalVolume.pdf
Resumes	PDF	3 pages each	Resumes.pdf
Cost Share Commitment Letter(s)	PDF	1 page each	CSCL.pdf
DAC Hub Owner Commitment Letter (TA-3)	PDF	1 Page	DHOCL.pdf
Storage Site Commitment Letter(s) (TA-2 and TA-3)	PDF	1 page each	SSCL.pdf
Team Commitment Letter(s) (TA-2 and TA-3)	PDF	1 page each	TCL.pdf
DAC Hub Data Tables (TA-2 and TA-3)	PDF	N/A	DHDT.pdf
Summary of Integrated DAC Pre-FEED Study (TA-2)	PDF	15 pages	PFEED.pdf
Summary of Integrated DAC FEED Study (TA-3)	PDF	25	FEED.pdf
Summary of DAC Hub Balance-of-Plant (BOP) Conceptual Design (TA-2)	PDF	10	BOPCON.pdf
Summary of DAC Hub Balance-of-Plant (BOP) Pre-FEED (TA-3)	PDF	10	BOPPFEED.pdf
Summary of the UIC Class VI permit Application, if required (TA-3)	PDF	10 pages	ClassVI.pdf
EH&S Risk Analysis (TA-2 and TA-3)	PDF	N/A	EHS.pdf
Statement of Project Objectives	MS Word	15	SOPO.doc or docx
Budget Justification Workbook	MS Excel	N/A	Budget_Justification.xls or xlsx
Subrecipient Budget Justification	MS Excel	N/A	Subrecipient_Budget_Justification.xls or xlsx
Summary/Abstract for Public Release	PDF	1	Summary.pdf
Summary Slides	MS PowerPoint	3	Slide.ppt or pptx

Authorization from cognizant Contracting Officer for FFRDC	PDF	N/A	FFRDCAuth.pdf
SF-LLL Disclosure of Lobbying Activities	Form	N/A	N/A
Foreign Entity Waiver Requests and Foreign Work Waiver Requests	PDF	N/A	FN_Waiver.pdf
Project Management Plan	PDF	10	PMP.pdf
Data Management Plan (**TA-2** and **TA-3** ONLY)	PDF	N/A	DMP.pdf
Community Benefits Plan (**TA-2** and **TA-3** ONLY)	PDF	20 (TA-2) 25 (TA-3)	CBP.pdf
Community Partnership Documentation (**TA-2** and **TA-3** ONLY)	PDF	3	PartnershipDocs.pdf
Business Plan (**TA-2** and **TA-3** ONLY)	PDF	N/A	BP.pdf
Financial Plan (**TA-2** and **TA-3** ONLY)	PDF	N/A	FP.pdf
Life Cycle Analysis (LCA) (**TA-2** and **TA-3** ONLY)	PDF	N/A	LCA.pdf
Environmental Questionnaire	PDF	N/A	Env.pdf
Current and Pending Support	PDF	N/A	CPS.pdf
Summary of the Storage Field Development Plan (TA-3 only)	PDF	10	SFDP.pdf

Note: The maximum file size that can be uploaded to the Grants.gov website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA it must be broken into parts and denoted to that effect. For example:

TechnicalVolume_Part_1
TechnicalVolume_Part_2

DOE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 10MB.

DOE provides detailed guidance on the content and form of each component below.

ii. SF-424: Application for Federal Assistance

Complete the SF 424 form first to populate data in other forms. Complete all required fields in accordance with the instructions on the form. The list of certifications and assurances in Field 21 can be found at https://www.energy.gov/management/financial-assistance-forms-and-information-applicants-and-recipients under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period of performance and not just the first project year, first phase or other subset of the project period of performance.

iii. Project/Performance Site Location(s)

Indicate the primary site where the work will be performed by the prime recipient or subrecipient(s). If a portion of the project will be performed at any other site(s), identify the site location(s) in the blocks provided.

Note that the Project/Performance Site Congressional District is entered in the format of the 2-digit state code followed by a dash and a 3 digit Congressional district code, for example VA-001. Hover over this field for additional instructions.

Use the Next Site button to expand the form to add additional Project/Performance Site Locations.

iv. Technical Volume

The Technical Volume must be submitted in PDF format and may not be more than 40 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics. If applicants exceed the maximum page lengths indicated below, DOE will review only the authorized number of pages and disregard any additional pages.

The Technical Volume must address the technical review criteria as discussed in Section V. of the FOA. The applicant should consider the weighting of each of the technical review criterion (see Section V. of the FOA) when preparing the Technical Volume. The Technical Volume must include all of the information in the table below.

Save the Technical Volume in a single PDF file using the following convention for the title “TechnicalVolume.pdf” and click on "Add Mandatory Other Attachment" to attach.

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. However, DOE and reviewers are under no obligation to review cited sources.

SECTION/PAGE LIMIT	DESCRIPTION
Cover Page **(1-page maximum)**	The cover page should include the project title, the specific FOA Topic Area being addressed, both the technical and business points of contact, names of all team member organizations, names of the project managers, senior/key personnel and their organizations, and any statements regarding confidentiality.

Project Overview (Approximately 10% of the Technical Volume)	The Project Overview should contain the following information: • Background: The applicant should discuss the background of their organization, including the history, successes, and current research and development status and/or commercial readiness (i.e., the technical baseline) relevant to the technical topic area being addressed in the Full Application. • Project Goal: The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal, including the ways in which the proposed project location and related infrastructure, skilled workforce, community benefits etc. will contribute to the success of the overall project. • DOE Impact: The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the project objectives. • CBPs: The applicant should summarize the overall anticipated impacts (both benefits and any negative impacts) that will accrue to the local community, workforce organizations including labor unions, and those most vulnerable to project impacts including disadvantage communities. The applicant should summarize strategies to conduct meaningful engagement that impacts project decisions, create good jobs and support workforce development, and advance DEIA. • Identify any potential long-term constraints project will have on community's access to natural resources (e.g., water) and Tribal cultural resources. If applicable, describe a long-term cleanup strategy that ensures communities and neighborhoods remain healthy and safe and not burden with cleanup costs and waste. • Outline a climate resilience strategy that will accounts for climate impacts and extreme weather patterns such as high winds (tornadoes and hurricanes), heat and freezing temperatures, drought, wildfire and floods.
Technical Description, Innovation, and Impact (Approximately 30% of the Technical Volume)	The Technical Description section should be formatted to address each of the merit review 1 (Technological Merit and DAC Hub Site Suitability) criterion and sub-criterion listed in Section V.A. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria. This section should only address Merit Review 1 Criteria when those criteria are not addressed in other required documents, i.e., documents that are required to be submitted under unique file names and have stated page limits. The Technical Description section should also contain the following information:

	• Relevance and Outcomes: The applicant should provide a detailed description of the DAC Hub concept. This section should describe the relevance of the proposed project to the goals and objectives of the FOA and specific TA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. • DAC Hub Feasibility: The applicant should demonstrate the technical feasibility of the proposed DAC Hub and capability of achieving the anticipated performance targets, including a description of previous work and prior results, if applicable. • DAC Technology Readiness Level Evaluation: The applicant should provide a discussion of the proposed DAC Hub project from technical, environmental, cost effectiveness, and integrated systems perspectives. Scientific, engineering, and technical information and data should be provided to support evidence of the readiness of the proposed DAC technology proposed. It is expected that the applicants have already validated the DAC technology at TRL 5 (for TA-2) or TRL 6 (for TA-3) For TA-2 and TA-3 the performance of the proposed DAC technology should be substantiated by providing experimental evidence. • DAC Technology Identification or Description: TA-1 Applicants should identify potential DAC technologies and describe key parameters. TA-2 and TA-3 Applicants are required to describe key parameters of the DAC technology or how the parameters will be developed. The description of the DAC technology should include, but is not limited to, the following: a. Preliminary process flow diagrams; b. Mass and energy balances; c. Steam and power requirements; d. As applicable, a discussion of the absorption/desorption chemistry and operating cycle for solvent and sorbent systems; and e. As applicable, a description of relevant membrane chemistry, including transport mechanism. • Innovation and Impacts: The applicant should describe the current state-of-the-art in the applicable field, the specific innovation of the proposed DAC technology, the advantages of the proposed DAC technology over current and emerging technologies, and the overall impact on advancing the maturation if the project is successful.

	• Plans to use and/or transition to low-carbon energy over the life of the project. • Plans to store CO_2 geologically. If CO_2 will be stored in conjunction with hydrocarbon extraction during any phase of the project, the Applicant should detail plans for maximizing the amount of CO_2 storage relative to associated hydrocarbon extraction over the life of the project or, where applicable, directly displacing non-anthropogenic CO_2 currently sourced from geologic domes with anthropogenic CO_2. See also **Appendix A, B, or C** for specific requirements for the respective topic area.
Workplan (Approximately 40% of the Technical Volume)	The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go Decision Points, and Project Schedule. A detailed SOPO is separately requested. The Workplan section should be formatted to address each of the merit review 2 (Technical Approach and Workplan)) criterion and sub-criterion listed in Section V.A. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria. This section should only address Merit Review 2 Criteria when those criteria are not addressed in other required documents, i.e., documents that are required to be submitted under unique file names and have stated page limits. The Workplan should also contain the following information: • Project Objectives: The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes. • Technical Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period, including milestones detailed in the CBP. • WBS and Task Description Summary: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard WBS for any project. This should include any relevant tasks from the CBP. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as “we will then complete a proprietary process” is

	unacceptable). It is the applicant's responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. This should include any relevant milestones from the CBP. The summary provided should be consistent with the Milestone Summary Table in the PMP. • Go/No-Go Decision Points (**TA-1 Only**): The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered "SMART" and can fulfill the requirement for an annual SMART milestone. (See Section VI.B.xv for more information on the Go/No-Go Review). • End of Project Goal: The applicant should provide a summary of the end of project goal(s). At a minimum, each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO. • Buy America Requirements for Infrastructure Projects: Within the first 2 pages of the Workplan, include a short statement on whether the project will involve the construction, alteration, and/or repair of infrastructure in the United States. See Appendix J for applicable definitions and other information to inform this statement. • Summary of the business plan (if applicable) See also **Appendix A, B, or C** for specific requirement for the respective topic area.
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	The Technical Qualifications and Resources section should be formatted to address each of the merit review 3 (Applicant/Team Capabilities, Commitments, and Management Capabilities) criterion and sub-criterion listed in Section V.A. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria. This section should only address Merit Review 3 Criteria when those criteria are not addressed in other required documents, i.e., documents that are required to be submitted under unique file names and have stated page limits. The Technical Qualifications and Resources section should also contain the following information: • Regional DAC Hub Team Description. See **Appendix A, B, or C** for specific requirements for the respective topic area.

	• Describe the project team's unique qualifications and expertise, including those of key subrecipients. Describe the project team's existing equipment and facilities that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project.
	• This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives.
	• Describe the time commitment of the key team members to support the project.
	• Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable.
	• For multi-organizational or multi-investigator projects, describe succinctly:
	  ○ The roles and the work to be performed by each PI and senior/key personnel;
	  ○ Business agreements between the applicant and each PI and senior/key personnel;
	  ○ How the various efforts will be integrated and managed;
	  ○ Process for making decisions on scientific/technical direction;
	  ○ Publication arrangements;
	  ○ Intellectual Property issues; and
	  ○ Communication plans

Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers **(<u>Not</u> included in the page limitation)**	Provide the following information in this section: • Collaborators and Co-editors: List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this application. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this application. If there are no collaborators or co-editors to report, state "None." • Graduate and Postdoctoral Advisors and Advisees: List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates.

v. Resumes

A resume provides information that can be used by reviewers to evaluate the relevant skills and experience of the key project personnel. Applicants must submit a two-page resume for the project director and other key personnel that includes the following:

1. Contact Information;
2. Education: Include all academic institutions attended, major/area, degree;
3. Training: (e.g.,) certification or credential from a Registered Apprenticeship or Labor Management Partnership;
4. Professional Experience: Beginning with the current position, list professional/academic positions in chronological order with a brief description; and
5. There should be no lapses in time over the past ten years or since age 18, which ever time period is shorter.

Save the resumes in a single PDF file using the following convention for the title "Resumes.pdf" and click on "Add Optional Other Attachment" to attach.

vi. Cost Share Commitment Letters

Cost share commitment letter(s) are required from any party (other than the organization submitting the application) proposing to provide all or part of the required cost share (including sub-recipients). If applicable, the letter should identify the name of the organization, state the party is committed to providing a specific minimum dollar amount of cost share or value of in-kind contributions allocated to cost sharing, identify the type of proposed cost share (e.g., cash or in-kind contribution) to be contributed, and be signed by the person authorized to commit the expenditure of funds by the entity. The Applicant should submit the letter(s) in PDF format. Save the cost share commitment letters in a single PDF file using the following convention for the title "CSCL.pdf" and click on "Add Optional Other Attachment" to attach.

vii. DAC Hub Owner Commitment Letter (TA-3 Only)

A DAC Hub Owner commitment letter is required to demonstrate commitment of the DAC Hub owner. The letter should state the party is committed to provide access to information and data needed to satisfy the required deliverables, detail the scope of engagement with the host sites owner/operator and employees, and be signed by the authorized person. The Applicant should submit the letter in PDF format. Save the DAC Hub Owner commitment letters in a single PDF file using the following convention for the title "DHOCL.pdf" and click on "Add Optional Other Attachment" to attach.

viii. Storage Site Commitment Letter(s) (TA-2 and TA-3 Only)

Storage site commitment letters are required to demonstrate commitment of the selected, domestic carbon dioxide storage site for the proposed DAC Hub. The letter should state the party is committed to provide access to information and data needed to satisfy the required deliverables, detail the scope of engagement with the storage site owner/operator and employees, and be signed by the person authorized to commit access to the storage site. The Applicant should submit the letter in PDF format. Save the Storage Site commitment letters in a single PDF file using the following convention for the title "SSCL.pdf" and click on "Add Optional Other Attachment" to attach.

ix. Team Commitment Letter(s) (TA-2 and TA-3 Only)

In addition to the commitment letters listed above, Applicants must submit a letter of commitment from each team member that agrees to participate in the DAC Hub including the following organizations, at a minimum: DAC and CO_2 conversion technology developer or licensor, carbon oxides pipeline operator (if applicable), Engineering, Procurement, and Construction Firm(s) (EPCs) and CBP consultant(s). These letters are required and must be signed by the person authorized to commit resources on behalf of that team member's organization. Letters should demonstrate the team member's level of commitment to the project, such as data access, consultation, etc. The Applicant should submit the letter in PDF format. Save the team commitment letters in a single PDF file using the following convention for the title "TCL.pdf" and click on "Add Optional Other Attachment" to attach.

x. DAC Hub Data Tables (Required for TA-2 and TA-3 Only)

TA-2 and TA-3 Applicants must submit DAC Hub Data Tables for the DAC Hub and the DAC and CO_2 conversion technologies. TA-1 Applicants should submit DAC Hub Data Tables for the proposed DAC and CO_2 conversion (if applicable) technologies. See **Appendix K** for guidance. The Applicant should submit the DAC Hub Data Tables in PDF format. Save the DAC Hub Data Tables in a single PDF file using the following convention for the title "DHDT.pdf" and click on "Add Optional Other Attachment" to attach.

xi. Summary of Integrated DAC Pre-FEED Study (TA-2 Only)

Applicants must submit summary results of a pre-FEED study for the proposed DAC system. See **Appendices B and L** for more guidance. The summary of the Pre-FEED(s) must not exceed **15** pages. Save the pre-FEED study in a single PDF file using the following convention for the title "PFEED.pdf" and click on "Add Optional Other Attachment" to attach.

xii. Summary of Integrated DAC FEED Study (TA-3 Only)

Applicants must submit summary results of a FEED study for the proposed DAC system. See **Appendices C and M** for more guidance. The summary of the FEED must not exceed **25** pages. Save the summary FEED study in a single PDF file using the following convention for the title “FEED.pdf” and click on "Add Optional Other Attachment" to attach.

xiii. Summary of DAC Hub Balance-of-Plant (BOP) Conceptual Design (TA-2 Only)

Applicants must submit summary results of a DAC Hub BOP conceptual design study. See **Appendix B** for more guidance. The summary of the BOP conceptual design must not exceed 10 pages. Save the summary of the DAC Hub BOP conceptual design study in a single PDF file using the following convention for the title “BOPCON.pdf” and click on "Add Optional Other Attachment" to attach.

xiv. Summary of DAC Hub Balance-of-Plant (BOP) Pre-FEED (TA-3)

Applicants must submit summary results of a DAC Hub BOP pre-FEED study. See **Appendix C** for more guidance. The summary of the DAC Hub BOP pre-FEED must not exceed 10 pages. Save the summary of the DAC Hub BOP pre-FEED study in a single PDF file using the following convention for the title “BOPPFEED.pdf” and click on "Add Optional Other Attachment" to attach.

xv. Summary of the UIC Class VI Permit Application (TA-3 Only)

Applicants must submit a summary of the UIC Class VI permit application materials or offtake agreement. See **Appendices C and N** for more guidance. The summary of the UIC Class VI permit application materials or offtake agreement must not exceed 10 pages. The applicant should submit the summary of the UIC Class VI permit application materials or offtake agreement in a single PDF file using the following convention for the title “ClassVI.pdf” and click on "Add Optional Other Attachment" to attach.

xvi. Environmental Health & Safety Risk Analysis (TA-2 and TA-3 Only)

Applicants must submit an initial EH&S risk analysis of the proposed DAC Hub in accordance with the format provided in **Appendix O**. The EH&S risk analysis should include discussion regarding air and water emissions and co-benefits, water utilization, solid waste streams, noise, and potential environmental impacts of the DAC Hub technologies including toxicological effects and hazards of emissions and waste streams. The Applicant should submit the EH&S risk analysis in a single PDF file using the following convention for the title “EHS.pdf” and click on "Add Optional Other Attachment" to attach.

xvii. Statement of Project Objectives (SOPO)

Applicants must submit a SOPO. A SOPO template is available as an **Appendix P** of the FOA. The SOPO, including the Milestone Table, must not exceed 15 pages. Save the SOPO in a single Microsoft Word file using the following convention for the title "SOPO.doc or docx" and click on "Add Optional Other Attachment" to attach.

xviii. Budget Justification Workbook

Applicants must complete the Budget Justification Workbook. This workbook is included as an attachment to this announcement for use and to describe the level of detail required in the budget justification. Although the data requested is mandatory, the use of the budget justification workbook is not.

Prime recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the prime recipient and its subrecipients and contractors. Applicants should include costs associated with required annual audits and incurred cost proposals in their proposed budget documents. The "Instructions and Summary" included with the Budget Justification Workbook will auto-populate as the applicant enters information into the Workbook. Applicants must carefully read the "Instructions and Summary" tab provided within the Budget Justification Workbook. Applicants should include costs associated with implementing the various BIL-specific requirements (e.g., Buy America requirements for infrastructure projects, Davis Bacon, Community Benefits Plan, reporting, oversight) and with required annual audits and incurred cost proposals in their proposed budget documents. Such costs may be reimbursed as a direct or indirect cost. Save the Budget Justification Workbook in a single Microsoft Excel file using the following convention for the title "Recipient_Budget_Justification.xls or xlsx" and click on "Add Optional Other Attachment" to attach.

xix. Subrecipient Budget Justification (if applicable)

Applicants must provide a separate budget justification for each subrecipient that is expected to perform work estimated to be more than $100,000 or 25 percent of the total work effort (whichever is less). Note that FFRDCs/NLs are treated as subrecipients and are included in this required submittal if they meet the threshold. The budget justification must include the same justification information described in the "Budget Justification" section above. Save each subrecipient budget justification in a Microsoft Excel file using the following convention for the title "Subrecipient_Budget_Justification.xls or xlsx" and click on "Add Optional Other Attachment" to attach.

xx. Summary/Abstract for Public Release

Applicants must submit a one-page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (e.g., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as DOE may make it available to the public after selections are made. The project summary must not exceed 1 page. Save the Summary for Public Release in a single PDF file using the following convention for the title "Summary.pdf" and click on "Add Optional Other Attachment" to attach.

xxi. Summary Slides

Applicants must provide a maximum of three slides summarizing the proposed project.

The Summary Slides must include the following information:

- A DAC Hub summary;
- A description of the DAC Hub impact;
- Proposed project schedule and goals;
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Highlights of the Community Benefits Plan;
- Project title, prime recipient, Principal Investigator, and senior/key personnel information; and
- Requested DOE funds and proposed applicant cost share.

Save the Summary Slides in a single Microsoft PowerPoint file using the following convention for the title "Slide.ppt or pptx" and click on "Add Optional Other Attachment" to attach.

xxii. Authorization for non-DOE/NNSA or DOE/NNSA FFRDCs (if applicable)

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with the contractor's authority under its award. Save the Authorization in a single PDF file using the following convention for the title FFRDCAuth.pdf and click on "Add Optional Other Attachment" to attach.

xxiii. SF-LLL: Disclosure of Lobbying Activities (required)

Prime recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Prime recipients and subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

- An officer or employee of any federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

xxiv. Waiver Requests (if applicable)

i. Foreign Entity Participation

For projects selected under this FOA, as set forth in Section III.A., all prime recipients and subrecipients must qualify as domestic entities. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application. **Appendix G** lists the information that must be included in a waiver request.

ii. **Performance of Work in the United States (Foreign Work Waiver)**

As set forth in Section IV.I.iii., all work for projects selected under this FOA must be performed in the United States. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application. **Appendix G** lists the information that must be included in a foreign work waiver request.

Save the Waivers in a single PDF file using the following convention for the title "FN_Waiver.pdf" and click on "Add Optional Other Attachment" to attach.

xxv. Project Management Plan

The Project Management Plan (PMP) must not exceed 10 pages. Applicants shall prepare the PMP in the format provided in an **Appendix Q** of the FOA. Save this information in a file named "PMP.pdf," and click on "Add Optional Other Attachment" to attach.

xxvi. Data Management Plan (TA-2 and TA-3 Only)

Applicants must submit a Data Management Plan as part of their Full Application. The Data Management Plan is a document that outlines the proposed plan for

data sharing or preservation. Submission of this plan is required with the full application, and failure to submit the plan may result in rejection of the application without further consideration. Applicants shall prepare the DMP in the format provided in **Appendix R** of this FOA. Save this plan in a single file named "DMP.pdf".

xxvii. Community Benefits Plan (TA-2 and TA-3 Only)

The CBP must be submitted in PDF format and must conform to the following content and form requirements, including maximum page lengths. This document must address the requirements described under the Initial CBP header in Section I.B.iv. and the associated technical review criteria as discussed in Section V.A of the FOA. Save the CBP in a single PDF file using the following convention for the title "CBP.pdf"

Applicants should provide sufficient data and references to justify the claims and approaches made in the CBP. However, DOE and reviewers are under no obligation to review cited sources.

The CBP for the Application may not be more than 20 pages (TA-2) or 25 pages (TA-3), including table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The Applicant should consider the weighting of each of the technical review criterion (see Section V.A) when preparing the Initial CBP. The Initial CBP must conform to the following content requirements:

Community Benefits Plan Content Requirements	
SECTION/PAGE LIMIT	**DESCRIPTION**
Community and Labor Engagement	The Community and Labor Engagement section should contain the following information: □ Background □ Social Characterization Assessment □ Stakeholder Analysis □ Engagement Methods and Timeline □ Two-way Engagement Statement □ Project Agreements Statement □ Engagement Evaluation Strategy □ Resource Summary
Investing in the American Workforce	The Investing in the American Workforce section should contain the following information: □ Background □ Quality Jobs

	☐ Workforce Development ☐ Worker Rights ☐ Strategies, Milestones and Timelines ☐ Resource Summary
DEIA	The DEIA section should contain the following information: ☐ Background ☐ Strategies, Milestones, and Timelines ☐ Resource Summary
Justice40 Initiative	The Justice40 Initiative section should contain the following information: Assessment: ☐ Assessment of impacted communities and groups ☐ Assessment of DAC Hub benefits and where they flow ☐ Assessment of DAC Hub negative impacts and where they flow ☐ Assessment of information gaps Implementation Strategy: ☐ Background ☐ Milestones and Timelines ☐ Assessment of barriers to realizing benefits and minimizing negative impacts ☐ Resource Summary

xxviii. Community Partnership Documentation (TA-2 and TA-3 Only)

In support of the CBP, Applicants may submit documentation to demonstrate existing or planned partnerships with community entities, such as, organizations that work with local stakeholders such residents and businesses, organizations that carry out workforce development programs, trade associations, worker organizations including labor unions, and community-based organizations that work with disadvantaged communities. The Partnership Documentation could be in the form of letter on the partner's letterhead outlining the planned partnership signed by an officer of the entity, a Memorandum of Understanding, or other similar agreement. Such letters must state the specific nature of the partnership and must not be general letters of support. If the applicant intends to enter into a Workforce and Community Agreement as part of the CBP, please include letters from proposed partners as appropriate. Each letter must not exceed 3 pages. Save the partnership documentation in a single PDF file using the following convention for the title PartnershipDocs.pdf and click on "Add Optional Other Attachment" to attach.

xxix. Business Plan (TA-2 and TA-3 Only)

Applicants must submit a Business Plan. More guidance for the Business plan is provided in **Appendix S**. Save this plan in a single file named “BCA.pdf” and click on “Add Optional Other Attachment” to attach.

xxx. Financial Plan (TA-2 and TA-3 Only)

Applicants must submit a financial plan. Requirements for the financial plan are described in **Appendix T**. Save this plan in a single file named “FP.pdf” and click on “Add Optional Other Attachment” to attach.

xxxi. Preliminary Life Cycle Analysis (LCA) (TA-2 Only)

Applicants must submit a preliminary LCA. Requirements for the LCA are described in **Appendix B** and **Appendix D**. Save this plan in a single file named “LCA.pdf” and click on “Add Optional Other Attachment” to attach.

xxxii. Life Cycle Analysis (LCA) (TA-3 Only)

Applicants must submit a LCA. Requirements for the LCA are described in **Appendix C** and **Appendix D**. Save this plan in a single file named “LCA.pdf” and click on “Add Optional Other Attachment” to attach.

xxxiii. Environmental Questionnaire

Applicants (and sub-recipients) must submit an environmental questionnaire (NETL Form 451.1-1/3) for each work location proposed in the application as an attachment. The environmental questionnaire is available at http://www.netl.doe.gov/File%20Library/Business/forms/451_1-1-3.pdf . Save the questionnaire in a single file named "Env.pdf" (or “Env-FILL IN TEAM MEMBER.pdf” if more than questionnaire is submitted) and click on "Add Optional Other Attachment” to attach.

xxxiv. Current and Pending Support

Current and pending support is intended to allow the identification of potential duplication, overcommitment, potential conflicts of interest or commitment, and all other sources of support. As part of the application, the principal investigator and all senior/key personnel at the applicant and subrecipient level must provide a list of all sponsored activities, awards, and appointments, whether paid or unpaid; provided as a gift with terms or conditions or provided as a gift without terms or conditions; full-time, part-time, or voluntary; faculty, visiting, adjunct, or honorary; cash or in-kind; foreign or domestic; governmental or private-sector; directly supporting the individual’s research or indirectly supporting the individual by supporting students, research staff, space, equipment, or other research expenses. All connections with foreign government-sponsored talent recruitment programs must be identified in current and pending support.

For every activity, list the following items:

- The sponsor of the activity or the source of funding
- The award or other identifying number
- The title of the award or activity. If the title of the award or activity is not descriptive, add a brief description of the research being performed that would identify any overlaps or synergies with the proposed research
- The total cost or value of the award or activity, including direct and indirect costs and cost share. For pending proposals, provide the total amount of requested funding
- The award period (start date – end date)
- The person-months of effort per year being dedicated to the award or activity

To identify overlap, duplication of effort, or synergistic efforts, append a description of the other award or activity to the current and pending support.

Details of any obligations, contractual or otherwise, to any program, entity, or organization sponsored by a foreign government must be provided on request to either the applicant institution or DOE. Supporting documents of any identified source of support must be provided to DOE on request, including certified translations of any document.

PIs and senior/key personnel must provide a separate disclosure statement listing the required information above regarding current and pending support. Each individual must sign and date their respective disclosure statement and include the following certification statement:

> I, [Full Name and Title], certify to the best of my knowledge and belief that the information contained in this Current and Pending Support Disclosure Statement is true, complete and accurate. I understand that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or omissions of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (18 U.S.C. §§ 1001 and 287, and 31 U.S.C. 3729-3733 and 3801-3812). I further understand and agree that (1) the statements and representations made herein are material to DOE's funding decision, and (2) I have a responsibility to update the disclosures during the project period of performance of the award should circumstances change which impact the responses provided above.

The information may be provided in the format approved by the National Science Foundation (NSF), which may be generated by the Science Experts Network Curriculum Vita (SciENcv), a cooperative venture maintained at

https://www.ncbi.nlm.nih.gov/sciencv/, and is also available at https://www.nsf.gov/bfa/dias/policy/nsfapprovedformats/cps.pdf. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats. If the NSF format is used, the individual must still include a signature, date, and a certification statement using the language included in the paragraph above.

Save the Current and Pending Support in a single PDF file using the following convention for the title "CPS.pdf" and click on "Add Optional Other Attachment" to attach.

Current and pending support – (a) All resources made available, or expected to be made available, to an individual in support of the individual's RD&D efforts, regardless of (i) whether the source is foreign or domestic; (ii) whether the resource is made available through the entity applying for an award or directly to the individual; or (iii) whether the resource has monetary value; and (b) includes in-kind contributions requiring a commitment of time and directly supporting the individual's RD&D efforts, such as the provision of office or laboratory space, equipment, supplies, employees, or students. This term has the same meaning as the term Other Support as applied to researchers in NSPM-33: For researchers, Other Support includes all resources made available to a researcher in support of and/or related to all of their professional RD&D efforts, including resources provided directly to the individual or through the organization, and regardless of whether or not they have monetary value (e.g., even if the support received is only in-kind, such as office/laboratory space, equipment, supplies, or employees). This includes resource and/or financial support from all foreign and domestic entities, including but not limited to, gifts provided with terms or conditions, financial support for laboratory personnel, and participation of student and visiting researchers supported by other sources of funding.

Foreign Government-Sponsored Talent Recruitment Program – An effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to relocate physically to the foreign state for the above purpose. Some programs allow for or encourage continued employment at U.S. research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their

participation to U.S. entities. Compensation could take many forms including cash, research funding, complementary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

Senior/key personnel – an individual who contributes in a substantive, meaningful way to the scientific development or execution of a research, development and demonstration (RD&D) project proposed to be carried out with DOE award.[22]

xxxv. Summary of the Storage Field Development Plan (TA-3)

TA-3 Applicants must submit a summary of the Storage Field Development Plan. Guidance for the Storage Field Development Plan is described in **Appendix U**. The summary of the Storage Field Development Plan, must not exceed **10** pages. Save this plan in a single file named "SFDP.pdf" and click on "Add Optional Other Attachment" to attach

E. Post Selection Information Requests

If selected for award negotiations, DOE reserves the right to require that selected applicants provide additional or clarifying information regarding the application submissions, the project, the project team, the award requirements, and any other matters related to anticipated award. The following is a non-exhaustive list of examples information that may be required:

- Cybersecurity Plan
- Personnel proposed to work on the project and collaborating organizations (See Section VI.B.xix. Participants and Collaborating Organizations);
- Current and Pending Support (See Sections IV.D.xxxiv and VI.B.xx. Current and Pending Support);
- An Intellectual Property Management Plan (if applicable) describing how the project team/consortia members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies in accordance with VI.B.xi. Intellectual Property Management Plan;
- Data Management Plan (if applicable) describing how all research data displayed in publications resulting from the proposed work will be digitally accessible at the time of publication;
- Indirect cost information;
- Other budget information;

[22] Typically, these individuals have doctoral or other professional degrees, although individuals at the masters or baccalaureate level may be considered senior/key personnel if their involvement meets this definition. Consultants, graduate students, and those with a postdoctoral role also may be considered senior/key personnel if they meet this definition.

- Commitment Letters from Third Parties Contributing to Cost Share, if applicable;
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5);
- Information for the DOE Office of Civil Rights to process assurance reviews under 10 CFR 1040;
- Representation of Limited Rights Data and Restricted Software, if applicable;
- Information related to Davis-Bacon Act Requirements;
- Information related to Community Benefits Plan; and
- Environmental Questionnaire.

F. Unique Entity Identifier (UEI) and System for Award Management (SAM)

Each applicant (unless the applicant is an individual or federal awarding agency that is excepted from those requirements under 2 CFR 25.110(b) or (c), or has an exception approved by the federal awarding agency under 2 CFR 25.110(d)) is required to: (1) Be registered in the SAM at https://www.sam.gov before submitting its application; (2) provide a valid UEI number in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, the DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

NOTE: Due to the high demand of UEI requests and SAM registrations, entity legal business name and address validations are taking longer than expected to process. Entities should start the UEI and SAM registration process as soon as possible. If entities have technical difficulties with the UEI validation or SAM registration process they should utilize the HELP feature on SAM.gov. SAM.gov will work entity service tickets in the order in which they are received and asks that entities not create multiple service tickets for the same request or technical issue. Additional entity validation resources can be found here: GSAFSD Tier 0 Knowledge Base - Validating your Entity**.**

G. Submission Dates and Times

All required submissions must be submitted as specifically stated in the announcement no later than the time and date provided on the cover page of this FOA.

H. Intergovernmental Review

This FOA is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

I. Funding Restrictions

i. Allowable Costs

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable federal cost principles. Pursuant to 2 CFR 910.352, the cost principles in the Federal Acquisition Regulations (48 CFR Part 31.2) apply to for-profit entities. The cost principles contained in 2 CFR Part 200, Subpart E apply to all entities other than for-profits.

Costs to support or oppose union organizing, whether directly or as an offset for other funds, are unallowable.

ii. Pre-Award Costs

Applicants selected for award negotiations (selectees) must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the federal award directly pursuant to the negotiation and in anticipation of the federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that they would have been allowable if incurred after the date of the federal award and **only** with the written approval of the federal awarding agency, through the DOE Contracting Officer.

Pre-award costs cannot be incurred prior to the Selection Official signing the Selection Statement and Analysis.

Pre-award expenditures are made at the selectee's risk. DOE is not obligated to reimburse costs: (1) in the absence of appropriations; (2) if an award is not made; or (3) if an award is made for a lesser amount than the selectee anticipated.

1. **National Environmental Policy Act (NEPA) Requirements Related to Pre-Award Costs**

   DOE's decision whether and how to distribute federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to DOE completing the NEPA review process.

DOE does not guarantee or assume any obligation to reimburse pre-award costs incurred prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that DOE determines may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the applicant is doing so at risk of not receiving federal funding for their project and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer override the requirement to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives. Likewise, if an application is selected for negotiation of award, and the prime recipient elects to undertake activities that are not authorized for federal funding by the Contracting Officer in advance of DOE completing a NEPA review, the prime recipient is doing so at risk of not receiving federal funding and such costs may not be recognized as allowable cost share.

iii. Performance of Work in the United States (Foreign Work Waiver)

1. Requirement

All work performed under awards issued under this FOA must be performed in the United States. The prime recipient must flow down this requirement to its subrecipients.

2. Failure to Comply

If the prime recipient fails to comply with the Performance of Work in the United States requirement, DOE may deny reimbursement for the work conducted outside the United States and such costs may not be recognized as allowable recipient cost share. The prime recipient is responsible should any work under this award be performed outside the United States, absent a waiver, regardless of whether the work is performed by the prime recipient, subrecipients, contractors or other project partners.

3. Waiver

To seek a foreign work waiver, the applicant must submit a written waiver request to DOE. **Appendix G** lists the information that must be included in a request for a foreign work waiver.

Save the waiver request(s) in a single PDF file. The applicant does not have the right to appeal DOE's decision concerning a waiver request.

iv. Construction

Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs.

v. Foreign Travel

If international travel is proposed for your project, please note that your organization must comply with the International Air Transportation Fair Competitive Practices Act of 1974 (49 U.S.C. 40118), commonly referred to as the "Fly America Act," and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a U.S. flag carrier, if service is available. Foreign travel costs are allowable only with the written prior approval of the Contracting Officer assigned to the award.

vi. Equipment and Supplies

Property disposition will be required at the end of a project if the current fair market value of property exceeds $5,000. For-profit entity disposition requirements are set forth at 2 CFR 910.360. Property disposition requirements for other non-federal entities are set forth in 2 CFR 200.310 – 200.316.

vii. Buy America Requirements for Infrastructure Projects

Pursuant to the Build America Buy America Act, subtitle IX of BIL (Buy America or "BABA"), federally assisted projects that involve infrastructure work, undertaken by applicable recipient types, require that:

- all iron, steel, and manufactured products used in the infrastructure work are produced in the United States; and
- all construction materials used in the infrastructure work are manufactured in the United States.

Whether a given project must apply this requirement is project-specific and dependent on several factors, such as the recipient's entity type, whether the work involves "infrastructure," as that term is defined in Section 70914 of the BIL, and whether the infrastructure in question is publicly owned or serves a public function.

Applicants are strongly encouraged to consult Appendix J of this FOA to determine whether their project may have to apply this requirement, both to make an early determination as to the need of a waiver, as well as to determine what impact, if any, this requirement may have on the proposed project's budget.

Please note that, based on implementation guidance from the Office of Management and Budget (OMB) issued on April 18, 2022, the Buy America requirements of the BIL do not apply to DOE projects in which the prime recipient is a for-profit entity; the requirements only apply to projects whose prime recipient is a "non-Federal entity," e.g., a State, local government, Indian tribe, Institution of Higher Education, or nonprofit organization. Subawards should conform to the terms of the prime award from which they flow; in other words, for-profit prime recipients are not required to flow down these Buy America requirements to subrecipients, even if those subrecipients are non-Federal entities as defined above. Conversely, prime recipients which are non-Federal entities must flow the Buy America requirements down to all subrecipients, even if those subrecipients are for-profit entities. Finally, for all applicants—both non-Federal entities and for-profit entities—DOE is including a Program Policy Factor that the Selection Official may consider in determining which Full Applications to select for award negotiations that considers whether the applicant has made a commitment to procure U.S. iron, steel, manufactured products, and construction materials in its project.

The DOE financial assistance agreement will require each recipient: (1) to fulfill the commitments made in its application regarding the procurement of U.S.-produced products, and (2) to fulfill the commitments made in its application regarding the procurement of other key component metals and manufactured products domestically that are deemed available in sufficient and reasonably available quantities or of a satisfactory quality at the time of award negotiation. Applicants may seek waivers of these requirements in very limited circumstances and for good cause shown. Further details on requesting a waiver can be found in Appendix J and the terms and conditions of an award.

Applicants are strongly encouraged to consult **Appendix J** of this FOA for more information.

viii. Davis-Bacon Act Requirements

Projects awarded under this FOA will be funded under Division D of the Bipartisan Infrastructure Law. Accordingly, per Section 41101 of that law, all laborers and mechanics employed by the recipient, subrecipients, contractors or subcontractors in the performance of construction, alteration, or repair work funded in whole or in part under this FOA shall be paid wages at rates not less than those prevailing on similar projects in the locality, as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code commonly referred to as the "Davis-Bacon Act" (DBA).

Applicants shall provide written assurance acknowledging the DBA requirements above, and confirming that all of the laborers and mechanics performing

construction, alteration, or repair work on projects funded in whole or in part by awards made as a result of this FOA are paid or will be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by subchapter IV of Chapter 31 of Title 40, United States Code (Davis-Bacon Act).

Applicants acknowledge that they will comply with all of the Davis-Bacon Act requirements, including but not limited to:

(1) ensuring that the wage determination(s) and appropriate Davis-Bacon clauses and requirements are flowed down to and incorporated into any applicable subcontracts or subrecipient awards.

(2) ensuring that if wage determination(s) and appropriate Davis-Bacon clauses and requirements are improperly omitted from contracts and subrecipient awards, the applicable wage determination(s) and clauses are retroactively incorporated to the start of performance.

(3) being responsible for compliance by any subcontractor or subrecipient with the Davis-Bacon labor standards.

(4) receiving and reviewing certified weekly payrolls submitted by all subcontractors and subrecipients for accuracy and to identify potential compliance issues.

(5) maintaining original certified weekly payrolls for 3 years after the completion of the project and must make those payrolls available to the DOE or the United States Department of Labor (DOL) upon request, as required by 29 CFR 5.6(a)(2).

(6) conducting payroll and job-site reviews for construction work, including interviews with employees, with such frequency as may be necessary to assure compliance by its subcontractors and subrecipients and as requested or directed by the DOE.

(7) cooperating with any authorized representative of the Department of Labor in their inspection of records, interviews with employees, and other actions undertaken as part of a Department of Labor investigation.

(8) posting in a prominent and accessible place the wage determination(s) and Department of Labor Publication: WH-1321, Notice to Employees Working on Federal or Federally Assisted Construction Projects.

(9) notifying the Contracting Officer of all labor standards issues, including all complaints regarding incorrect payment of prevailing wages and/or fringe benefits, received from the recipient, subrecipient, contractor, or subcontractor employees; significant labor standards violations, as defined in 29 CFR 5.7; disputes concerning labor standards pursuant to 29 CFR parts 4, 6, and 8 and as defined in FAR 52.222-14; disputed labor standards determinations; Department of Labor investigations; or legal or judicial proceedings related to the labor standards under this Contract, a subcontract, or subrecipient award.

(10) preparing and submitting to the Contracting Officer, the Office of Management and Budget Control Number 1910-5165, Davis Bacon Semi-Annual Labor Compliance Report, by April 21 and October 21 of each year. Form submittal will be administered through the iBenefits system (https://doeibenefits2.energy.gov) or its successor system, or other manner of compliance as directed by the Contracting Officer.

Recipients of funding under this FOA will also be required to undergo Davis-Bacon Act compliance training and to maintain competency in Davis-Bacon Act compliance. The Contracting Officer will notify the recipient of any DOE sponsored Davis-Bacon Act compliance trainings. The DOL offers free Prevailing Wage Seminars several times a year that meet this requirement, at https://www.dol.gov/agencies/whd/government-contracts/construction/seminars/events.

For additional guidance on how to comply with the Davis-Bacon provisions and clauses, see https://www.dol.gov/agencies/whd/government-contracts/construction and https://www.dol.gov/agencies/whd/government-contracts/protections-for-workers-in-construction .

ix. Lobbying

Recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Recipients and subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (https://www.grants.gov/web/grants/forms/sf-424-individual-family.html) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

- An officer or employee of any federal agency;

- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

x. Risk Assessment

Pursuant to 2 CFR 200.206, DOE will conduct an additional review of the risk posed by applications submitted under this FOA. Such risk assessment will consider:

1. Financial stability;
2. Quality of management systems and ability to meet the management standards prescribed in 2 CFR 200 as amended and adopted by 2 CFR 910;
3. History of performance;
4. Audit reports and findings; and
5. The applicant's ability to effectively implement statutory, regulatory, or other requirements imposed on non-federal entities.

DOE may make use of other publicly available information and the history of an applicant's performance under DOE or other federal agency awards.

Depending on the severity of the findings and whether the findings were resolved, DOE may elect not to fund the applicant.

In addition to this review, DOE must comply with the guidelines on government-wide suspension and debarment in 2 CFR Part 180, and must require non-federal entities to comply with these provisions. These provisions restrict federal awards, subawards and contracts with certain parties that are debarred, suspended or otherwise excluded from or ineligible for participation in federal programs or activities.

Further, as DOE invests in critical infrastructure and funds critical and emerging technology areas, DOE also considers possible vectors of undue foreign influence in evaluating risk. If high risks are identified and cannot be sufficiently mitigated, DOE may elect to not fund the applicant.

xi. Invoice Review and Approval

DOE employs a risk-based approach to determine the level of supporting documentation required for approving invoice payments. Recipients may be required to provide some or all of the following items with their requests for reimbursement:

- Summary of costs by cost categories;
- Timesheets or personnel hours report;

- Proof of compliance with Davis-Bacon and electronic submittals of certified payroll reports;
- Invoices/receipts for all travel, equipment, supplies, contractual, and other costs;
- UCC filing proof for equipment acquired with project funds by for-profit recipients and subrecipients;
- Explanation of cost share for invoicing period;
- Analogous information for some subrecipients; and
- Other items as required by DOE.

xii. Prohibition related to Foreign Government-Sponsored Talent Recruitment Programs

a. Prohibition

Persons participating in a *Foreign Government-Sponsored Talent Recruitment Program of a Foreign Country of Risk* are **prohibited** from participating in projects selected for federal funding under this FOA. Should an award result from this FOA, the recipient must exercise ongoing due diligence to reasonably ensure that no individuals participating on the DOE-funded project are participating in a *Foreign Government-Sponsored Talent Recruitment Program of a Foreign Country of Risk*. Consequences for violations of this prohibition will be determined according to applicable law, regulations, and policy. Further, the recipient must notify DOE within five (5) business days upon learning that an individual on the project team is or is believed to be participating in a foreign government talent recruitment program of a foreign country of risk. DOE may modify and add requirements related to this prohibition to the extent required by law.

b. Definitions

1. **Foreign Government-Sponsored Talent Recruitment Program.** An effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to relocate physically to the foreign state for the above purpose. Some programs allow for or encourage continued employment at U.S. research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and

some direct participants not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complementary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

2. **Foreign Country of Risk.** DOE has designated the following countries as foreign countries of risk: Iran, North Korea, Russia, and China. This list is subject to change.

xiii. Affirmative Action and Pay Transparency Requirements

All federally assisted construction contracts exceeding $10,000 annually will be subject to the requirements of Executive Order 11246:

(1) Recipients are prohibited from discriminating in employment decisions on the basis of race, color, religion, sex, sexual orientation, gender identity or national origin.

(2) Recipients must take affirmative action to ensure that equal opportunity is provided in all aspects of their employment. This includes flowing down the appropriate language to all subrecipients and contractors.

(3) Recipients are prohibited from taking adverse employment actions against applicants and employees for asking about, discussing, or sharing information about their pay or, under certain circumstances, the pay of their co-workers.

The Department of Labor's (DOL) Office of Federal Contractor Compliance Programs (OFCCP) uses a neutral process to schedule compliance evaluations. OFCCP's Technical Assistance Guide[23] should be consulted to gain an understanding of the requirements and possible required actions.

As a condition of grant award and consistent with EO 11246, Equal Employment Opportunity (30 FR 12319, and as amended), all Federally assisted construction contractors are required to make good faith efforts to meet the goals as determined in accordance with 41 C.F.R. Part 60-4 of 6.9 percent of construction project hours being performed by women, in addition to goals that vary based on geography for construction work hours and for work being performed by minorities.

[23] See OFCCP's Technical Assistance Guide at: https://www.dol.gov/sites/dolgov/files/ofccp/Construction/files/ConstructionTAG.pdf?msclkid=9e397d68c4b111ec9d8e6fecb6c710ec Also see the National Policy Assurances http://www.nsf.gov/awards/managing/rtc.jsp

xiv. Foreign Collaboration Considerations

a. Consideration of new collaborations with foreign organizations and governments. The recipient will be required to provide DOE with advanced written notification of any potential collaboration with foreign organizations or governments in connection with its DOE-funded award scope. The recipient will then be required to await further guidance from DOE prior to negotiating the terms of any potential agreement or collaborating with the proposed foreign organization or government.

b. Existing collaborations with foreign organizations and governments. The recipient will be required to provide DOE with a written list of all existing foreign collaborations in which recipient has entered in connection with its DOE-funded award scope.

c. Description of collaborations that should be reported: In general, a collaboration will involve some provision of a thing of value to, or from, the recipient. A thing of value includes. but may not be limited to, all resources made available to, or from, the recipient in support of and/or related to the DOE award, regardless of whether or not they have monetary value. Things of value also may include in-kind contributions (such as office/laboratory space, data, equipment, supplies, employees, students). In-kind contributions not intended for direct use on the DOE award but resulting in provision of a thing of value from or to the DOE award must also be reported. Collaborations do not include routine workshops, conferences, use of the recipient's services and facilities by foreign investigators resulting from its standard published process for evaluating requests for access, or the routine use of foreign facilities by awardee staff in accordance with the recipient's standard polies and procedures.

V. Application Review Information

A. Technical Review Criteria

i. Letters of Intent

Feedback will not be provided on letters of intent; they will only be used for DOE planning purposes.

ii. Full Applications

Applications will be evaluated against the technical merit review criteria (MRC) shown below. All sub-criteria are of equal weight. The following table summarizes the MRC weighting for each TA.

MRC	TA-1	TA-2	TA-3
1	45%	30%	30%
2	25%	15%	15%
3	30%	25%	20%
4	N/A	20%	20%
5	N/A	10%	15%

Merit Review Criterion 1: Technological Merit and DAC Hub Site Suitability (TA-1: 45%) (TA-2 and TA-3: 30%)

All Applicants

- Thoroughness, completeness, and identification of knowledge gaps and key technical challenges.

TA-1 Only

- Thoroughness of the description of the proposed DAC Hub site(s) and degree to which the concept meets the stated objectives, application requirements and technical specifications of the FOA and TA.
- Soundness, adequacy, and significance of the proposed DAC Hub site(s) and degree to which the proposed site(s) are suitable for DAC Hub development and implementation.
- Degree to which the Applicant discussed the resource requirements and availability for the DAC Hub, including CO_2 transport infrastructure, CO_2 storage capacity, CO_2 conversion capacity (if applicable), energy, land, and water requirements.
- Thoroughness of the discussion of DAC and CO_2 conversion (if applicable) technology(ies) under consideration.

TA-2 and TA-3 Only

- Thoroughness of the description of the proposed DAC Hub concept and degree to which the proposed concept meets the stated objectives, application requirements and technical specifications of the FOA and TA. Adequacy of the Applicant's discussion of the proposed DAC Hub project from technical, environmental, permitting, cost effectiveness, and integrated systems perspectives.
- Soundness, adequacy, and significance of the proposed DAC Hub site(s) and degree to which the proposed site(s) are suitable for DAC Hub development and implementation.
- Degree to which the Applicant provided a complete description of the resource requirements and availability for the DAC Hub, including CO_2 transport infrastructure, CO_2 storage capacity, CO_2 conversion capacity (if applicable) or offtake agreements, energy, land, and water requirements.
- Adequacy of plans for the development of a DAC Hub with larger initial capacity and greater potential for expansion.
- Thoroughness of the description of the DAC Hub technology(ies) for atmospheric CO_2 capture and conversion (if applicable). Completeness of the description of the atmospheric CO_2 capture adsorption/desorption/conversion chemistry, kinetics and thermodynamics, and chemical and mechanical stability under the adsorption/desorption conditions for the proposed capture and conversion material(s).
- Evidence that the project is proposed at an appropriate scale based on current and planned technology development activities, technology scaling methodology, and scaling factor analysis to which the Applicant provided technical detail (i.e., experimental results, diagrams, and graphs from their previous and active research) to support the readiness for deployment of the proposed technology(ies) in the DAC Hub.
- Completeness and relevance of the description of available (and/or status, plans, and schedule for obtaining) test data that would be reasonable for scale-up to a capacity of at least 50,000 tonnes CO_2 captured from the atmosphere (50 KTA). The likelihood that development of this technology(ies) will result in a successful deployment at the proposed scale.
- Soundness, adequacy, thoroughness, and significance of information provided in the DAC Hub data tables.
- Soundness, adequacy, thoroughness, and significance of the DAC Hub capacity build-out plan to remove at least 1,000,000 tonnes of CO_2 from the atmosphere annually (1 MTA), including schedule, cost estimate, plans for securing required utilities (e.g., electricity, heat, water, etc.), CO_2 transport routes, and secure CO_2 storage capacity that enable DAC Hub growth with maximal removal potential over the DAC Hub lifespan, and plans for adding new technologies (if applicable).

- Adequacy of the Environmental Health and Safety (EH&S) Risk Analysis of the anchoring integrated DAC system. Completeness of the discussion regarding air and water emissions, water utilization, solid waste streams, noise, and potential environmental impacts of the technology including toxicological effects and hazards of emissions and waste streams.
- Adequacy of the LCA and degree to which a complete description of the LCA was provided, including ability to assess net-climate benefits of the project. Degree to which the Applicant provided details for the selection and characterization of plausible options for carbon storage and/or CO_2 conversion to valuable products which demonstrate a reduction in life cycle greenhouse gas emissions when compared to the equivalent incumbent product.

TA-2 Only

- Adequacy and completeness of information provided in the summary of the integrated DAC system pre-FEED, including mass and energy balances, estimates of heating and cooling duties and electric power requirements covering the anchoring integrated DAC system and balance-of-plant, and cost of CO_2 removal.
- Adequacy and completeness of information provided in the DAC Hub balance-of-plant conceptual design. Completeness of process flow diagram illustrating the mass and energy balances of the mature DAC Hub.
- Adequacy of the proposed storage site(s) and thoroughness of the discussion of the status of the characterization and permitting activities or offtake agreements.

TA-3 Only

- Adequacy and completeness of information provided in the summary of the integrated DAC system FEED, including mass and energy balances, estimates of heating and cooling duties and electric power requirements covering the anchoring integrated DAC system and balance-of-plant, and cost of CO_2 removal.
- Adequacy and completeness of information provided in the DAC Hub balance-of-plant pre-FEED study. Completeness of process flow diagram illustrating the mass and energy balances of the mature DAC Hub.
- Adequacy and completeness of information provided in the summary of the Storage Field Development Plan for the final capacity (at least 12 years of Hub operation).
- Degree to which the Applicant provided a complete description of the proposed domestic pipeline (or other required) transportation route(s), including specifications, requirements, challenges, maps, rights-of-way, and current status of permitting activities.

- Evidence that the Applicant will be able to select and secure access to suitable domestic pipeline or other required transportation route(s) for the proposed project.

Merit Review Criterion 2: Technical Approach and Workplan (TA-1: 25%) (TA-2 and TA-3: 15%)

All Applicants

- Adequacy and feasibility of the Applicant's approach to achieving the objectives of the FOA and AOI.
- Feasibility, appropriateness, rationale, and completeness of the proposed Statement of Project Objectives (SOPO), such that there is a logical progression of work, and necessary tasks and deliverables of the project were sufficiently identified and described.
- The adequacy and completeness of the Project Management Plan (PMP) in establishing baselines (technical scope, budget, schedule), performance metrics that will be assessed during the proposed project, and in managing project performance relative to those baselines; defining the actions that will be taken when these baselines must be revised; and identification of project risks and strategies for mitigation. The following aspects of the PMP shall be evaluated:
    - Soundness and completeness of the Integrated Project Schedule; including all tasks necessary for successful completion of the project; incorporating and showing inter-relationships among all technical, financial, NEPA, CBP, and permitting and other appropriate factors; including a critical path schedule with milestones and decision points; allocating sufficient and appropriate time to complete the project deliverables;
    - Adequacy of the Baseline Cost Plan for establishing the baseline cost for the project and incorporating costs for all tasks necessary for performing the proposed project;
    - Adequacy of the project management system to monitor and control project scope, cost, and schedule;
    - Adequacy of the Project Communication Protocol for ensuring effective communication between the Recipient, Subrecipients, and DOE; and
    - Adequacy of the Risk Management Plan for quantitatively and qualitatively assessing, identifying, tracking, and managing project risk; completeness of the identification of potential risk elements with potential impacts, quality and adequacy of the approach to assessing and managing risk, conformance of risk management approach with industry standards, and adequacy of the approaches to risk mitigation.
    - Adequacy of the Environmental Management Plan for assessing, monitoring, and reporting the potential environmental impacts to air,

land and water resources, and potential impacts of waste production.

TA-2 and TA-3 Only

- Thoroughness of the project description and plans necessary for the engineering design and permitting.
- The adequacy and completeness of the Data Management Plan (DMP) in conveying a clear explanation of data collection methodologies, file types, data analytics considerations, machine learning applications (if applicable), and data storage.
- Thoroughness and significance of the details concerning how project data will be shared with DOE and the public.

Merit Review Criterion 3: Applicant/Team Capabilities, Commitments, and Management Capabilities (TA-1: 30%; TA-2: 25%; TA-3: 20%)

All Applicants

- Demonstrated experience of the Applicant and partnering organizations in the technology areas addressed in the application and in managing projects of similar size, scope, and complexity.
- Thoroughness of the depth and clarity of the discussion of previous or current DAC projects involving one or more of the proposed partners to demonstrate the experience of the partners, including evidence of past cooperation among various partners and commitment to cost share.
- Adequacy of the credentials, capabilities, and experience of key personnel and partnering organizations.
- Clarity and likely effectiveness of the project organization, including sub-recipients or partners, to successfully complete the project. Adequacy of plans to add new team members (if applicable).
- Adequacy and availability of proposed personnel, facilities, and equipment to perform project tasks.

TA-2 and TA-3 Only

- Completeness of the proposed project team, soundness of the proposed DAC Hub ownership structure, and ability of the proposed team to successfully provide the engineering, procurement, and construction (EPC) competencies and resources, including cost share, needed to implement the project.
- Strength of project team member commitments to the project as evidenced by letters of commitment or signed agreements among team members.
- Strength of the host community(ies), landowner(s), and/or host site(s) commitments to the project as evidenced by letters of commitment and/or signed agreements.
- Completeness and adequacy of the proposed DAC Hub safety culture and DAC Hub site and cybersecurity considerations.

Merit Review Criterion 4: Community Benefits Plan (TA-2 and TA-3: 20%)

TA-2 and TA-3 Only

Overall Approach

- The extent to which the plan specifically and convincingly demonstrates how the proposed DAC Hub will provide societal benefits and mitigate/minimize negative impacts to workers and communities.
- The extent to which the actions outlined in the Community Benefits Plan (CBP) are supported by enforceable, negotiated Workforce and Community Agreements (e.g., good neighbor agreements, workforce agreements, project labor agreements, collective bargaining agreements, and similar agreements).
- The extent to which the team and resources—including staff, facilities, capabilities, and budget—are capable of implementing plans outlined in the CBP.
- The extent to which the project includes plans for analysis, workforce, and/or engagement efforts that address community, labor, and workforce desires and/or concerns which go beyond regulatory compliance and technical, business, environmental, labor, and other project requirements.
- Extent to which the Community Benefits Plan is integrated into the project management schedule and other key documents and provides mechanisms, supported by measurable actions, to impact project direction in a timely manner.

Community and Labor Engagement

- The extent to which the project demonstrates a clear and appropriately robust plan to meaningfully engage local stakeholders, including community-based organizations that support or work with disadvantaged communities, labor unions and/or Indian Tribes, in a manner that can impact project decisions.
- The extent to which impacted communities and workforce organizations, including labor unions, are appropriately included as core partners in the project and/or affirm support.

Investing in the American Workforce

- The extent to which the CBP demonstrates that the jobs supported by the proposed project will be quality jobs and provides robust and credible plan to attract, train, and retain skilled workers (e.g., through a workforce and community agreement and commitment to workers' free and fair choice to join a union or labor organization of their choosing; and/or commitments to wages above prevailing wage requirements, benefits, or other worker support).
- The extent to which the Community Benefits Plan demonstrates plans to invest in workforce education and training, support workers' skill acquisition and opportunities for advancement, and utilize an appropriately credentialed workforce , including but not limited to partnerships with high-quality workforce

development programs with supportive services[24] to help train, place, and retain individuals from underrepresented communities in good-paying jobs or registered apprenticeships.

Diversity, Equity, Inclusion, and Accessibility

- The extent to which the CBP includes specific and high-quality actions to meet DEIA goals, which may include DEIA recruitment procedures; partnerships with workforce training or support organizations serving workers facing systematic barriers to employment; and other DEIA commitments.
- The extent to which the proposed project partners or contracts with Minority-Serving Institutions (MSIs), Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, and/or Tribal nations.

Justice40 Initiative

- The extent to which the CBP identifies specific and measurable benefits, how the benefits will flow, and how negative impacts would be mitigated—and specifically describes these impacts on disadvantaged communities.
- The extent to which the project illustrates the ability to support the overall goal of the Justice40 Initiative that 40% of the benefits of the overall investments flow to disadvantaged communities.

Merit Review Criterion 5: Financial and Market Viability (TA-2: 10%; TA-3: 15%)

TA-2 and TA-3 Only

- Degree to which the application justifies the proposed DAC Hub's economic viability, sustainability, and potential growth beyond DOE funding, including achieving market liftoff and follow-on investments to build out a regional DAC Hub.
- Adequacy, completeness, and viability of the proposed Financial Plan. Reasonableness and completeness of the plan, including a financing schedule, demonstrating the potential for the Applicant to successfully implement the project.
- Consistency of the financial information with the funding and financial business plans and with other application materials (e.g., SOPO).
- Viability of financial projections in the financial model to attract investors and lenders.

[24] Supportive services are critical to help women and people facing systemic barriers to employment be able to participate and thrive in training and employment. Recommended supportive services include childcare, tools, work clothing, application fees and other costs of apprenticeship or required pre-employment training, transportation and travel to training and work sites, and services aimed at helping to retain underrepresented groups like mentoring, support groups, and peer networking.

- Availability, credibility, and risk/terms of non-federal cost share sources and funds necessary to meet ongoing cost share needs. This includes the ability to leverage DOE financial assistance funding from this FOA with state and local incentives and private financing.
- Adequacy and justification of the proposed DAC Hub budget and spend plan covering both DOE funding and non-federal cost share. Correspondence between the budget estimate and the magnitude of the work proposed in the SOPO.
- Degree to which the Applicant addresses each key participating organization's financial commitment to the proposed DAC Hub, including overall financial strength and financial capability to implement the proposed DAC Hub.
- Adequacy of the proposed Business Plan for developing key project agreements, such as financing, acquisition strategies, power purchase agreements, feedstock supply, offtake (sales) agreements, and other relevant project documents.
- Adequacy and clarity of the financial risk management discussion and a demonstrated understanding of financial and market risks involved in the proposed work, as well as the quality of the mitigation strategies to address them.

Budget Information Evaluation Criteria (TA-1 Only)

A budget review, which is not point scored, will be conducted to determine the following:

- Reasonableness, allowability, and allocation of the proposed Phase 0 cost.
- Completeness and adequacy of the supporting documentation for the cost estimate.
- Statement of Project Objectives and proposed budget are provided in the same format, by budget period, task, etc.
- Correspondence between the Phase 0 SOPO and budget, and adequacy of associated supporting documentation.

B. Standards for Application Evaluation

Applications that are determined to be eligible will be evaluated in accordance with this FOA and the guidance provided in the "DOE Merit Review Guide for Financial Assistance," effective October 2021, which is available at: DEPARTMENT OF ENERGY GUIDE TO FINANCIAL ASSISTANCE October 2021

C. Other Selection Factors

i. Program Policy Factors

In addition to the Merit Review Criteria, the Selection Official may consider the following program policy factors in determining to select, for negotiation of award, a project of less or equal technical merit than another project(s):

- It may be desirable to select for award a project, or group of projects, that represent a diversity of technologies under this FOA;
- It may be desirable to select for award a project, or group of projects, with a broad or specific geographic distribution under this FOA;
- It may be desirable to select for award a project, or group of projects, if such a selection will optimize use of available funds, including proposed cost share;
- It may be desirable to select for award a project, or group of projects, if such a selection presents lesser schedule risk, lesser budget risk, lesser technical risk, lesser societal considerations and impacts risk, and/or lesser environmental risks. Environmental risk includes, but is not limited to, an adverse impact to air, soil, water, or increase in overall cradle to grave greenhouse gas footprint (carbon dioxide equivalent, CO_2e);
- It may be desirable to select for award a project, or group of projects, with a higher level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers;
- It may be desirable to select for award a project, or group of projects, that are located in a region with (1) existing carbon-intensive fuel production or industrial capacity, or (2) carbon-intensive fuel production or industrial capacity that has retired or closed in the preceding 10 years;
- It may be desirable to select for award a project, or group of projects, located in economically distressed communities[25] in the regions of the United States with high levels of coal, oil, or natural gas resources;
- The degree to which the proposed project will employ procurement of U.S. iron, steel, manufactured products, and construction materials;
- It may be desirable to select for award a project, or group of projects, that when compared to the existing DOE project portfolio and other projects to be selected from the subject FOA, contributes to the total portfolio meeting Justice40 goals; and
- It may be desirable to select for award a project, or group of projects, that has broad public support from the communities most directly impacted by or most vulnerable to impacts from the project.

[25] https://www.census.gov/programs-surveys/acs/data.html

D. Evaluation and Selection Process

i. Overview

The evaluation process consists of multiple phases; each includes an initial eligibility review and a thorough technical review. Rigorous technical reviews of eligible submissions are conducted by reviewers that are experts in the subject matter of the FOA. Ultimately, the Selection Official considers the recommendations of the reviewers, along with other considerations such as program policy factors, in determining which applications to select.

ii. Recipient Integrity and Performance Matters

DOE, prior to making a federal award with a total amount of federal share greater than the simplified acquisition threshold, is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. § 2313).

The applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.

DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under federal awards when completing the review of risk posed by applicants as described in 2 CFR 200.206.

iii. Pre-Selection Interviews (TA-3 Applicants Only)

As part of the evaluation and selection process, DOE may invite one or more TA-3 applicants to participate in Pre-Selection Interviews. The invited applicant(s) will meet with DOE representatives to provide clarification on the contents of the Full Applications and to provide DOE an opportunity to ask questions regarding the proposed project. The information provided by applicants to DOE through Pre-Selection Interviews contributes to DOE's selection decisions.

DOE will arrange to meet with the invited applicants in person at DOE's offices or a mutually agreed upon location. DOE may also arrange site visits to certain applicants' facilities. Alternatively, DOE may invite certain applicants to participate in a one-on-one conference with DOE via webinar, videoconference, or conference call.

DOE will not reimburse applicants for travel and other expenses relating to the Pre-Selection Interviews, nor will these costs be eligible for reimbursement as pre-award costs.

Participation in Pre-Selection Interviews with DOE does not signify that an applicant has been selected for award negotiations.

iv. Selection

The Selection Official may consider the technical merit, the Federal Consensus Board's recommendations, program policy factors, and the amount of funds available in arriving at selections for this FOA.

E. Anticipated Notice of Selection and Award Negotiation Dates

DOE anticipates notifying applicants selected for negotiation of award and negotiating awards by the dates provided on the cover page of this FOA.

VI. Award Administration Information

A. Award Notices

i. Ineligible Submissions

Ineligible Full Applications will not be further reviewed or considered for award. The Contracting Officer will send a notification letter by email to the technical and administrative points of contact designated by the applicant. The notification letter will state the basis upon which the Full Application is ineligible and not considered for further review.

ii. Full Application Notifications

DOE will notify Applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the applicant in Grants.gov. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, DOE may notify one or more applicants that a final selection determination on particular Full Applications will be made at a later date, subject to the availability of funds or other factors.

iii. Successful Applicants

Receipt of a notification letter selecting a Full Application for award negotiations does not authorize the applicant to commence performance of the project. If an application is selected for award negotiations, it is not a commitment by DOE to issue an award. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement, accessible by the prime recipient in FedConnect.

The award negotiation process will take approximately 60 days. Applicants must designate a primary and a backup point-of-contact in Grants.gov with whom DOE will communicate to conduct award negotiations. The Applicant must be responsive during award negotiations (i.e., provide requested documentation) and meet the negotiation deadlines. If the Applicant fails to do so or if award negotiations are otherwise unsuccessful, DOE will cancel the award negotiations and rescind the Selection. DOE reserves the right to terminate award negotiations at any time for any reason.

Please refer to Section IV.I.ii. of the FOA for guidance on pre-award costs.

iv. Alternate Selection Determinations

In some instances, an applicant may receive a notification that its application was not selected for award and DOE designated the application to be an alternate. As an alternate, DOE may consider the Full Application for federal funding in the future. A notification letter stating the Full Application is designated as an alternate does not authorize the applicant to commence performance of the project. DOE may ultimately determine to select or not select the Full Application for award negotiations.

v. Unsuccessful Applicants

DOE shall promptly notify in writing each Applicant whose application has not been selected for award or whose application cannot be funded because of the unavailability of appropriated funds.

B. Administrative and National Policy Requirements

i. Registration Requirements

There are several one-time actions before submitting an application in response to this FOA, and it is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA, or to meet the negotiation deadlines and receive an award if the application is selected. These requirements are as follows:

1. **System for Award Management**
   Register with the SAM at https://www.sam.gov. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called a Marketing Partner ID Number (MPIN) are important steps in SAM registration. Please update your SAM registration annually.

2. **FedConnect**
   Register in FedConnect at https://www.fedconnect.net. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

3. **Grants.gov**
   Register in Grants.gov https://www.grants.gov to receive automatic updates when Amendments to this FOA are posted. However, please note that Letters of Intent will not be accepted through Grants.gov.

4. **Electronic Authorization of Applications and Award Documents**
   Submission of an application and supplemental information under this FOA through electronic systems used by the DOE, including Grants.gov and FedConnect.net, constitutes the authorized representative's approval and electronic signature.

ii. Award Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR Part 200 as amended by 2 CFR Part 910.

iii. Foreign National Participation (September 2021)

All Applicants selected for an award under this FOA and project participants (including subrecipients and contractors) who anticipate involving foreign nationals in the performance of an award, will be required to provide DOE with specific information about each foreign national to satisfy requirements for foreign national participation. A "foreign national" is defined as any person who is not a United States citizen by birth or naturalization. The volume and type of information collected may depend on various factors associated with the award. DOE concurrence may be required before a foreign national can participate in the performance of any work under an award.

Approval for foreign nationals from countries identified on the U.S. Department of State's list of State Sponsors of Terrorism must be obtained from DOE before they can participate in the performance of any work under an award.

iv. Subaward and Executive Reporting

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR Part 170. Prime recipients must register with the new FFATA Subaward Reporting System database and report the required data on their first tier subrecipients. Prime recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

v. National Policy Requirements

The National Policy Assurances that are incorporated as a term and condition of award are located at: http://www.nsf.gov/awards/managing/rtc.jsp.

vi. Environmental Review in Accordance with National Environmental Policy Act (NEPA)

DOE's decision whether and how to distribute federal funds under this FOA is subject to NEPA (42 U.S.C. § 4321, et seq.). NEPA requires federal agencies to integrate environmental values into their decision-making processes by

considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at https://www.energy.gov/nepa.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project. If DOE determines certain records must be prepared to complete the NEPA review process (e.g., biological evaluations or environmental assessments), the recipient may be required to prepare the records and the costs to prepare the necessary records may be included as part of the project costs.

vii. Flood Resilience

Applications should indicate whether the proposed project location(s) is within a floodplain, how the floodplain was defined, and how future flooding will factor into the project's design. The base floodplain long used for planning has been the 100-year floodplain, that is, a floodplain with a 1.0 percent chance of flooding in any given year. As directed by Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input (2015), Federal agencies, including DOE, continue to avoid development in a floodplain to the extent possible. When doing so is not possible, Federal agencies are directed to "expand management from the current base flood level to a higher vertical elevation and corresponding horizontal floodplain to address current and future flood risk and ensure that projects funded with taxpayer dollars last as long as intended." The higher flood elevation is based on one of three approaches: climate-informed science (preferred), freeboard value, or 0.2 percent annual flood change (500-year floodplain). EO 13690 and related information is available at https://www.energy.gov/nepa/articles/eo-13690-establishing-federal-flood-risk-management-standard-and-process-further.

viii. Applicant Representations and Certifications

1. Lobbying Restrictions

By accepting funds under this award, the prime recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. § 1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

2. Corporate Felony Conviction and Federal Tax Liability Representations

In submitting an application in response to this FOA, the applicant represents that:

a. It is **not** a corporation that has been convicted of a felony criminal violation under any federal law within the preceding 24 months; and

b. It is **not** a corporation that has any unpaid federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

For purposes of these representations the following definitions apply:

A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

3. Nondisclosure and Confidentiality Agreements Representations

In submitting an application in response to this FOA the applicant represents that:

a. It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contactors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a federal department or agency authorized to receive such information.

b. It **does not and will not** use any federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

(1) *''These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive Order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling*

Executive Orders and statutory provisions are incorporated into this agreement and are controlling.''

(2) The limitation above shall not contravene requirements applicable to Standard Form 312 Classified Information Nondisclosure Agreement (https://fas.org/sgp/othergov/sf312.pdf), Form 4414 Sensitive Compartmented Information Disclosure Agreement (https://fas.org/sgp/othergov/intel/sf4414.pdf), or any other form issued by a federal department or agency governing the nondisclosure of classified information.

(3) Notwithstanding the provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

ix. Statement of Federal Stewardship

DOE will exercise normal federal stewardship in overseeing the project activities performed under DOE awards. Stewardship Activities include, but are not limited to, conducting site visits; reviewing performance and financial reports; providing assistance and/or temporary intervention in unusual circumstances to correct deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

x. Statement of Substantial Involvement

DOE has substantial involvement in work performed under awards made as a result of this FOA. DOE does not limit its involvement to the administrative requirements of the award. Instead, DOE has substantial involvement in the direction and redirection of the technical aspects of the project as a whole. Substantial involvement includes, but is not limited to, the following:

Recipient's Responsibilities. The Recipient is responsible for:

- Performing the activities supported by this award in accordance with the Project Management Plan, including providing the required personnel, facilities, equipment, supplies and services;
- Managing and controlling project activities in accordance with established processes and procedures to ensure tasks and subtasks are completed within schedule and budget constraints defined by the current Project Management Plan;
- Implementing an approach to identify, analyze, and respond to project risks that is commensurate with the complexity of the project;
- Defining and revising approaches and plans, submitting the plans to DOE for review, and incorporating DOE comments;
- Coordinating related project activities with subrecipients and external suppliers, including contractors, to ensure effective integration of all work elements;
- Attending annual project review meetings and reporting project status;
- Participating in peer review evaluations of the project, or peer review evaluations of the program that their project supports;
- Submitting technical reports and publicly releasable documents that incorporate DOE comments;
- Presenting the project results at appropriate technical conferences or meetings as directed by the DOE Project Officer; and
- Submitting data generated as a result of this project to NETL for inclusion in the NETL Energy Data eXchange (EDX), https://edx.netl.doe.gov/.

DOE Responsibilities. DOE has the right to intervene in the conduct or performance of project activities for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities. Suspension or termination of the cooperative agreement under 2 CFR part 200, as amended by 2 CFR part 910 (DOE Financial Assistance Regulations) does not constitute intervention in the conduct or performance of project activities.

DOE is responsible for:

- Reviewing in a timely manner project plans, including project management, testing and technology transfer plans, and recommending alternate approaches, if the plans do not address critical programmatic issues;
- Participating in project management planning activities, including risk analysis, to ensure DOE's program requirements or limitations are considered in performance of the work elements;
- Conducting annual project review meetings to ensure adequate progress and that the work accomplishes the program and project objectives. Recommending alternate approaches or shifting work emphasis, if needed;

- Providing substantial involvement to ensure that project results address critical system and programmatic goals established by the DOE's Offices of Fossil Energy and Carbon Management and Clean Energy Demonstrations, and in coordination with DOE's Carbon Dioxide Removal, Carbon Conversion, and Carbon Storage Programs;
- Promoting and facilitating technology transfer activities, including disseminating program results through presentations and publications;
- Serving as scientific/technical liaison between awardees and other program or industry staff; and
- Reviewing and concurring with ongoing technical performance to ensure that adequate progress has been obtained within the current Budget Period authorized by DOE before work can commence on subsequent Budget Periods.

xi. Intellectual Property Management Plan (IPMP)

As part of negotiations for award, selected TA-2 and TA-3 Applicants must submit an executed IPMP between the members of the consortia or team.

The award will set forth the treatment of and obligations related to intellectual property rights between DOE and the individual members. The IPMP should describe how the members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies (see Sections VIII.K.-VIII.N. of this FOA for more details on applicable federal intellectual property laws and regulations).

The following is a non-exhaustive list of examples of items that the IPMP may cover:

- Evidence that the Recipient has secured the rights to practice all necessary intellectual property to complete the proposed project;
- The treatment of confidential information between members (e.g., the use of NDAs);
- The treatment of background intellectual property (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the award (e.g., any requirements for disclosing to the other members on an application, filing patent applications, paying for patent prosecution, and cross-licensing or other licensing arrangements between the members);
- The treatment of data produced, including software, under the award (e.g., any publication process or other dissemination strategies, copyrighting strategy or arrangement between members);
- Any technology transfer and commercialization requirements or arrangements between the members;

- The treatment of any intellectual property issues that may arise due to a change in membership of the consortia or team; and
- The handling of disputes related to intellectual property between the members.

xii. Subject Invention Utilization Reporting

In order to ensure that prime recipients and subrecipients holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, DOE may require that each prime recipient holding title to a subject invention submit annual reports for ten (10) years from the date the subject invention was disclosed to DOE on the utilization of the subject invention and efforts made by prime recipient or their licensees or assignees to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the prime recipient, and such other data and information as DOE may specify.

xiii. Intellectual Property Provisions

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

xiv. Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist, attached to the award agreement.

Additional reporting requirements apply to projects funded by BIL. As part of tracking progress toward key departmental goals – ensuring justice and equity, investing in the American workforce, boosting domestic manufacturing, reducing greenhouse gas emissions, and advancing a pathway to private sector – DOE may require specific data collection. Examples of data that may be collected include:

- New manufacturing production, or recycling capacity
- Jobs data including
    - Number and types of jobs provided, wages and benefits paid
    - Demographics of workforce including local hires
    - Efforts to minimize risks of labor disputes and disruptions
    - Contributions to training provided; certificates and training credentials received by employees; ration of apprentice-to-journey level workers employed
- Justice and Equity data, including:
    - Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses and Veteran Owned Businesses acting as vendors and sub-contractors for bids on supplies, services and equipment.

    - Value, number, and type of partnerships with MSIs
    - Stakeholder engagement events, consent-based siting activities
    - Other relevant indicators from the Community Benefits Plan
- Number and type of energy efficient and clean energy equipment installed
- Funding leveraged, follow-on-funding, Intellectual Property (IP) Generation and IP Utilization

xv. Go/No-Go Review

*Go/No-Go Decision Points - Project(s) selected under **TA-1** and **TA-3** of this FOA will have go/no-go decision points incorporated into the SOPO as appropriate to ensure that projects meet certain criteria prior to proceeding beyond the go/no go point. **CBP work will be considered as part of Go/No-Go decisions** (see **Appendices E and F**).*

Each project selected under this FOA will be subject to a periodic project evaluation referred to as a Go/No-Go Review. At the Go/No-Go decision points, DOE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, and overall contribution to the DOE program goals and objectives. Federal funding beyond the Go/No-Go decision point (continuation funding) is contingent upon (1) availability of federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 of the award; (4) recipient's submittal of required reports; (5) recipient's compliance with the terms and conditions of the award; (6) DOE's Go/No-Go decision; (7) the recipient's submission of a continuation application; and (8) written approval of the continuation application by the Contracting Officer.

As a result of the Go/No-Go Review, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the project because of insufficient progress, change in strategic direction, or lack of funding.

The Go/No-Go decision is distinct from a non-compliance determination. In the event a recipient fails to comply with the requirements of an award, DOE may

take appropriate action, including but not limited to, redirecting, suspending or terminating the award.

xvi. Conference Spending

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States government would otherwise exceed $20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

xvii. Uniform Commercial Code (UCC) Financing Statements

Per 2 CFR 910.360 (Real Property and Equipment) when a piece of equipment is purchased by a for-profit recipient or subrecipient with federal funds, and when the federal share of the financial assistance agreement is more than $1,000,000, the recipient or subrecipient must:

Properly record, and consent to the Department's ability to properly record if the recipient fails to do so, UCC financing statement(s) for all equipment in excess of $5,000 purchased with project funds. These financing statement(s) must be approved in writing by the Contracting Officer prior to the recording, and they shall provide notice that the recipient's title to all equipment (not real property) purchased with federal funds under the financial assistance agreement is conditional pursuant to the terms of this section, and that the government retains an undivided reversionary interest in the equipment. The UCC financing statement(s) must be filed before the Contracting Officer may reimburse the recipient for the federal share of the equipment unless otherwise provided for in the relevant financial assistance agreement. The recipient shall further make any amendments to the financing statements or additional recordings, including appropriate continuation statements, as necessary or as the Contracting Officer may direct.

xviii. Implementation of Executive Order 13798, Promoting Free Speech and Religious Liberty

States, local governments, or other public entities may not condition sub-awards in a manner that would discriminate, or disadvantage sub-recipients based on their religious character.

xix. Participants and Collaborating Organizations

If selected for award negotiations, the selected applicant must submit a list of personnel who are proposed to work on the project, both at the recipient and subrecipient level and a list of collaborating organizations within 30 days after the applicant is notified of the selection. Recipients will have an ongoing responsibility to notify DOE of changes to the personnel and collaborating organizations, and submit updated information during the life of the award.

xx. Current and Pending Support

If selected for award negotiations, within 30 days of the selection notice, the selectee must submit 1) current and pending support disclosures and resumes for any new PIs or senior/key personnel, and 2) updated disclosures if there have been any changes to the current and pending support submitted with the application. Throughout the life of the award, the recipient has an ongoing responsibility to submit 1) current and pending support disclosure statements and resumes for any new PI and senior/key personnel, and 2) updated disclosures if there are changes to the current and pending support previously submitted to DOE. Also See Section IV.D.xxxiv.

xxi. U.S. Manufacturing Commitments

A primary objective of DOE's multi-billion-dollar research, development, and demonstration investments is to cultivate new research and development ecosystems, manufacturing capabilities, and supply chains for and by U.S. industry and labor. Therefore, in exchange for receiving taxpayer dollars to support an applicant's project, the applicant must agree to a U.S. Competitiveness provision requiring that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States unless the Recipient can show to the satisfaction of DOE that it is not commercially feasible. Award terms, including the specific U.S. Competitiveness Provision applicable to the various types of Recipients and projects, are available at https://www.energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

Please note that a subject invention is any invention conceived or first actually reduced to practice in performance of work under an award. An invention is any invention or discovery which is or may be patentable. The recipient includes any awardee, recipient, sub-awardee, or sub-recipient.

As noted in the U.S. Competitiveness Provision, if an entity cannot meet the requirements of the U.S. Competitiveness Provision, the entity may request a modification or waiver of the U.S. Competitiveness Provision. For example, the entity may propose modifying the language of the U.S. Competitiveness

Provision in order to change the scope of the requirements or to provide more specifics on the application of the requirements for a particular technology. As another example, the entity may request that the U.S. Competitiveness Provision be waived in lieu of a net benefits statement or U.S. manufacturing plan. The statement or plan would contain specific and enforceable commitments that would be beneficial to the U.S. economy and competitiveness. Examples of such commitments could include manufacturing specific products in the U.S., making a specific investment in a new or existing U.S. manufacturing facility, keeping certain activities based in the U.S. or supporting a certain number of jobs in the U.S. related to the technology. DOE may, in its sole discretion, determine that the proposed modification or waiver promotes commercialization and provides substantial U.S. economic benefits, and grant the request. If granted, DOE will modify the award terms and conditions for the requesting entity accordingly.

More information and guidance on the waiver and modification request process can be found in the DOE Financial Assistance Letter on this topic, available at https://www.energy.gov/management/pf-2022-09-fal-2022-01-implementation-doe-determination-exceptional-circumstances-under. Additional information on DOE's Commitment to Domestic Manufacturing for DOE-funded R&D is available at https://www.energy.gov/gc/us-manufacturing.

The U.S. Competitiveness Provision is implemented by DOE pursuant to a Determination of Exceptional Circumstances (DEC) under the Bayh-Dole Act and DOE Patent Waivers. See Section VIII.J. Title to Subject Inventions of this FOA for more information on the DEC and DOE Patent Waivers.

xxii. Interim Conflict of Interest Policy for Financial Assistance

The DOE interim Conflict of Interest Policy for Financial Assistance (COI Policy)[26] is applicable to all non-Federal entities applying for, or that receive, DOE funding by means of a financial assistance award (e.g., a grant, cooperative agreement, or technology investment agreement) and, through the implementation of this policy by the entity, to each Investigator who is planning to participate in, or is participating in, the project funded wholly or in part under the DOE financial assistance award. The term "Investigator" means the PI and any other person, regardless of title or position, who is responsible for the purpose, design, conduct, or reporting of a project funded by DOE or proposed for funding by DOE. Recipients must flow down the requirements of the interim COI Policy to any subrecipient non-Federal entities. Further, for DOE funded projects, the recipient must include all financial conflicts of interest (FCOI) (i.e., managed and unmanaged/ unmanageable) in their initial and ongoing FCOI reports.

[26] DOE's interim COI Policy can be found at PF 2022-17 FAL 2022-02 Department of Energy Interim Conflict of Interest Policy Requirements for Financial Assistance.

It is understood that non-Federal entities and individuals receiving DOE financial assistance awards will need sufficient time to come into full compliance with DOE's interim COI Policy. To provide some flexibility, DOE allows for a staggered implementation. **Specifically, prior to award, applicants selected for award negotiations must: ensure all Investigators complete their significant financial disclosures; review the disclosures; determine whether a FCOI exists; develop and implement a management plan for FCOIs; and provide DOE with an initial FCOI report that includes all FCOIs (i.e., managed and unmanaged/ unmanageable).** Recipients will have 180 days from the date of the award to come into full compliance with the other requirements set forth in DOE's interim COI Policy. **Prior to award, the applicant must certify that it is, or will be within 180 days of the award, compliant with all requirements in the COI Policy.**

xxiii. Fraud, Waste and Abuse

The mission of the DOE Office of Inspector General (OIG) is to strengthen the integrity, economy and efficiency of the Department's programs and operations including deterring and detecting fraud, waste, abuse and mismanagement. The OIG accomplishes this mission primarily through investigations, audits, and inspections of DOE activities to include grants, cooperative agreements, loans, and contracts.

The OIG maintains a Hotline for reporting allegations of fraud, waste, abuse, or mismanagement. To report such allegations, please visit https://www.energy.gov/ig/ig-hotline.

Additionally, recipients of DOE awards must be cognizant of the requirements of 2 CFR § 200.113 Mandatory disclosures:

> The non-Federal entity or applicant for a Federal award must disclose, in a timely manner, in writing to the Federal awarding agency or pass-through entity all violations of Federal criminal law involving fraud, bribery, or gratuity violations potentially affecting the Federal award. Non-Federal entities that have received a Federal award including the term and condition outlined in appendix XII of 2 CFR Part 200 are required to report certain civil, criminal, or administrative proceedings to SAM (currently FAPIIS). Failure to make required disclosures can result in any of the remedies described in § 200.339. (See also 2 CFR part 180, 31 U.S.C. § 3321, and 41 U.S.C. § 2313.) [85 FR 49539, Aug. 13, 2020]

Applicants and subrecipients (if applicable) are encouraged to allocate sufficient costs in the project budget to cover the costs associated for personnel and data infrastructure needs to support performance management and program evaluation needs including but not limited to

independent program and project audits to mitigate risks for fraud, waste, and abuse.

xxiv. Cybersecurity Plan

In accordance with BIL section 40126, applicants selected for award negotiations must submit an acceptable cybersecurity plan to DOE prior to receiving funding.[27] These plans are intended to foster a cybersecurity-by-design approach for BIL efforts. The Department will also use these plans to ensure effective integration and coordination across its research, development, and demonstration programs. A cybersecurity plan is NOT required as part of the application submission for this FOA, but all projects selected under this FOA will be required to submit a cybersecurity plan during the award negotiation phase.

The Department recommends using open guidance and standards such as the National Institute of Standards and Technology's (NIST) Cybersecurity Framework (CSF) and the DOE Cybersecurity Capability Maturity Model (C2M2).[28] The cybersecurity plan created pursuant to BIL section 40126 should document any deviation from open standards, as well as the utilization of proprietary standards where the awardee determines that such deviation is necessary.

- Cybersecurity plans should be commensurate to the threats and vulnerabilities associated with the proposed efforts and demonstrate the cybersecurity maturity of the project.
- Cybersecurity plans may cover a range of topics relevant to the proposed project, e.g., software development lifecycle, third-party risks, and incident reporting.
- At a minimum, cybersecurity plans should address questions noted in BIL section 40126 (b) 'Contents of Cybersecurity Plan'.[29]

[27] 42 U.S.C. § 18725

[28] NERC critical infrastructure protection (CIP) standards for entities responsible for the availability and reliability of the bulk electric system. NIST IR 7628: 2 Smart grid cyber security strategy and requirements. NIST SP800-53, Recommended Security Controls for Federal Information Systems and Organizations: Catalog of security controls in 18 categories, along with profiles for low-, moderate-, and high-impact systems. NIST SP800-82, Guide to Industrial Control Systems (ICS) Security. NIST SP800-39, Integrated Enterprise-Wide Risk Management: Organization, mission, and information system view. AMI System Security Requirements: Security requirements for advanced metering infrastructure. ISO (International Organization for Standardization) 27001, Information Security Management Systems: Guidance on establishing governance and control over security activities (this document must be purchased). IEEE (Institute of Electrical and Electronics Engineers) 1686-2007, Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities (this document must be purchased). DOE Cybersecurity Capability Maturity Model (C2M2).

[29] 42 U.S.C. § 18725

A draft version of supplementary guidance on the cybersecurity plan requirement will be available at https://www.energy.gov/ceser/bipartisan-infrastructure-law-implementation.

xxv. Indemnity

Awards resulting from this FOA will contain the following provision reminding Recipients of DOE's rights of indemnification.

The Recipient shall indemnify the Government and its officers, agents, or employees for any and all liability, including litigation expenses and attorneys' fees, arising from suits, actions, or claims of any character for death, bodily injury, or loss of or damage to property or to the environment, resulting from the project, except to the extent that such liability results from the direct fault or negligence of Government officers, agents or employees, or to the extent such liability may be covered by applicable allowable costs provisions.

xxvi. Human Subjects Research

Research involving human subjects, biospecimens, or identifiable private information conducted with DOE funding is subject to the requirements of DOE Order 443.1C, Protection of Human Research Subjects, 45 CFR Part 46, Protection of Human Subjects (subpart A which is referred to as the "Common Rule"), and 10 CFR Part 745, Protection of Human Subjects. Additional information on the DOE Human Subjects Research Program can be found at: HUMAN SUBJECTS Human Subjects Pr... | U.S. DOE Office of Science (SC) (osti.gov).

xxvii. Energy Data eXchange (EDX) Requirements

The DOE is required to improve access to federally funded research results, proper archiving of digital data, and expanded discovery and reuse of research datasets per DOE and Executive Orders. The Energy Data eXchange (EDX) is a data laboratory developed and maintained by NETL to find, connect, curate, use, and re-use data to advance fossil energy and environmental research and development (R&D).

Data products generated under the resulting award will be required to be submitted in the EDX at https://edx.netl.doe.gov/. Data products include but are not limited to software code, tools, applications, webpages, portfolios, images, videos, and datasets.

EDX uses federation and web services to elevate visibility for publicly approved assets in the system, including connections with DOE's Office of Scientific and Technical Information (OSTI) systems, Data.gov, and Re3Data. This ensures

compliance with federal requirements, while raising visibility for researcher's published data products to promote discoverability and reuse.

EDX supports a wide variety of file types and formats including: 1) data, 2) metadata, 3) software/tools, and 4) articles (provided that there is an accompanying Government use license). A partial list of file formats accepted by EDX is provided below, however, EDX is designed for flexibility and accepts all types of file formats.

- Common Data Product Submission Formats: ASC, AmiraMesh, AVI, CAD, CSV, DAT, DBF, DOC, DSV, DWG, GIF, HDF, HTML, JPEG2000, JPG, MOV, MPEG4, MSH/CAS/DAT, NetCDF, PDF, PNG, PostScript, PPT, RTF, Surface, TAB, TIFF, TIFF Stacks, TXT, XLS, XML, ,Xradio, ZIP, and others.
- Geographic Formats: APR, DBF, DEM, DLG, DRG, DXF, E00, ECW, GDB, GeoPDF, GeoTIFF, GML, GPX, GRID, IMG, KML, KMZ, MDB, MrSID, SHP, and others.

Information provided to EDX will be made publicly available, unless authorized under the resulting award. Additional information on EDX is available at https://edx.netl.doe.gov/about.

When data products are submitted to EDX, the data product will need to be registered with a digital object identifier (DOI) through OSTI to ensure more visibility in other search repositories (i.e., osti.gov, data.gov, Google Scholar, etc.). The OSTI DOI can be established through an application programming interface (API) by completing just a few additional fields.

The Recipient or subrecipient should coordinate with the Project Manager on an annual basis to assess if there is data that should be submitted to EDX and identify the proper file formats prior to submission. All final data products shall be submitted to EDX by the Recipient prior to the completion of the project.

C. Program Down-Select

In addition to the Go/No-Go Reviews required for each TA-1 project, DOE intends to conduct a competitive project review (down-selection process) upon the end of Phase 2 for TA-3. Recipients will present their projects to DOE individually (not to other recipients). Subject matter experts from academia, national laboratories, industry, and non-governmental organizations (including community-based organizations) may be used as reviewers, subject to conflict of interest and non-disclosure considerations.

Note that only Recipients that have successfully completed all Phase 2 (TA-3) activities and requirements (**Appendix C**) will be afforded the opportunity to

submit a renewal application for subsequent Phases for consideration under the competitive, down-selection process outlined in this FOA. The comprehensive list of Phase 3-4 application requirements, including Merit Review Criteria that will be used to evaluate the Phase 3-4 application, will be contained in Phase 2 awards.

Upon completion of the competitive project review (down-selection process), DOE will select which projects, if any, will receive federal funding beyond Phase 2 (TA-3).

The down-selection process will include consideration of Community Benefits Plan implementation.

VII. Questions/Agency Contacts

Upon the issuance of a FOA, DOE personnel are prohibited from communicating (in writing or otherwise) with applicants regarding the FOA except through the established question and answer process as described below. **Specifically, questions regarding the content of this FOA must be submitted through the FedConnect portal.** You must register with FedConnect to respond as an interested party to submit questions, and to view responses to questions. It is recommended that you register as soon after release of the FOA as possible to have the benefit of all responses. Applicants are encouraged to review previously issued Questions and Answers prior to the submission of questions.

Questions must be submitted not later than 3 business days prior to the application due date. Please note, feedback on individual concepts will not be provided through Q&A.

NOTE: Please be as clear and concise when asking a question under the FOA and be as specific as possible to which TA you are asking the question. Otherwise, DOE will be required to ask for additional information and clarity on the question to provide an accurate response which will take additional time.

All questions and answers related to this FOA will be posted on the FedConnect portal at: https://www.FedConnect.net. DOE will attempt to respond to a question within 3 business days, unless a similar question and answer has already been posted on the website.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. DOE/NNSA cannot answer these questions.

VIII. Other Information

A. FOA Modifications

Amendments to this FOA will be posted on the Grants.gov system and the FedConnect portal. However, you will only receive an email when an amendment or a FOA is posted on these sites by registering with FedConnect as an interested party for this FOA. DOE recommends that you register as soon after the release of the FOA as possible to ensure you receive timely notice of any amendments or other FOAs.

B. Government Right to Reject or Negotiate

DOE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. Commitment of Public Funds

The Contracting Officer is the only individual who can make awards or commit the government to the expenditure of public funds. A commitment by anyone other than the Contracting Officer, either express or implied, is invalid.

D. Treatment of Application Information

Applicants should not include business sensitive (e.g., commercial or financial information that is privileged or confidential), trade secrets, proprietary, or otherwise confidential information in their application unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in the FOA. Applicants are advised to not include any critically sensitive proprietary detail.

If an application includes business sensitive, trade secrets, proprietary, or otherwise confidential information, it is furnished to the federal Government (government) in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for merit review of the application 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.
If an applicant chooses to submit business sensitive, trade secrets, proprietary, or otherwise confidential information, the applicant must provide **two copies** of the submission (e.g, Concept Paper, Full Application). The first copy should be

marked, “non-confidential” with the information believed to be confidential deleted. The second copy should be marked “confidential” and must clearly and conspicuously identify the business sensitive, trade secrets, proprietary, or otherwise confidential information and 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 government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose as authorized by law.

The cover sheet of the Full Application, and other applicant submission must be marked as follows and identify the specific pages business sensitive, trade secrets, proprietary, or otherwise confidential information::

> **Notice of Restriction on Disclosure and Use of Data:**
> Pages [list applicable pages] of this document may contain business sensitive, trade secrets, proprietary, or otherwise confidential information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance 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]

In addition, (1) the header and footer of every page that contains business sensitive, trade secrets, proprietary, or otherwise confidential information must be marked as follows: “Contains Business Sensitive, Trade Secrets, Proprietary, or Otherwise Confidential Information Exempt from Public Disclosure,” And (2) every line or paragraph containing such information must be clearly marked with double brackets or highlighting. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

E. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, the Go/No-Go Reviews and Peer Reviews, the government may seek the advice of qualified non-federal personnel as reviewers. The government may also use non-federal personnel to conduct routine, nondiscretionary administrative activities, including DOE contractors. The applicant, by submitting its application, consents to the use of non-federal reviewers/administrators. Non-federal reviewers must sign conflict of interest (COI) and non-disclosure acknowledgements (NDA) prior to reviewing an application. Non-federal personnel conducting administrative activities must sign an NDA.

F. Notice Regarding Eligible/Ineligible Activities

Eligible activities under this FOA include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

G. Notice of Right to Conduct a Review of Financial Capability

DOE reserves the right to conduct an independent third-party review of financial capability for applicants that are selected for negotiation of award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

H. Requirement for Full and Complete Disclosure

Applicants are required to make a full and complete disclosure of all information requested. Any failure to make a full and complete disclosure of the requested information may result in:

- The termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;
- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

I. Retention of Submissions

DOE expects to retain copies of all Full Applications and other submissions. No submissions will be returned. By applying to DOE for funding, applicants consent to DOE's retention of their submissions.

J. Title to Subject Inventions

Ownership of subject inventions is governed pursuant to the authorities listed below:

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions;
- All other parties: The federal Non-Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the government obtains title to new inventions unless a waiver is granted (see below);
- Class Patent Waiver:

DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States.

K. Government Rights in Subject Inventions

Where prime recipients and subrecipients retain title to subject inventions, the U.S. government retains certain rights.

i. Government Use License

The U.S. government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world. This license extends to contractors doing work on behalf of the government.

ii. March-In Rights

The U.S. government retains march-in rights with respect to all subject inventions. Through "march-in rights," the government may require a prime recipient or subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention to a third party. In addition, the government may grant licenses for use of the subject invention when a prime recipient, subrecipient, or their assignees and exclusive licensees refuse to do so.

DOE may exercise its march-in rights only if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by federal statutes in a reasonably satisfied manner; or
- The U.S. manufacturing requirement has not been met.

Any determination that march-in rights are warranted must follow a fact-finding process in which the recipient has certain rights to present evidence and witnesses, confront witnesses and appear with counsel and appeal any adverse decision. To date, DOE has never exercised its march-in rights to any subject inventions.

L. Rights in Technical Data

Data rights differ based on whether data is first produced under an award or instead was developed at private expense outside the award.

"Limited Rights Data": The U.S. government will not normally require delivery of confidential or trade secret-type technical data developed solely at private expense prior to issuance of an award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.

Government Rights in Technical Data Produced Under Awards: The U.S. government normally retains unlimited rights in technical data produced under government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of data generated under DOE awards may be protected from public disclosure for up to five years after the data is generated ("Protected Data"). For awards permitting Protected Data, the protected data must be marked as set forth in the award's intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

For this FOA, an extended period of data protection (more than five years and not to exceed thirty years) may be authorized if reasonably required for commercialization. Such extended protection period will apply to certain categories of data first produced under the resulting awards in accordance with 15 U.S.C. § 3710a(c)(7)(B)(ii) and the Energy Policy Acts of 1992 and 2004. Information describing the process for requesting the extended period of protection will be provided during the negotiation process.

M. Copyright

The prime recipient and subrecipients may assert copyright in copyrightable works, such as software, first produced under the award without DOE approval. When copyright is asserted, the government retains a paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works, distribute copies to the public, and to perform publicly and display publicly the copyrighted work. This license extends to contractors and others doing work on behalf of the government.

N. Export Control

The U.S. government regulates the transfer of information, commodities, technology, and software considered to be strategically important to the U.S. to

protect national security, foreign policy, and economic interests without imposing undue regulatory burdens on legitimate international trade. There is a network of federal agencies and regulations that govern exports that are collectively referred to as “Export Controls”. All recipients and subrecipients are responsible for ensuring compliance with Export Control Laws and regulations relating to any work performed under a resulting award.

The Recipient must immediately report to DOE any export control violations related to the project funded under the DOE award, at the recipient or subrecipient level, and provide the corrective action(s) to prevent future violations.

O. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment

As set forth in 2 CFR 200.216, recipients and subrecipients are prohibited from obligating or expending project funds (federal funds and recipient cost share) to procure or obtain; extend or renew a contract to procure or obtain; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in section 889 of Public Law 115-232, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

See Public Law 115-232, section 889, 2 CFR 200.216, and 2 CFR 200.471 for additional information.

P. Personally Identifiable Information (PII)

All information provided by the applicant must to the greatest extent possible exclude PII. The term “PII” refers to information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, alone, or when combined with other personal or identifying information which is linked or linkable to a specific individual, such as date and place of birth, mother’s maiden name.

By way of example, applicants must screen resumes to ensure that they do not contain PII such as personal addresses, personal landline/cell phone numbers, and personal emails. **Under no circumstances should Social Security Numbers (SSNs) be included in the application**. Federal agencies are prohibited from the collecting, using, and displaying unnecessary SSNs. (See, the Federal Information Security Modernization Act of 2014 (Pub. L. No. 113-283, Dec 18, 2014; 44 U.S.C. § 3551).

Q. Annual Independent Audits

If a for-profit entity is a prime recipient and has expended $750,000 or more of DOE awards during the entity's fiscal year, an annual compliance audit performed by an independent auditor is required. For additional information, please refer to 2 CFR 910.501 and Subpart F.

If an educational institution, non-profit organization, or state/local government is a prime recipient or subrecipient and has expended $750,000 or more of federal awards during the non-federal entity's fiscal year, then a Single or Program-Specific Audit is required. For additional information, please refer to 2 CFR 200.501 and Subpart F.

Applicants and subrecipients (if applicable) should propose sufficient costs in the project budget to cover the costs associated with the audit. DOE will share in the cost of the audit at its applicable cost share ratio.

R. Real Property and Equipment

Real property and equipment purchased with project funds (federal share and recipient cost share) are subject to the requirements at 2 CFR 200.310, 200.311, and 200.316 (non-Federal entities, except for-profit entities) and 2 CFR 910.360 (for-profit entities). For projects selected for award under this FOA, the recipient may (1) take disposition action on the real property and equipment; or (2) continue to use the real property and equipment after the conclusion of the award period of performance, with Contracting Officer approval.

The recipient's written Request for Continued Use must identify the property and include: a summary of how the property will be used (must align with the authorized project purposes); a proposed use period, (e.g., perpetuity, until fully depreciated, or a calendar date where the recipient expects to submit disposition instructions); acknowledgement that the recipient shall not sell or encumber the property or permit any encumbrance without prior written DOE approval; current fair market value of the property; and an Estimated Useful Life or depreciation schedule for equipment.

When the property is no longer needed for authorized project purposes, the recipient must request disposition instructions from DOE. For-profit entity disposition requirements are set forth at 2 CFR 910.360. Property disposition requirements for other non-federal entities are set forth in 2 CFR 310-200.316.

APPENDIX A – TA-1 (FEASIBILITY) PHASE 0 APPLICATION REQUIREMENTS, ACTIVITIES, AND DELIVERABLES

TA-1 Applications should describe the overall long-term vision and strategy for the DAC Hub, detailed plans for Phase 0 activities, and higher-level plans for Phase 1 through 4 activities along with planned partnerships and financing strategies/commitments. Applicants should describe the rationale for the preliminary DAC Hub site locations, system designs, market potential (if applicable), and commercial viability. DOE understands that some Applicants will be unable to initially provide a complete, detailed plan for all activities beyond Phase 0 and that certain partnering agreements and financing details will emerge during the early phases. The following sections contain thorough details of application requirements, activities and deliverables.

TA-1 Applicants are expected to include the following in their Phase 0 applications:

DAC Hub Summary. Applicants must describe the proposed DAC Hub owner and team, preliminary site location(s), CO_2 transport options, CO_2 storage sites, and CO_2 conversion technologies, if applicable. Applicants should include the key partners and/or leadership organizations for the proposed DAC Hub; however, DOE understands that Recipients may finalize some new partners or secure commitments during project execution. Applicants must discuss the DAC Hub ownership structure and current team commitments and cost share plan with Phase 0 cost share secured. Applicants must provide an initial conceptual design for the proposed DAC Hub balance of plant (BOP). Additionally, Applicants must discuss CO_2 storage site characterization and capacity, offtake options and/or CO_2 conversion technology integration.[30] Applicants are encouraged to familiarize themselves with the full CBP requirements under TA-2 and TA-3 prior to beginning the CBPDP.

DAC Technology Identification. Applicants must identify and describe potential DAC technology(ies) that may be deployed in the proposed DAC Hub**.** Applicants must provide the current DAC technology state of development and scale.

CO_2 Conversion Technology Identification (if applicable). Applicants must identify and describe potential CO_2 conversion technology(ies) that may be deployed in the proposed DAC Hub**.** Applicants must provide the current CO_2 conversion technology state of development and scale.

TA-1 (Phase 0a) Activities and Deliverables:

[30] If the Applicant has already conducted or is currently conducting activities meeting the Phase 0 requirements under a different DOE award (i.e., DE-FOA-0001999) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed under this FOA. If you have a current application into DOE (DE-FOA-0002711 or DE-FOA-0002730), but DOE has not made selections yet, duplicate scope is appropriate in this FOA.

At a minimum, at the end of Budget Period 1 (Phase 0a), TA-1 Recipients should have completed or accomplished the following:

DAC Hub Description. Recipients must describe the selected DAC Hub owner and team, site location, CO_2 transport routes, CO_2 storage sites, and CO_2 conversion technologies (if applicable) for the pre-FEED study to be completed in Phase 0b. Recipients must indicate the geographic region of the United States, including any specific cities, metropolitan areas, states, and/or groups of states, including economically distressed communities (if applicable), that may be involved in the DAC Hub. The site location should include a discussion of the carbon intensity of the local industry, fossil energy production history (if applicable), availability of renewable and low carbon energy production, land and water resources, existing infrastructure, CO_2 storage and/or conversion potential, and include information on economically distressed communities impacted (if applicable). Recipients must discuss the current status of the CO_2 storage site(s), including development, characterization, and permitting activities conducted to date (see **Appendix U**) for a secure CO_2 storage site with sufficient capacity for a minimum 12 years of DAC Hub operation. Recipients must discuss the current status of, and plans for submitting, the UIC Class VI permit to construct application (see **Appendix N**). Recipients must provide an initial design for the DAC Hub BOP, including utilities (e.g., sources for electricity, steam, water), CO_2 transport, for the DAC Hub capacity build-out.

DAC Technology Selection. Recipients must select anchoring DAC technology(ies) (i.e., minimum capacity of at least 50,000 tonnes CO_2 captured from the atmosphere (50 KTA)) for the pre-FEED study to be completed in Phase 0b**.** Recipients must provide the current DAC technology readiness level (TRL) and scale. Recipients must discuss resource requirements (i.e., energy, land, water, etc.) and justify the energy source(s) for the selected DAC technology(ies). Recipients must complete the conceptual design for the initial DAC Hub capacity (minimum 50 KTA CO_2) integrated with required CO_2 storage and/or CO_2 conversion (if applicable).

CO_2 Conversion Technology Selection (if applicable). Recipients must select CO_2 conversion technology(ies) for the pre-FEED study to be completed in Phase 0b**.** Recipients must provide the current TRL and scale. Recipients must discuss the estimated quantity of CO_2 converted to valuable products, resource requirements (i.e., energy, land, water, etc.), and justify the energy source(s) for the selected CO_2 conversion technology(ies).

DAC Hub Data Tables. Recipients must provide data tables with preliminary estimates for the DAC Hub, and selected DAC and CO_2 conversion (if applicable) technologies. See **Appendix K** for guidance.

Technology Maturation Plan(s) (TMP). Recipients must prepare a TMP(s) (in the format provided in an **Appendix V**) that describes the current TRL of the selected technology/technologies, relates the proposed project work to maturation of the proposed technology, describes the expected TRL at the end of the project, and describes any known post-project research and development necessary to further mature the technology. If applicable, additional TMP(s) will be required as new technologies are added to support DAC Hub capacity build-out.

Preliminary Life Cycle Analysis (LCA). Recipients must submit a Preliminary LCA in the format provided **Appendix D** to convey a high-level description of life cycle considerations for the initial DAC Hub capacity (i.e., minimum 50 KTA CO_2). If quantitative data are not available, the Recipient should provide a qualitative discussion and highlight any major uncertainties and missing information.

Safety, Security, and Regulatory Requirements. Recipients must deliver a description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history, Recipients should include a detailed description of their intended safety culture for the DAC Hub. Recipients must also discuss site and cybersecurity considerations for the DAC Hub.

Recipients must also complete a permitting workflow overview that identifies the relevant and applicable federal, state, and local codes, regulations, and permitting requirements anticipated to site, construct, implement, and operate the DAC Hub. As DAC Hubs will likely span multiple site locations, the overview should be organized by site location and should identify the Authority Having Jurisdiction (AHJ)s and relevant regulatory bodies that may have approval authority during the course of the project (e.g., U.S. Nuclear Regulatory Commission for DAC Hubs involving commercial nuclear power plants). DOE recognizes that the material in this overview document will likely change during the award and, as such, will require that it be revised and updated during project execution. DOE encourages DAC Hubs to conduct outreach to AHJs and submit any written confirmation from AHJs regarding the project, if received. Frequent communication with AHJs through the life of the project is encouraged as a means of mitigating permitting delays.

Community Benefits Plan Development Proposal. Recipients are required to develop a Community Benefits Plan Development Proposal (CBPDP). The CBPDP must set forth the applicant's proposal to generate a plan to ensure that Federal investments advance the following four goals: 1) community and labor engagement; 2) investing in the American workforce 3) advancing diversity, equity, inclusion, and accessibility (DEIA); and 4) contributing to the Justice40 Initiative. The requirements for the CBPDP are outlined in **Appendix E**. Recipients are encouraged to familiarize themselves with the full CBP requirements under TA-2 and TA-3 prior to beginning the CBPDP.

TA-1 (Phase 0b) Activities and Deliverables:

At a minimum, at the end of Budget Period 2 (Phase 0b), TA-1 Recipients should have completed or accomplished the following:

DAC Hub Concept. Recipients must describe the selected geographic region in the United States and discuss the carbon intensity of the local industry, fossil energy production history (if applicable), availability of renewable and low carbon energy production, land and water

resources, existing infrastructure, and CO_2 storage and/or conversion potential, and include information on economically distressed communities impacted (if applicable). Recipients must discuss the fit of the site(s) from a social and environmental justice standpoint (including social characterization of nearby communities, community support for the project, and workforce availability), with reference to the CBP, as appropriate. Recipients must define their DAC Hub concept, including selection and siting of DAC and CO_2 conversion (if applicable) technology(ies) with a discussion of ongoing NEPA and permitting activities. Recipients must discuss plans for the development of a DAC Hub with larger initial capacity, greater potential for expansion, and lower levelized cost per net tonne of CO_2e removed from the atmosphere.

DAC Technology Description(s). Recipients must provide a thorough description and data supporting the efficiency of the anchoring DAC technology(ies). Recipients must provide the current TRL and discuss plans for scale-up. Recipients must describe key parameters of the anchoring DAC technology(ies). The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., energy, land, water, etc.); (4) discussion of the absorption/desorption chemistry and operating cycle for solvent and sorbent systems (as applicable); and (5) description of relevant membrane chemistry, including transport mechanism (as applicable).

CO_2 Conversion Technology Description(s) (if applicable). Recipients must provide a thorough description and data supporting the efficiency of the anchoring CO_2 conversion technology(ies), including the estimated quantity of CO_2 converted to valuable products and results of the LCA of the proposed system done in accordance to the latest NETL CO2U LCA Guidance. Recipients must provide the current TRL and discuss plans for scale-up. The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., feedstocks, energy, land, water, etc.); and (4) discussion of the conversion chemistry and operating cycle (as applicable).

DAC Hub Data Tables. Recipients must provide data tables for the DAC Hub, and selected DAC and CO_2 conversion (if applicable) technologies. See **Appendix K** for guidance.

Technology Maturation Plan(s) (TMP). Recipients must prepare a TMP(s) (in the format provided in an **Appendix V**) that describes the current TRL of the selected technology/technologies and describes any known post-project research and development necessary to further mature the technology. If applicable, additional TMP(s) will be required as new technologies are added to support DAC Hub capacity build-out.

Preliminary Life Cycle Analysis (LCA). Recipients must submit preliminary LCAs for both (i) the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) and (ii) the final DAC Hub capacity in the format provided in **Appendix D**. If quantitative data are not available, the Recipient should provide a qualitative discussion and highlight any major uncertainties and missing information.

Integrated DAC System pre-FEED Study (i.e., Initial DAC Hub Capacity). Recipients must complete a pre-FEED study (i.e., Class 4 estimate with expected cost accuracy of +/- 30% and project definition maturity of at least 5%) for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required BOP sited in the selected DAC Hub and designed for a minimum capacity of 50 KTA CO_2. Recipients shall prepare the DAC pre-FEED Study in the format provided in **Appendix L**, with additional guidance provided in **Appendices U and W**, and submit it 90 days prior to project completion.

DAC Hub Balance-of-Plant (BOP) Conceptual Design (i.e., Final DAC Hub Capacity). Recipients must complete a DAC Hub BOP conceptual design, including utilities (e.g., sources for electricity, steam, water), and CO_2 transport for the final DAC Hub capacity. Recipients must submit the conceptual design 90 days prior to project completion. Recipients must quantitatively show the flow of energy, water, and CO_2 through the DAC Hub and are strongly encouraged to provide a process flow diagram illustrating the mass and energy balances of the mature DAC Hub concept.

Storage Field Development Plan Status (if applicable). Recipients must have identified and secured the CO_2 storage site(s) for the DAC Hub. Carbon storage facilities should have sufficient capacity to store carbon from the DAC Hub for at least *12 years* of operation. Recipients must discuss the status of the Storage Field Development Plan (see **Appendix U**) for the selected carbon storage site(s) supported by Authorization for Expenditures (AFEs), including development, characterization, and UIC Class VI permitting activities (see **Appendix N**) conducted to date. Recipients must discuss preliminary plans for CO_2 monitoring, reporting, and verification (MRV) during CO_2 injection and conversion (if applicable). Recipients must submit the status 90 days prior to project completion in the format provided in **Appendix U**.

Business Plan. Recipients must submit a Business Plan in the format provided **Appendix S** to convey a high-level description of pertinent information to understand the DAC Hub business plans.

Financial Plan. Recipients must submit a Financial Plan in the format provided **Appendix T** to convey a high-level description of the Recipient's financial capability to fund, or obtain funding, for the non-DOE share for the proposed DAC Hub.

Environmental Health and Safety (EH&S) Risk Analysis. Recipients must complete an EH&S analysis of the anchoring integrated DAC system in accordance with the format provided in **Appendix O**. EH&S analysis should include discussion regarding air and water emissions, water utilization, solid waste streams, noise, and potential environmental impacts of the technology including toxicological effects and hazards of emissions and waste streams.

Safety, Security, and Regulatory Requirements. Recipients must deliver a detailed description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history,

Recipients should include a detailed description of their intended safety culture for the DAC Hub. Recipients must also discuss site and cybersecurity considerations for the DAC Hub.

Recipients must also complete a permitting workflow overview that identifies the relevant and applicable federal, state, and local codes, regulations, and permitting requirements anticipated to site, construct, implement, and operate the DAC Hub. As DAC Hubs will likely span multiple site locations, the overview should be organized by site location and should identify the Authority Having Jurisdiction (AHJ) and relevant regulatory bodies that may have approval authority during the course of the project (e.g., U.S. Nuclear Regulatory Commission for DAC Hubs involving commercial nuclear power plants). DOE encourages DAC Hubs to conduct outreach to AHJs and submit any written confirmation from AHJs regarding the project, if received. Frequent communication with AHJs through the life of the project is encouraged as a means of mitigating permitting delays.

Community Benefits Plan. Recipients are required to implement the Community Benefits Plan Development Proposal (Phase 0a deliverable). A full CBP will be required as a deliverable at the end of Phase 0b (see Section I.B.iv. and **Appendix F**). Applicants to TA-1 are encouraged to familiarize themselves with the full CBP requirements under TA-2 and TA-3.

APPENDIX B – TA-2 (DETAILED PLAN AND FEED STUDIES) PHASE 1 APPLICATION REQUIREMENTS, ACTIVITIES, AND DELIVERABLES

TA-2 Applications should describe the overall long-term vision and strategy for the DAC Hub, detailed plans for Phase 1 activities, and higher-level plans for Phase 2 through 4 activities along with existing and planned partnerships and financing strategies/commitments. Applicants should thoroughly describe the rationale for the DAC Hub site locations, system designs, market potential (if applicable), and commercial viability. DOE understands that some Applicants will be unable to initially provide a complete, detailed plan for all activities beyond Phase 1 and that certain partnering agreements and financing details will emerge during the early phases. The following sections contain thorough details of application requirements, activities and deliverables.

TA-2 Applicants are expected to include the following in their Phase 1 applications:

DAC Hub Concept. Applicants must describe the selected geographic region in the United States and discuss the carbon intensity of the local industry, fossil energy production history (if applicable), availability of renewable and low carbon energy production, land and water resources, existing infrastructure, and CO_2 storage and/or conversion potential, and include information on economically distressed communities impacted (if applicable). Applicants must discuss the fit of the site(s) from a social and environmental justice standpoint (including social characterization of nearby communities, community support for the project, and workforce availability), with reference to the CBP, as appropriate. Applicants must define their DAC Hub concept, including selection and siting of DAC and CO_2 conversion (if applicable) technology(ies) with a discussion of ongoing NEPA and permitting activities. Applicants must discuss plans for the development of a DAC Hub with larger initial capacity, greater potential for expansion, and lower levelized cost per net tonne of CO_{2e} removed from the atmosphere.

DAC Technology Description(s). Applicants must provide a thorough description and data supporting the efficiency of the anchoring DAC technology(ies). Applicants must provide the current TRL and discuss plans for scale-up. Applicants must describe key parameters of the anchoring DAC technology(ies). The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., energy, land, water, etc.); (4) discussion of the absorption/desorption chemistry and operating cycle for solvent and sorbent systems (as applicable); and (5) description of relevant membrane chemistry, including transport mechanism (as applicable).

CO_2 Conversion Technology Description(s) (if applicable). Applicants must provide a thorough description and data supporting the efficiency of the anchoring CO_2 conversion technology(ies), including the estimated quantity of CO_2 converted to valuable products and results of the LCA of the proposed system done in accordance to the latest NETL CO2U LCA Guidance. Applicants must provide the current TRL and discuss plans for scale-up. The description of the technology should

include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., feedstocks, energy, land, water, etc.); and (4) discussion of the conversion chemistry and operating cycle (as applicable).

DAC Hub Data Tables. Applicants must provide data tables for the for the DAC Hub, and selected DAC and CO_2 conversion (if applicable) technologies. Applicants must prepare the data tables based on the experimental data obtained at the largest scale the technology has been validated. To apply to **TA-2**, the proposed DAC and CO_2 conversion (if applicable) anchoring technology(ies) must have achieved a minimum TRL 5, and must have been validated in an integrated, continuous, pilot-scale system at a minimum scale of 1 TPY CO_2. Applicants must submit the data tables in a separate document to the Technical Volume. **Note: The DAC Hub Data Tables are required to be completed in accordance with Appendix K and submitted with your application. Applicants that do not submit the required DAC Hub Data Tables or submit incomplete table(s) will be considered non-compliant and DOE will not review or consider noncompliant submissions. See Section III.**

Preliminary Life Cycle Analysis (LCA). Applicants must submit preliminary LCAs for both (i) the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) and (ii) the proposed final DAC Hub capacity in the format provided in **Appendix D** to demonstrate robust accounting of full lifecycle emissions, as a separate document to the Technical Volume. If quantitative data are not available, the Recipient should provide a qualitative discussion and highlight any major uncertainties and missing information.

Integrated DAC System pre-FEED Study (i.e., Initial DAC Hub Capacity). Applicants must submit a summary of the pre-FEED study (i.e., Class 4 estimate with expected cost accuracy of +/- 30% and project definition maturity of at least 5%) for the proposed anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required BOP sited in the selected DAC Hub and designed for a minimum capacity of 50 KTA CO_2. Applicants shall prepare the summary of the DAC pre-FEED study in the format provided in **Appendix L**, with additional guidance provided in **Appendices U and W,** in a separate fifteen (15) page document to the Technical Volume.

DAC Hub Balance-of-Plant (BOP) Conceptual Design (i.e., Final DAC Hub Capacity). Applicants must submit a summary of the DAC Hub BOP conceptual design, including utilities (e.g., sources for electricity, steam, water), and CO_2 transport for the proposed final DAC Hub Capacity. Applicants must quantitatively show the flow of energy, water, and CO_2 through the DAC Hub and are encouraged to provide a process flow diagram illustrating the mass and energy balances of the mature DAC Hub concept.

Storage Field Development Plan Status (if applicable).
Applicants must have secured the CO_2 storage site(s) for the DAC Hub. Carbon storage facilities should have sufficient capacity to store carbon from the DAC Hub build-out capacity for at least *12 years* of operation. Applicants must discuss the current status of the Storage Field Development Plan for the selected carbon storage site(s) supported by Authorization for

Expenditures (AFEs) (see **Appendix U)**, including development, characterization, and permitting activities conducted to date. Applicants must discuss the current status of, and plans for submitting, the UIC Class VI permit to construct application (see **Appendix N**). Applicants must discuss preliminary plans for CO_2 monitoring, reporting, and verification (MRV) during CO_2 injection and conversion (if applicable).[31] Alternatively, Applicants must discuss the status of the offtake agreement.

Environmental Health and Safety (EH&S) Risk Analysis. Applicants must complete an EH&S analysis of the anchoring integrated DAC system in accordance with the format provided in **Appendix O**, as a separate document to the Technical Volume. EH&S analysis should include discussion regarding air and water emissions, water utilization, solid waste streams, noise, and potential environmental impacts of the technology including toxicological effects and hazards of emissions and waste streams.

Safety, Security, and Regulatory Requirements. Applicants must deliver a detailed description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history, Applicants should include a detailed description of their intended safety culture for the DAC Hub. Applicants must also discuss site and cybersecurity considerations for the DAC Hub.

Applicants must also complete a permitting workflow overview that identifies the relevant and applicable federal, state, and local codes, regulations, and permitting requirements anticipated to site, construct, implement, and operate the DAC Hub. As DAC Hubs will likely span multiple site locations, the overview should be organized by site location and should identify the Authority Having Jurisdiction (AHJ) and relevant regulatory bodies that may have approval authority during the course of the project (e.g., U.S. Nuclear Regulatory Commission for DAC Hubs involving commercial nuclear power plants). DOE recognizes that the material in this overview document will likely change during the award and, as such, will require that it be revised and updated during project execution. DOE encourages DAC Hubs to conduct outreach to AHJs and submit any written confirmation from AHJs regarding the project, if received. Frequent communication with AHJs through the life of the project is encouraged as a means of mitigating permitting delays.

Business Plan. Applicants must submit a Business Plan in the format provided **Appendix S** to convey a high-level description of pertinent information to understand the DAC Hub business plans, as a separate document to the Technical Volume.

Financial Plan. Applicants must submit a Financial Plan in the format provided **Appendix T** to convey a high-level description of the Recipient's financial capability to fund, or obtain funding,

[31] If the Applicant has already conducted or is currently conducting activities meeting the Phase 1 requirements under a different DOE award (e.g., DE-FOA-0001999) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed under this FOA. If you have a current application into DOE (DE-FOA-0002711 or DE-FOA-0002730), but DOE has not made selections yet, duplicate scope is appropriate in this FOA.

for the non-DOE share for the proposed DAC Hub, as a separate document to the Technical Volume.

Community Benefits Plan. Applicants must submit a CBP as a separate document to the Technical Volume. Please note that the full requirements are in Section I.B.iv., and Applicants are encouraged to consult guidance documents provided as an attachment to this FOA for assistance with preparing each section of the Phase 1 CBP.

TA-2 (Phase 1) Activities and Deliverables:

At a minimum, at the end of Phase 1, TA-2 Recipients should have completed or accomplished the following:

Initial DAC Hub Capacity Defined. Recipients must define the initial DAC Hub capacity (minimum 50 KTA CO_2). Recipients must have selected the DAC Hub geographic region in the United States, and must have finalized the DAC Hub ownership structure and team commitments. Recipients must discuss plans for the development of a Regional DAC Hub with larger initial capacity, greater potential for expansion, and lower levelized cost per net tonne of CO_{2e} removed from the atmosphere. At a minimum, the DAC Hub description must include the following:

1. Availability of renewable and low carbon energy production, land and water resources, existing infrastructure,
2. CO_2 storage and/or conversion potential,
3. Carbon intensity of the local industry, fossil energy production history (if applicable),
4. Social characterization of nearby communities, community support for the project, and workforce availability, with reference to the CBP plans as appropriate, and
5. Team description and commitments.

DAC Technology Description(s). Recipients must provide a thorough description and data supporting the efficiency of the anchoring DAC technology(ies). Recipients must provide the current TRL and discuss plans for scale-up. Recipients must describe key parameters of the anchoring DAC technology(ies). The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., energy, land, water, etc.); (4) discussion of the absorption/desorption chemistry and operating cycle for solvent and sorbent systems (as applicable); and (5) description of relevant membrane chemistry, including transport mechanism (as applicable).

CO_2 Conversion Technology Description(s) (if applicable). Recipients must provide a thorough description and data supporting the efficiency of the anchoring CO_2 conversion technology(ies), including the estimated quantity of CO_2 converted to valuable products and results of the LCA of the proposed system done in accordance to the latest NETL CO2U LCA Guidance. Recipients must

provide the current TRL and discuss plans for scale-up. The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., feedstocks, energy, land, water, etc.); and (4) discussion of the conversion chemistry and operating cycle (as applicable).

DAC Hub Data Tables. Recipients must provide data tables for the DAC Hub, and selected DAC and CO_2 conversion (if applicable) technologies. Recipients must prepare the data tables (see **Appendix K** for guidance) based on the experimental data obtained at the largest scale the technology has been validated.

Technology Maturation Plan(s) (TMP). Recipients must prepare a TMP(s) in the format provided in an **Appendix V** that describes the current TRL of the selected technology/technologies and describes any known post-project research and development necessary to further mature the technology. To be considered ready for Phase 2, the DAC and CO_2 conversion (if applicable) anchoring technology(ies) must have achieved a minimum TRL 6, and must have been validated in an integrated, continuous, engineering-scale system test at a scale of (i) a minimum 1000 tonne of CO_2 per year (1 KPA), or (ii) the final commercial form factor. If applicable, additional TMP(s) will be required as new technologies are added to support DAC Hub capacity build-out.

Life Cycle Analysis (LCA). Recipients must submit LCAs for both (i) the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) consistent with the DAC FEED study and (ii) the proposed final DAC Hub capacity in the format provided in **Appendix D** to demonstrate robust accounting of full lifecycle emissions. Given the stage of the project, it is expected that there will be significant uncertainty in some portions of the LCA. These should be addressed through the evaluation of multiple scenarios and sensitivities analyses as provided in the technology-specific guidance in **Appendix D**.

Integrated DAC System FEED Study (i.e., Initial DAC Hub Capacity). Recipients must complete a FEED Study (i.e., Class 3 estimate with expected cost accuracy of +/- 15% and project definition maturity of 40%) for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required BOP sited in the selected DAC Hub and designed for a minimum capacity of 50 KTA CO_2. The FEED activities performed will include, but are not limited to, project scope and design, project design basis, engineering design package, transport infrastructure required to connect the capture, storage, and/or conversion site(s) selected for the DAC Hub, and the Class 3 project cost estimate. The results should provide: (i) mass and energy balances, (ii) estimates of heating and cooling duties and electric power requirements covering the DAC system and balance-of-plant through CO_2 transport and conversion (if applicable), (iii) the cost of the proposed DAC system, (iv) the cost of atmospheric CO_2 capture for a minimum capacity of 50 KTA CO_2, as well as (v) the cost of the carbon conversion product, if applicable. CO_2 pressure, CO_2 quality and quantity at the DAC plant "gate" should meet the requirements of the transport and secure geologic storage and/or conversion process. Recipients shall prepare the DAC FEED Study in the format provided in **Appendix M**, with additional guidance provided in **Appendix W**, and submit it *90 days prior to project completion*.

DAC Hub Balance-of-Plant (BOP) pre-FEED Study (i.e., Final DAC Hub Capacity). Recipients must complete a pre-FEED study for the DAC Hub BOP, including utilities (e.g., sources for electricity, steam, water) and CO_2 transport, for the final DAC Hub capacity and submit it 90 days prior to project completion. Recipients must prepare the DAC Hub BOP pre-FEED Study (i.e., Class 4 estimate with expected cost accuracy of +/- 30% and project definition maturity of at least 5%) in the format provided in **Appendix L**, with additional guidance provided in **Appendix W** for the Pipeline Concept Study. Recipients must quantitatively show the flow of energy, water, and CO_2 through the DAC Hub and must provide a detailed process flow diagram illustrating the mass and energy balances of the mature DAC Hub concept.

Storage Field Development Plan (if applicable). Recipients must complete the Storage Field Development Plan for the selected carbon storage site(s) supported by Authorization for Expenditures (AFEs). Carbon storage facilities should have sufficient capacity to store carbon from the DAC Hub capacity for at least *12 years* of operation. Recipients must submit the plan 90 days prior to project completion in the format provided in **Appendix U**. Alternatively, Recipients must discuss the status of the offtake agreement.

UIC Class VI Permit Application Materials or Offtake Agreement (if applicable). Recipients must submit documentation confirming submittal of Underground Injection Control (UIC) Class VI permit to construct (see **Appendix N**) for the selected CO_2 storage site to the appropriate regulatory agency. Alternatively, Recipients must discuss the status of the offtake agreement.

Environmental Health and Safety (EH&S) Risk Analysis. Recipients must submit an EH&S analysis of the proposed DAC technologies (i.e., to meet the initial DAC Hub capacity) sited in the proposed DAC Hub and integrated with required DAC Hub BOP installations in the format provided in **Appendix O**. EH&S analysis should include discussion regarding air and water emissions, water utilization, solid waste streams, noise, and potential environmental impacts of the technology including toxicological effects and hazards of emissions and waste streams. Recipients must include any recommendations from an initial Hazard and Operability (HAZOP) study performed for the anchoring integrated DAC system.

Safety, Security, and Regulatory Requirements. Recipients must deliver a detailed description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history, Recipients should include a detailed description of their intended safety culture for the DAC Hub. Recipients must also discuss site and cybersecurity considerations for the DAC Hub.

Recipients must also complete a permitting workflow overview that identifies the relevant and applicable federal, state, and local codes, regulations, and permitting requirements anticipated to site, construct, implement, and operate the DAC Hub. As DAC Hubs will likely span multiple site locations, the overview should be organized by site location and should identify the Authority Having Jurisdiction (AHJ)s and relevant regulatory bodies that may have approval authority during the course of the project (e.g., U.S. Nuclear Regulatory Commission for DAC Hubs involving

commercial nuclear power plants). DOE encourages DAC Hubs to conduct outreach to AHJs and submit any written confirmation from AHJs regarding the project, if received. Frequent communication with AHJs through the life of the project is encouraged as a means of mitigating permitting delays.

Business Plan. Recipients must submit a Business Plan in the format provided **Appendix S** to convey a description of pertinent information to understand the DAC Hub business plans for Phases 2-4.

Financial Plan. Recipients must submit a Financial Plan in the format provided **Appendix T** to convey a description of the Recipient's financial capability to fund, or obtain funding, for the non-DOE share for DAC Hub implementation in Phases 2-4.

National Environmental Policy Act (NEPA) Compliance. Recipients must discuss the current status of, and plans to complete, the NEPA compliance process, as described in **Appendix X.** Recipients must submit an Environmental Information Volume (EIV). EIV should include the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) sited in the DAC Hub and designed for a minimum unit capacity of 50 KTA CO_2, as well as the secure carbon storage (for at least 12 years of operation).

Community Benefits Plan. Recipients must implement the Phase 1 CBP during the performance period. Recipients must also update the CBP for Phases 2-4 based on Phase 1 activities at the end of the performance period. Please note that the full requirements are in Section I.B.iv., and Recipients are encouraged to consult guidance documents provided as an attachment to the FOA for assistance with preparing each section of the Phase 1 CBP.

APPENDIX C – TA-3 (BUILD) PHASE 2 APPLICATION REQUIREMENTS, ACTIVITIES, AND DELIVERABLES

For **TA-3 Phase 2** Applicants must meet the specific application requirements and clearly describe their current state of readiness for, and plans to complete, the proposed project. For the purpose of TA-3/Phase 2 activities, "site selection" refers to the site chosen for the purpose of the Detailed Design, permitting studies and other work within the proposed project; project siting decisions cannot be finalized prior to successful completion of National Environmental Policy Act (NEPA) reviews, as well as any other applicable processes such as satisfactory progress of CBP work.

TA-3 Applicants are expected to include the following in their Phase 2 applications:

Initial DAC Hub Capacity Defined. Applicants must define the initial DAC Hub capacity (minimum 50 KTA CO_2).[32] Applicants must have selected the DAC Hub geographic region in the United States, and finalized the DAC Hub ownership structure and team commitments. Applicants must discuss plans for the development of a Regional DAC Hub with larger initial capacity, greater potential for expansion, and lower levelized cost per net tonne of CO_2e removed from the atmosphere. At a minimum, the DAC Hub description must include the following:

1. Availability of renewable and low carbon energy production, land and water resources, existing infrastructure,
2. CO_2 storage and/or conversion potential,
3. Carbon intensity of the local industry, fossil energy production history (if applicable),
4. Social characterization of nearby communities, community support for the project, and workforce availability, with reference to the CBP plans as appropriate, and
5. Team description and commitments.

DAC Technology Description(s). Applicants must provide a thorough description and data supporting the efficiency of the anchoring DAC technology(ies). Applicants must provide the current TRL and discuss plans for scale-up. Applicants must describe key parameters of the anchoring DAC technology(ies). The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., energy, land, water, etc.); (4) discussion of the absorption/desorption chemistry and operating cycle for solvent and sorbent systems (as applicable); and (5) description of relevant membrane chemistry, including transport mechanism (as applicable).

[32] If the Applicant has already conducted or is currently conducting activities meeting the Phase 2 requirements under a different DOE award (e.g., DE-FOA-0001999) or at private expense, the status of such activities should be clearly described in the application, and only complementary (but not redundant) additional activities should be proposed under this FOA. If you have a current application into DOE (DE-FOA-0002711 or DE-FOA-0002730), but DOE has not made selections yet, duplicate scope is appropriate in this FOA.

CO_2 Conversion Technology Description(s) (if applicable). Applicants must provide a thorough description and data supporting the efficiency of the anchoring CO_2 conversion technology(ies), including the estimated quantity of CO_2 converted to valuable products and results of the LCA of the proposed system done in accordance to the latest NETL CO2U LCA Guidance. Applicants must provide the current TRL and discuss plans for scale-up. The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., feedstocks, energy, land, water, etc.); and (4) discussion of the conversion chemistry and operating cycle (as applicable).

DAC Hub Data Tables. Applicants must provide data tables for the DAC Hub, and selected DAC and CO_2 conversion (if applicable) technologies. Applicants must prepare the data tables based on the experimental data obtained at the largest scale the technology has been validated. To apply to **TA-3**, the DAC and CO_2 conversion (if applicable) anchoring technology(ies) must have achieved a minimum TRL 6, and must have been validated in an integrated, continuous, engineering-scale system test at a scale of (i) a minimum 1000 tonne of CO_2 per year (1 KPA), or (ii) the final commercial form factor. Applicants must submit the data tables in a separate document to the Technical Volume. **Note: The DAC Hub Data Tables are required to be completed in accordance with Appendix K and submitted with your application. Applicants that do not submit the required DAC Hub Data Tables or submit incomplete table(s) will be considered non-compliant and DOE will not review or consider noncompliant submissions. See Section III.**

Life Cycle Analysis (LCA). Applicants must submit LCAs for both (i) the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) consistent with the DAC FEED study and (ii) the final DAC Hub capacity in the format provided in **Appendix D** to demonstrate robust accounting of full lifecycle emissions. Given the stage of the project, it is expected that there will be significant uncertainty in some portions of the LCA. These should be addressed through the evaluation of multiple scenarios and sensitivities analyses as provided in the technology-specific guidance in **Appendix D**., Applicants must submit the LCAs as a separate document to the Technical Volume.

Summary of Integrated DAC System FEED Study (i.e., Initial DAC Hub Capacity). Applicants must provide a summary of the FEED Study (i.e., Class 3 estimate with expected cost accuracy of +/- 15% and project definition maturity of 40%) for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) sited in the DAC Hub and designed for a minimum capacity of 50 KTA CO_2. The FEED activities performed will include, but are not limited to, project scope and design, project design basis, engineering design package, transport infrastructure required to connect the capture, storage, and/or conversion site(s) selected for the DAC Hub, and the Class 3 project cost estimate. The results should provide: (i) mass and energy balances, (ii) estimates of heating and cooling duties and electric power requirements covering the DAC system and balance-of-plant through CO_2 transport and conversion (if applicable), (iii) the cost of the proposed DAC system, (iv) the cost of atmospheric CO_2 capture for a minimum capacity of 50 KTA CO_2, as well as (v) the cost of the carbon conversion product, if applicable. CO_2 pressure, CO_2 quality and quantity at the DAC plant "gate" should meet the requirements of the transport and secure geologic storage and/or conversion process. Applicants must prepare the summary of the

DAC system FEED study in the format provided in **Appendix M**, with additional guidance provided in **Appendix W** for the Pipeline FEED Study**,** in a separate twenty-five (25) page document to the Technical Volume.

Summary of DAC Hub Balance-of-Plant (BOP) pre-FEED (i.e., Final DAC Hub Capacity). Applicants must submit summary results of the pre-FEED study for the DAC Hub BOP, including utilities (e.g., sources for electricity, steam, water) and CO_2 transport for the final DAC Hub capacity. Applicants shall prepare the summary of the DAC Hub BOP pre-FEED study (i.e., Class 4 estimate with expected cost accuracy of +/- 30% and project definition maturity of at least 5%) in the format provided in **Appendix L**, with additional guidance provided in **Appendix W** for the Pipeline Concept Study. Applicants must quantitatively show the flow of energy, water, and CO_2 through the DAC Hub and are encouraged to provide a detailed process flow diagram illustrating the mass and energy balances of the mature DAC Hub concept.

Summary of Storage Field Development Plan (if applicable). Applicants must submit summary results of the Storage Field Development Plan (see **Appendix U**) for the selected carbon storage site(s) supported by Authorization for Expenditures (AFEs). Carbon storage facilities should have sufficient capacity to store carbon from the DAC Hub capacity for at least *12 years* of operation. Detailed site characterization of the selected carbon storage site is required to be completed prior to application to TA-3. Carbon storage facilities should have sufficient capacity to store carbon from the DAC Hub capacity for at least *12 years* of operation.

UIC Class VI Permit Application Materials or Offtake Agreement (if applicable). Applicants must submit documentation confirming submittal of Underground Injection Control (UIC) Class VI permit to construct (see **Appendix N**) for the selected CO_2 storage site to the appropriate regulatory agency. If the permit is not granted at the time of the application, the Applicant should discuss the timing when the permit is expected to be granted. Alternatively, Applicants must discuss the status of the offtake agreement.

Environmental Health and Safety (EH&S) Risk Analysis. Applicants must submit an EH&S analysis of the proposed DAC technologies (i.e., to meet the initial DAC Hub capacity) sited in the proposed DAC Hub and integrated with required DAC Hub BOP installations in the format provided in **Appendix O**. EH&S analysis should include discussion regarding air and water emissions, water utilization, solid waste streams, noise, and potential environmental impacts of the technology including toxicological effects and hazards of emissions and waste streams. Applicants must include any recommendations from an initial Hazard and Operability (HAZOP) study performed for the anchoring integrated DAC system.

Safety, Security, and Regulatory Requirements. Applicants must deliver a detailed description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history, Applicants should include a detailed description of their intended safety culture for the DAC Hub. Applicants must also discuss site and cybersecurity considerations for the DAC Hub.

Applicants must also complete a permitting workflow overview that identifies the relevant and applicable federal, state, and local codes, regulations, and permitting requirements anticipated to site, construct, implement, and operate the DAC Hub. As DAC Hubs will likely span multiple site locations, the overview should be organized by site location and should identify the Authority Having Jurisdiction (AHJ)s and relevant regulatory bodies that may have approval authority during the course of the project (e.g., U.S. Nuclear Regulatory Commission for DAC Hubs involving commercial nuclear power plants). DOE recognizes that the material in this overview document will likely change during the award and, as such, will require that it be revised and updated during project execution. DOE encourages DAC Hubs to conduct outreach to AHJs and submit any written confirmation from AHJs regarding the project, if received. Frequent communication with AHJs through the life of the project is encouraged as a means of mitigating permitting delays.

Business Plan. Applicants must submit a Business Plan in the format provided **Appendix S** to convey a description of pertinent information to understand the DAC Hub business plans for Phases 2-4.

Financial Plan. Applicants must submit a Financial Plan in the format provided **Appendix T** to convey a description of the Recipient's financial capability to fund, or obtain funding, for the non-DOE share for DAC Hub implementation in Phases 2-4.

National Environmental Policy Act (NEPA) Compliance. Applicants must discuss the current status of, and plans to complete, the NEPA compliance process, as described in **Appendix X.**

Community Benefits Plan. Applicants must submit a full CBP as a separate document to the Technical Volume. Please note that the full requirements are in Section I.B.iv., and Recipients are encouraged to consult guidance documents provided as an attachment to the FOA for assistance with preparing each section of the Phase 2 CBP.

TA-3 (Phase 2) Activities and Deliverables:

At a minimum, at the end of Phase 2, TA-3 Recipients should have completed or accomplished the following:

DAC Hub Description. Recipients must describe the Regional DAC Hub sited within the selected the DAC Hub geographic region in the United States, finalized the DAC Hub ownership structure, and secured team, offtake, and feedstock agreements and commitments (as applicable). Applicants must define their DAC Hub concept, including selection and siting of DAC and CO_2 conversion (if applicable) technology(ies). Recipients must discuss plans for the development of a Regional DAC Hub with larger initial capacity, greater potential for expansion, and lower levelized cost per net tonne of CO_2e removed from the atmosphere. Recipients must have secured the right-of-way for CO_2 transport route(s) connecting atmospheric CO_2 capture, storage,

and conversion (if applicable) sites. Applicants must demonstrate that access to the atmospheric CO_2 capture, transport, storage, and/or conversion site(s) has been secured. Applicants must discuss preliminary plans for CO_2 monitoring, reporting, and verification (MRV) during CO_2 injection and conversion (if applicable). At a minimum, the DAC Hub description must include the following:

1. Availability of renewables and low carbon energy production, land and water resources, existing infrastructure,
2. CO_2 storage and/or conversion potential,
3. Carbon intensity of the local industry, fossil energy production history (if applicable),
4. Social characterization of nearby communities, community support for the project, and workforce availability, with reference to the CBP plans as appropriate, and
5. Team description and commitments.

DAC Technology Description(s). Recipients must provide a thorough description and data supporting the efficiency of the anchoring DAC technology(ies). Recipients must provide the current TRL and discuss plans for scale-up. Recipients must describe key parameters of the anchoring DAC technology(ies). The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., energy, land, water, etc.); (4) discussion of the absorption/desorption chemistry and operating cycle for solvent and sorbent systems (as applicable); and (5) description of relevant membrane chemistry, including transport mechanism (as applicable).

CO_2 Conversion Technology Description(s) (if applicable). Recipients must provide a thorough description and data supporting the efficiency of the anchoring CO_2 conversion technology(ies), including the estimated quantity of CO_2 converted to valuable products and results of the LCA of the proposed system done in accordance to the latest NETL CO2U LCA Guidance. Recipients must provide the current TRL and discuss plans for scale-up. The description of the technology should include, but is not limited to, the following: (1) overall process flow diagrams; (2) mass and energy balances; (3) resource requirements (i.e., feedstocks, energy, land, water, etc.); and (4) discussion of the conversion chemistry and operating cycle (as applicable).

DAC Hub Data Tables. Recipients must provide data tables for the DAC Hub, and selected DAC and CO_2 conversion (if applicable) technologies. Recipients must prepare the data tables (see **Appendix K** for guidance) based on the experimental data obtained at the largest scale the technology has been validated.

Technology Maturation Plan(s) (TMP). Recipients must prepare a TMP(s) (in the format provided in an **Appendix V**) that describes the current TRL of the selected technology/technologies and describes any known post-project research and development necessary to further mature the technology. To be considered ready for Phase 3, the DAC and CO_2 conversion (if applicable) anchoring technology(ies) must have achieved a minimum TRL 7, and must have been validated in an integrated, continuous, pilot-scale system at a maximum ten (10) times scaling factor to the

initial DAC Hub capacity. If applicable, additional TMP(s) will be required as new technologies are added to support DAC Hub capacity build-out.

Refined Life Cycle Analysis (LCA). Recipients must submit LCAs for both (i) the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) consistent with the DAC Detailed Design and (ii) the final DAC Hub capacity in the format provided in **Appendix D** to demonstrate robust accounting of full lifecycle emissions. Given the stage of the project, it is expected that there will be significant uncertainty in some portions of the LCA. These should be addressed through the evaluation of multiple scenarios and sensitivities analyses as provided in the technology-specific guidance in **Appendix D**.

Integrated DAC System Detailed Design (i.e. Initial DAC Hub Capacity). Recipients must prepare and submit a detailed design study (i.e., Class 1 estimate with expected cost accuracy of +/- 5% and project definition maturity of 90%) for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required BOP sited in the selected DAC Hub and designed for a minimum unit capacity of 50 KTA CO_2. Recipients shall complete 90% of the engineering such that the main contractors and all the sub-contractors can provide construct details (shop fabrication drawings) of all sub-systems and construction bids that will result in +/- 5% capital cost estimate. Quality Assurance/Quality Control (QA/QC) plans, as well as validation and verification (V&V) plans should be included in the detailed design study. The DAC system detailed design study must be submitted 90 days prior to project completion in the format provided in **Appendix Y**.

DAC Hub Balance-of-Plant (BOP) pre-FEED (i.e. Final DAC Hub Capacity). At a minimum, Recipients must prepare and submit a pre-FEED study for the DAC Hub BOP, including utilities (e.g., sources for electricity, steam, water) and CO_2 transport, for the final DAC Hub capacity. Recipients must prepare the DAC Hub BOP pre-FEED study (i.e., Class 4 estimate with expected cost accuracy of +/- 20% and project definition maturity of 15%) in the format provided in **Appendix L**, with additional guidance provided in **Appendix W** for the Pipeline Concept and FEED Study.

Permits Secured. Recipients must secure all permits necessary to commence construction, including air and building permits, CO_2 pipeline permits and right-of-way access (if needed), and UIC Class VI Permit to Construct for the selected CO_2 storage site. See **Appendix N and W** for additional information. Permitted carbon storage facilities should have sufficient capacity to store carbon from the DAC Hub for *at least 12 years of operation*. Alternatively, Recipients must provide a report documenting the status of the offtake agreement.

Environmental Health and Safety (EH&S) Risk Analysis. Recipients must submit an EH&S analysis of the anchoring integrated DAC system sited in the DAC Hub and integrated with required DAC Hub BOP installations in the format provided in **Appendix O**. EH&S analysis must include discussion regarding air and water emissions, water utilization, solid waste streams, noise, and potential environmental impacts of the technology including toxicological effects and hazards of emissions and waste streams. Recipients shall also include any recommendations from a refined

Hazard and Operability (HAZOP) study performed for the anchoring integrated DAC system. Recipients must deliver execution-ready safety plans for Phases 3-4.

Environmental Pollution Impact Assessment. TA-3 recipients should have completed a task for an in-depth environmental pollution impact assessment (including cumulative pollution impacts) of any installation of DAC and balance of plant systems within the DAC Hub. Funding of any future Phases of the work will be dependent on the results of the completed pollutant assessment.

Safety, Security, and Regulatory Requirements. Recipients must deliver a detailed description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history, Recipients should include a detailed description of their intended safety culture for the DAC Hub. Recipients must also discuss site and cybersecurity considerations for the DAC Hub.

Business Plan. Recipients must submit a Business Plan in the format provided **Appendix S** to convey a description of pertinent information to understand the DAC Hub business plans for Phases 3-4. Recipients should discuss labor and engineering, procurement, construction, and operations (EPCO) agreements.

Financial Plan. Recipients must submit a Financial Plan in the format provided **Appendix T** to confirm the Recipient's financial capability to fund, or obtain funding, for the non-DOE share for DAC Hub implementation in Phases 3-4. The Financial Plan shall address the Applicant's financial commitment to the project by including a commitment letter for the entire non-DOE share of the total project cost (i.e., Phase 3 through 4) for the required non-federal cost share, including contingency reserves based on risk analysis. Detailed requirements for the Phase 3 through 4 Project Financial Plan will be included in the down-selection application specifications to be included in the TA-3 Phase 2 awards.

National Environmental Policy Act (NEPA) Compliance. Recipients must submit an Environmental Information Volume (EIV) no later than 120 days after the award start date. EIV should include the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and related BOP sited in the DAC Hub and designed for a minimum capacity of 50 KTA CO_2, as well as the secure carbon storage for at least 12 years of operation. Recipients must complete the NEPA compliance process, as described in **Appendix X**, for the anchoring DAC system (minimum 50 KTA CO_2 capacity) as well as the secure carbon storage for at least 12 years of operation. Recipients must complete the NEPA Environmental Assessment (EA) or Environmental Impact Statement (EIS) compliance process, and receive a NEPA determination (i.e., Finding of No Significant Impact (FONSI) or Record of Decision (ROD)) by the end of Phase 2.

Community Benefits Plan. Recipients must implement the Phase 2 CBP during the performance period. Community and labor engagement should have progressed towards a comprehensive CBP and an overall project that reflects community input and implementation experience to date and sets the stage for ongoing engagement, including the potential for enforceable, negotiated

Workforce and Community Agreements Plans should be in place to monitor project impacts as the project progresses toward implementation. Recipients must also update the CBP for Phases 3-4 based on Phase 2 activities at the end of the performance period. Please note that the full requirements are in Section I.B.iv., and Recipients are encouraged to consult guidance documents provided as an attachment to the FOA for assistance with preparing each section of the Phase 2 CBP.

APPENDIX D – DAC HUB LIFE CYCLE ANALYSIS

Life Cycle Analysis/Assessment (LCA) is an existing framework that is well suited to evaluate CDR. By design, LCA provides a holistic perspective of the potential environmental impacts of a product or process throughout the entire lifetime. This includes the extraction of raw materials through the end-of-life. Emissions to the environment (air, water, and land) are translated to a variety of potential impacts ranging from climate change to human health. Two International Organization for Standardization (ISO) standards provide the principles and framework (14040) and requirements and guidelines (14044) for conducting LCA. LCA requirements for each TA are shown in the table below:

TA	Application	Phase 0 completion	Phase 1 completion	Phase 2 completion	Phase 3 completion
1	N/A	Pre-LCA	N/A	N/A	N/A
2	Pre-LCA	N/A	LCA	N/A	N/A
3	LCA	N/A	N/A	Refined LCA	Refined LCA

Preliminary LCA (Pre-LCA) Discussion:

The Pre-LCA is intended to define high-level description of life cycle considerations for the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) and final DAC Hub capacity. If quantitative data are not available, the Applicant should provide a qualitative discussion and highlight any major uncertainties and missing information.

LCA:

This effort should result in an LCA that is in conformance with the ISO 14040/14044 standards for the initial DAC Hub capacity (i.e., capacity of at least 50 KTA CO_2) and final DAC Hub capacity. Given the stage of the project, it is expected that there will be significant uncertainty in some portions of the LCA. These should be addressed through the evaluation of multiple scenarios and sensitivities analyses as provided in the technology-specific guidance below.

Refined LCA:

The Refined LCA is intended to be a revision of the LCA to reflect any changes as the project design progresses towards completion. At this stage, the Applicant should be prepared to assess specific regionalized inputs and scale-up considerations.

Life Cycle Analysis Requirements for DAC Hub Technologies

Pre-LCA

The following information should be provided or discussed in a qualitative nature for the Pre-LCA:

- Process
  - High-level carbon balance of the proposed approach
  - Disposition of the captured CO_2 – will it be stored underground or utilized in a long-lasting product
  - Define any co-products that might be produced as part of the DAC operation
- Energy and Material Inputs
  - Planned sources of energy (electricity and heat)
  - Ranges of energy and material requirements per kg CO_2 captured
- Impacts
  - Discuss potential co-benefits, including the reduction in criteria air pollutants (CAPs)

LCA

The approach and boundaries for the LCA depend on the ultimate fate of the captured CO_2 based on one of the two following options.

Option 1. In this option, the captured CO_2 from the DAC facility is sent to saline storage for permanent geologic storage. The majority of the necessary inputs for the LCA should be leveraged from the Techno-Economic Analysis (TEA) (e.g., materials and energy balances, block flow diagrams, etc.). The LCA shall be conducted in accordance with the "FECM Best Practices for LCA of Direct Air Capture with Storage (DACS)." Table 5 of the Best Practices document summarizes the requirements.

The following provides additional clarity and specificity for some items in the Best Practices.

- Required data:

  i. Separately report and account for any captured fossil CO_2 (e.g., from on-site fossil fuel combustion) from the captured atmospheric CO_2 for consistency with the functional unit
  ii. Include technical/physical flow amounts (e.g., kWh of electricity, MJ of heat) as key outputs in addition to the LCA impacts
  iii. Energy inputs to the facility including fuels and electricity
    1. For electricity inputs, a minimum of six scenarios should be modeled corresponding to different grid mix carbon intensities, available in the NETL CO2U openLCA LCI Database and the NETL CO2U LCA Documentation Spreadsheet as:

a. Regional grid consumption mix (modeled as the Balancing Authority) based on proposed location of hub
b. Current U.S. grid mix
c. 100% renewables
d. 100% grid average coal
e. 100% Natural Gas Combined Cycle (NGCC) with CCS
f. 2050 U.S. grid mix

2. For heat inputs, the following scenarios shall be assessed using the data provided by NETL:
    a. Regional source of natural gas
    b. National average natural gas
    c. If external low-grade/waste heat is utilized for the DAC process, describe the source and availability

iv. Carbon dioxide transport and saline aquifer storage life cycle inventory values (gate-to-grave emissions data to be used for all projects using saline storage) are available in the NETL CO2U openLCA LCI Database and the NETL CO2U LCA Documentation Spreadsheet as "Saline aquifer transport and storage."

- LCA results:
    i. Shall be normalized to 1 kg of CO_2 removed from the atmosphere and permanently stored
    ii. A contribution analysis shall be provided so that impacts can be differentiated by major operation/input

- Emissions scope:
    i. The scope of environmental impacts shall include all the impact categories listed in Section 4 of the Best Practices for LCA of DAC. To accomplish this, the environmental inventory will need to include data beyond greenhouse gas emissions.
    ii. For GHG emissions, the global warming potential shall be reported using the 100-year global warming potential (GWP) characterization factors as the default values from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) and the Sixth Assessment Report (AR6), sensitivity cases using the 20-year GWP values is required:

GHG	AR5 (IPCC 2013)[33]		AR6 (IPCC 2021)[34]	
	100-year (Default)	20-year	100-year (Default)	20-year
CO_2	1	1	1	1
CH_4	36	85	29.8	82.5
N_2O	298	264	273	273
SF_6	23,500	17,500	25,200	18,300

Note: These GWP characterization factors may be updated by NETL to reflect the latest science.

- Additional Resources – NETL has tools that may be helpful in completing the LCA requirement. These tools are not exhaustive but can be used to provide some life cycle inventory data for some energy and material inputs. The version of tools used for the life cycle analysis should be clearly specified in the report. The following resources are recommended:

  i. Additional General LCA guidance - CO2U LCA Guidance Document
  ii. NETL Life Cycle Inventory Data – NETL CO2U openLCA LCI Database
  iii. Electricity Consumption LCI Data – NETL Grid Mix Explorer

- LCA Submission Requirements for Phase Deliverables

  i. LCA Report – see CO2U LCA Guidance Document, Chapter 6 "Completing the NETL CO2U LCA Report Template"
  ii. LCA Model with Life Cycle Inventory Data – see CO2U LCA Guidance Document, for modeling guidance (no specific LCA software type is required)
  iii. List of all licensed LCA data used within the model (DOE will confirm or obtain license to access licensed data within the LCA model)

Option 2. If the CO_2 captured from the modeled DAC technology will be utilized to make a product, the LCA shall follow the guidelines set forth in the NETL report - "*Carbon Dioxide Utilization Life Cycle Analysis Guidance for the U.S. DOE Office of Fossil Energy*," known as the CO2U LCA Guidance Document, or simply, the guidance document. The guidance document is part of the NETL LCA CO2U Guidance Toolkit, which provides additional support for the creation of the required LCA. The guidance document outlines the analysis requirements and how to use the

[33] IPCC. (2013). *Climate Change 2013 The Physical Science Basis*. New York: Cambridge University Press: Intergovernmental Panel on Climate Change Retrieved December 12, 2013, from https://www.ipcc.ch/report/ar5/wg1/

[34] IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* New York: Cambridge University Press: Intergovernmental Panel on Climate Change Retrieved May 18, 2022, from https://www.ipcc.ch/report/ar6/wg1/

supporting data and tools. As outlined in the guidance document, the LCA must compare a proposed product system, the supply chain of the proposed CO_2 utilization project, to an appropriate comparison product system using a multiproduct functional unit and system expansion. All materials, including the guidance document can be accessed at www.netl.doe.gov/LCA/CO2U In addition to the LCA requirements outlined for Option 1, the following shall also be accounted for:

- Development of a Comparison Product System LCA – greenhouse gas benefits of capture and utilization technologies requires a comparison to the current commercial process for developing the same product or service as derived from the carbon utilization product proposed in the project. Guidance on how to develop the Comparison Product System are contained within the CO2U LCA Guidance Document.

Refined LCA

The Refined LCA is intended to reflect any changes in design since the original LCA. All of the steps for modeling and reporting should be consistent with the LCA description above. A qualitative discussion should also be provided to describe a summary of the changes from the LCA. The Refined LCA should include:

- Scale-up considerations (≥ 50 KTA CO_2 to up to final DAC Hub capacity) – economies of scale impacts
- Representation of regionalized sources of energy inputs, including contractual procurements for dedicated sources (e.g., Power Purchase Agreement [PPA])
- Representation of regionalized storage or utilization site

APPENDIX E – COMMUNITY BENEFITS PLAN DEVELOPMENT PROPOSAL (CBPDP)

During TA-1 Phase 0a, Recipients will be required to develop a CBP Development Proposal (CBPDP), which will be required as a deliverable at the end of Phase 0a and considered as part of the go/no-go decision between Phase 0a and Phase 0b.

The CBPDP must set forth the Applicant's proposal to generate a plan to ensure that Federal investments advance the following four goals: 1) community and labor engagement; 2) investing in the American workforce; 3) advancing diversity, equity, inclusion, and accessibility (DEIA); and 4) contributing to the Justice40 Initiative. The below sections set forth the CBPDP requirements for each of the foregoing goals.

Community and Labor Engagement

Community and Labor Engagement relates to the applicant's plans and actions to engage with community stakeholders, including such as community-based organizations representing local residents and businesses, labor unions and worker organizations, local government, emergency responders, communities with environmental justice concerns, and relevant Tribes/Alaska Native Corporations (ANCs). Communities involve both local communities — towns, cities or counties in geographic proximity to a project and Tribes/ANCs in close proximity to a project — and potentially, broader groups which experience common conditions, which will need to be identified and scoped as part of the Engagement Plan. Successful applicants will demonstrate the ability to develop a plan that would meet the intent of meaningful community and labor engagement.

The purpose of this section is to lay the groundwork for developing a robust Community and Labor Engagement Section as part of a CBP. This section includes a preliminary Engagement Assessment, which outlines prior engagement and aspects of the project that could be modified based on future engagement. This section also includes descriptions of research, partners, timeline, personnel, and resources required to develop the Engagement Section of a full CBP.

Elements of the Community and Labor Engagement Section of the CBPDP include:

1. A **preliminary Engagement Assessment** that includes:
    - A **description of prior engagement** efforts by the project team to engage communities, Tribes, and labor stakeholders. If applicable, provide an assessment of and evidence of (e.g., letters of support, memorandums of understanding (MOUs), etc.) existing labor and community support for and/or concerns with the project, including a description of steps taken to gather this information.
    - A description of what **project or technical aspects of the proposed project could be modified** based on future engagement, including a discussion of whether there is a pathway for the project to consider changing target site(s) based on social considerations.

- A description of plans for any novel governance or financing structures, oversight mechanisms, or other mechanisms to maximize localized benefits.

2. A **description of research** that will need to be done to develop a detailed plan, including scoping data sources for incorporation into the Plan (existing data sources, as well as datasets that need to be developed).
3. A **description of resources, references, or community partners** that will be useful in developing the Plan.
4. A **timeline** for developing the plan, including appropriate milestones.
5. A **description of personnel** who will work on the Plan, including training or qualifications that may need to be acquired.
6. An **estimate of financial resources** required for developing the Plan.

Investing in the American Workforce (IAW)

Quality jobs are the key to attracting and retaining the appropriately skilled, trained, or credentialed workforce required to meet the DAC Hubs FOA goals. These new jobs should be supported by workforce development activities to build a stable skilled and trained workforce that will meet project labor needs at all stages of maturation.

The purpose of this section is to lay the groundwork for developing a robust IAW Section as part of a CBP. This section includes a preliminary IAW Assessment, which outlines workforce needs and relevant labor unions, job creation, and any negative workforce impacts of the project. This section also includes descriptions of research, partners, timeline, personnel, and resources required to develop the IAW Section of a full CBP.

Elements of the IAW Section of the CBPDP include:

1. A **preliminary IAW Assessment** that includes:
    a. An assessment of **workforce needs and labor unions** representing workers or trades that will be needed for construction, operations, and maintenance.
    b. An assessment of the **jobs that will be created**, the occupational distribution, and skills or knowledge gaps that will need to be filled, and, if applicable, the training programs with whom the applicant could work to fill those gaps. Assess the job growth, skill and wage advancement, and improvements in job security.
    c. If applicable, an assessment of **any negative impacts on the workforce**, such as worker displacement resulting from this project, disruption to existing collective bargaining agreements, reduction in wages and benefits, etc.
2. A **description of research** that will need to be done to develop a detailed plan, including scoping data sources for incorporation into the plan (existing data sources as well as datasets that need to be developed).
3. A **description of any labor partners** who may be interested in collaborating on or learning about the plan.
4. A **timeline** for developing the plan, including appropriate milestones.
5. A **description of personnel** who will work on the plan, including trainings or qualifications that may need to be acquired.
6. An **estimate of financial resources** required for developing the plan.

Diversity, Equity, Inclusion, and Accessibility (DEIA)
Applicants should submit a DEIA section within the CBPDP that describes the actions the applicant will take, if selected for award, to foster a welcoming and inclusive environment, support people from groups underrepresented in Science, Technology, Engineering, and Mathematics (STEM) and/or applicable workforces, advance equity, and encourage the inclusion of individuals from these groups in all phases of the project. The section should detail how the Applicant will partner with underrepresented businesses, educational institutions, and training organizations that serve workers who face barriers to accessing quality jobs, and/or other project partners to help address DEIA.

Minority Serving Institutions, Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, Tribal Colleges and Universities, community-based groups, faith-based organizations, or entities located in an underserved community that meet the eligibility requirements (See Section III) are encouraged to participate on the application team.

Elements of the DEIA plan should include the following:

1. **Background**. Describe prior and ongoing efforts by the project team relevant to DEIA, based on findings from an initial assessment that examines the context of DEIA in organizations related to the project team.
2. **Strategies, Milestones, and Timelines**. Describe targeted DEIA outcomes and implementation strategies, including milestones, include a DEIA schedule for execution, and address accountability measures. Milestones and work descriptions should be included within the IPS and Workplan. Applicants are encouraged to use SMART (Specific, Measurable, Achievable, Relevant and Timely) milestones whenever possible.
3. **Resource Summary**. Describe project resources dedicated to implementing DEIA activities including staff, facilities, capabilities, and budget.

Justice40 Initiative
Executive Order 14008 created the Justice40 Initiative – which established a goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities[35] Recipients of DOE funds should ensure that performance of project tasks within disadvantaged communities meaningfully benefits disadvantaged communities and does not result in increased burden to the disadvantaged community.

The purpose of this section is to lay the groundwork for developing a robust Justice40 Section as part of a CBP. This section includes a preliminary Energy and Environmental Justice Assessment, which outlines groups and communities affected by the project and project impacts (benefits and

[35] Pursuant to E.O. 14008 and the Office of Management and Budget's Interim Justice40 Implementation Guidance M-21-28, DOE has developed a definition and tools to locate and identify disadvantaged communities. These resources can be located at https://energyjustice.egs.anl.gov/. DOE will also recognize disadvantaged communities as defined and identified by the White House Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST), which can be located at https://screeningtool.geoplatform.gov/

negative impacts). This section also includes descriptions of research, partners, timeline, personnel, and resources required to develop the Justice40 Section of a full CBP.

Elements of the Justice40 Initiative Section of the CBPDP include:

1. A **preliminary Energy and Environmental Justice Assessment** that includes:
    - An analysis of **communities, including disadvantaged communities**, that will be affected by the project. This can be accomplished by using environmental justice screening tools and DOE's working definition of disadvantaged communities. Specify what tools were used.
    - An analysis of **benefits**[36] **and negative impacts**[37], that can be anticipated based on project design, prior experience or readily available data. Specify what methodology/data sources were used.
2. A **description of research** that will need to be done to develop a detailed plan, including scoping data sources for incorporation into the plan (existing data sources as well as datasets that need to be developed).
3. A **description of any partners serving disadvantaged communities** who may be interested in collaborating on or learning about the plan.
4. A **timeline** for developing the plan, including appropriate milestones.
5. A **description of personnel** who will work on the plan, including trainings or qualifications that may need to be acquired.
6. An **estimate of financial resources** required for developing the plan.

[36] Benefits could include measurable direct or indirect investments or positive project outcomes that contribute to the eight DOE Justice40 policy priorities in disadvantaged communities: (1) a decrease in energy burden; (2) a decrease in environmental exposure and burdens; (3) an increase in access to low-cost capital; (4) an increase in job creation, the clean energy job pipeline, and job training for individuals; (5) increases in clean energy enterprise creation and contracting (e.g., minority-owned or disadvantaged business enterprises); (6) increases in energy democracy, including community ownership; (7) increased parity in clean energy technology access and adoption; and (8) an increase in energy resilience.

[37] Negative impacts could include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health impacts**.** Consider direct impacts, indirect impacts, and cumulative impacts.

APPENDIX F – COMMUNITY BENEFITS PLAN

Applicants to TA-2 and TA-3 must submit a Community Benefits Plan (CBP or Plan) as a separate part of their application package. The CBP must set forth the Applicant's proposal to ensure that Federal investments advance the following four goals: 1) community and labor engagement; 2) investing in the American workforce; 3) advancing diversity, equity, inclusion, and accessibility (DEIA); and 4) contributing to the Justice40 Initiative. The below sections set forth the CBP requirements for each of the foregoing goals.

Community and Labor Engagement

The Community and Labor Engagement section should describe the applicant's plans and actions to engage with community stakeholders such as community-based organizations representing local residents and businesses, labor unions and other worker organizations, workforce development organizations, local government, emergency responders, communities with environmental justice concerns, disadvantaged communities, and community-based organizations that support or work with disadvantaged communities. By facilitating labor and community input, social buy-in, and accountability, such engagement can substantially reduce or eliminate stalls or slowdowns, litigation, and other risks associated with project implementation.

If awarded and in conjunction with DOE, awardees will also identify to DOE any federally recognized Indian Tribes, which include Alaska Native Regional Corporations and Village Corporations (who are not project partners) for whom the proposed project may have implications. The awardee will provide information to support DOE's development of a Tribal engagement plan that acknowledges each Tribe's consultation policies, traditions, and expectations, and adheres to DOE Order 144.1 on Tribal consultation. Appropriate mitigation will be identified through government-to-government consultation to off-set any such potentially adverse implications. DOE is and remains responsible for government-to-government consultation with any federally recognized Indian Tribes, which include Alaska Native Regional Corporations and Village Corporations about the proposed project.

This section should include the following elements:

- **Background.** A description of prior and ongoing efforts by the applicant and its project partners to engage communities, Tribes, and labor stakeholders relevant to the DAC Hub.
- **Social Characterization Assessment.** A brief writeup that describes community dynamics, decision-making processes, etc.).
- **Stakeholder Analysis.** A description of how the DAC Hub identified stakeholders; what sectors, labor unions, communities, organizations, etc. the stakeholders and DAC Hub represents; and current or anticipated level of engagement (e.g., advisory committee, working group member, active public participant). Provide an assessment of existing labor and community support for and/or concerns with the DAC Hub, including a description of steps taken to gather this information.

- **Engagement Methods and Timeline.** Applicants should develop an engagement schedule which includes when and how they will engage stakeholders, workforce organizations including labor unions, and communities, as well as the objectives for the engagement. This should include a description of specific engagement methods (e.g., listening sessions, town halls, open houses, mediated discussions) which should be matched to DAC Hub phases. Methods should also be matched to goals, which may include learning about community and labor concerns and interests, seeking input, addressing input and concerns, and providing information, depending on project phase. DOE strongly encourages DAC Hubs to describe efforts that will be taken to address public safety perceptions. Applicants should describe how they will extend these methods to include traditionally excluded stakeholders. If awarded, awardees will work in conjunction with the Department of Energy to develop a Tribal engagement plan as appropriate.
- **Two-way Engagement Statement.** The application should include a statement discussing how the DAC Hub incorporates community input for the project and the extent to which the host community or communities have already indicated support for the DAC Hub. The statement should list the points in the phases of the DAC Hub where engagement can impact DAC Hub decisions or characteristics, including a discussion of whether there is a pathway for the DAC Hub to consider changing target site(s) based on social considerations. A discussion of how community engagement results will impact DAC Hub decisions and characteristics should be incorporated into the Technical Volume including the IPS and Project Management Plan. This section should also include a discussion of community participation in and access to monitoring data.
- **Project Agreements Statement.** The application should include a statement describing any plans to negotiate a Community Benefits Agreement, Good Neighbor Agreement, Project Labor Agreement, Community Workforce Agreement, and/or other collective bargaining agreements. Such agreements facilitate community and labor input and social buy-in, identify how concerns will be mitigated, and specify the distribution of community and economic benefits, including job quality, access to jobs and business opportunities for local residents, and mitigating community harms, thus reducing or eliminating these types of risks.
- **Engagement Evaluation Strategy.** The application should include a description of plans for activities to evaluate the success of stakeholder engagement, including evaluating community and labor stakeholder perceptions of the progress.
- **Resource Summary.** The application should describe the DAC Hub resources dedicated to implementing the plan including staff, facilities, capabilities, and budget that will support implementing the plan.

Investing in the American Workforce

Quality jobs are the key to attracting and retaining the appropriately skilled, trained, or credentialed workforce required to meet the DAC Hubs FOA goals. These new jobs should be supported by workforce development activities to build a stable skilled and trained workforce that will meet project labor needs at all stages of maturation. This section should describe the applicant's comprehensive plan for the creation and retention of high-paying quality jobs and

development of a skilled workforce, addressing labor needs and workforce impact at initial (minimum 50 KTA CO_2) and final DAC Hub capacity. Meaningful engagement with labor unions is a key component of job quality and workforce development and is covered in detail in the Community and Labor Engagement section. This section of the CBP should build on the description of prior and ongoing efforts by the applicant and its project partners to engage labor unions, community colleges, and other workforce organizations described above in the Community and Labor Engagement statement and the efforts to increase participation and leadership of people in underrepresented or excluded groups as described in the Diversity, Equity, Inclusion and Accessibility section.

This section should include the following elements:

- **Background.** Summarize the applicants' and its project partners' previous and planned efforts to provide above average pay and benefits to properly classified employees in the construction, operations, and scale-up phases; support the rights of workers to a free and fair chance to join a union; and invest in workforce development efforts.
- **Quality Jobs.** Describe plans to attract, train, and retain a skilled, qualified, local, and diverse workforce for construction, ongoing operations/production/maintenance, and scale-up activities, including the anticipated quality of jobs the DAC Hubs will create (i.e., wages– beyond compliance with Davis-Bacon prevailing wages and benefits, opportunities for wage progression, classification as employees, jobs for in-state workers, etc.). Describe how these jobs will be sufficiently attractive to skilled and trained workers under competitive labor market conditions.
- **Workforce Development.** A description of plans for:
    - Investing in workforce education and training (e.g., labor-management training programs, registered apprenticeships, partnerships with community colleges, sector-based approaches to workforce development);
    - Supporting workers' skill acquisition and opportunities for advancement;
    - Utilizing an appropriately credentialed workforce (e.g., requirements for appropriate and relevant professional and safety training, certification, and licensure, including where appropriate utilization of graduates from registered apprenticeship programs); and
    - Other plan elements deemed appropriate by the Applicant.
- **Worker Rights.** Employees' ability to organize, bargain collectively, and participate, through labor organizations of their choosing, in decisions that affect them contributes to the effective conduct of business and facilitates amicable settlements of any potential disputes between employees and employers, providing assurances of project efficiency, continuity, and multiple public benefits. Provide information including:
    - Descriptions of how the applicant will support and protect workers' free and fair chance to form or join unions of their choosing and exercising collective voice in the workplace, in both construction and ongoing operations;
    - Plans to ensure project success and continuity by mitigating labor disputes or strikes (e.g., neutrality with respect to union organizing and good faith negotiations);

    - Activities and policies to ensure worker engagement in the design and execution of workplace safety and health plans;
    - Plans to ensure workplace health and safety and worksites are free from harassment and discrimination;
    - Descriptions of how Project Labor Agreements[38] or Community Workforce Agreements will be utilized in construction activity (e.g., collective bargaining agreements between unions and contractors that govern terms and conditions of employment for all workers on a construction project);
    - Plans to track retention rates and address areas of worker or workplace concern.
- **Strategies, Milestones and Timelines**. A description of targeted outcomes and implementation strategies, including milestones as well as a schedule for execution.
- **Resource Summary**. A description of project resources dedicated to implementing activities including staff, facilities, capabilities, and budget—including those for relevant partner organizations/training providers.

Diversity, Equity, Inclusion, and Accessibility (DEIA)
Applicants should submit a DEIA section within the CBP that describes the actions the applicant will take, if selected for award, to foster a welcoming and inclusive environment, support people from groups underrepresented in Science, Technology, Engineering, and Mathematics (STEM) and/or applicable workforces, advance equity, and encourage the inclusion of individuals from these groups in all phases of the project. The section should detail how the applicant will partner with underrepresented businesses, educational institutions, and training organizations that serve workers who face barriers to accessing quality jobs, and/or other project partners to help address DEIA.

Minority Serving Institutions, Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, Tribal Colleges and Universities, community-based groups, faith-based organizations, or entities located in an underserved community that meet the eligibility requirements (See Section III) are encouraged to participate on the application team. The Selection Official may consider the inclusion of these types of entities as part of the selection decision (See Section V.C.i. Program Policy Factors).

DEIA plans should describe steps taken to ensure an inclusive workplace environment committed to equal opportunity and free of harassment. This should include compliance with civil rights obligations and nondiscrimination laws, including Title VI of the Civil Rights Act of 1964 and implementing regulations (49 CFR § 21), the Americans with Disabilities Act of 1990 (ADA), and Section 504 of the Rehabilitation Act, all other civil rights requirements, and accompanying regulations.
Elements of the DEIA plan should include the following:

[38] https://www.whitehouse.gov/briefing-room/presidential-actions/2022/02/04/executive-order-on-use-of-project-labor-agreements-for-federal-construction-projects/

- **Background**. Describe prior and ongoing efforts by the DAC Hubs team relevant to DEIA, based on findings from an initial assessment that examines the context of DEIA in organizations related to the project team.
- **Strategies, Milestones, and Timelines**. Describe targeted DEIA outcomes and implementation strategies, including milestones, and include a DEIA schedule for execution.
- **Resource Summary**. Describe project resources dedicated to implementing DEIA activities including staff, facilities, capabilities, and budget including project partners.

Justice40 Initiative

Applicants should submit Justice40 Initiative section within the CBP that describes plans to address energy and environmental justice (EEJ) concerns across all phases of project maturity, which will maximize the likelihood of successful DAC Hubs. The Justice40 Initiative section has two subsections: Subsection 1 is an Assessment, which assesses project impacts and where they flow, and Subsection 2 is the Implementation Strategy, which explains what actions the applicants will take to maximize benefits and minimize negative impacts and measure, track, and report project impacts. Both the Assessment and Implementation Strategy should address changes in the project's impacts on equity and justice as the project scales from initial to mature capacity. Meaningful engagement with impacted communities is a key component of environmental justice and is covered in detail as part of the Community and Labor Engagement section.

Subsection 1: The Assessment subsection should include:

- **Assessment of impacted communities and groups**. Applicants should describe all applicable communities or groups which could experience impacts from the proposed DAC Hub at both initial and mature capacity levels. Applicants should identify which of these are considered disadvantaged communities [39] and characterize the existing burdens they are facing using EJSCREEN,[40] disadvantaged community definition tools**,** or other analytic tools. Applicants should include which tool was used in their analysis. Impacts to communities and Tribes/ANCs should be considered for all inputs and outputs along all four phases, and at both initial and mature capacity levels, of the DAC Hub, in addition to impacts at the DAC Hub site(s) or work location(s).
- **Assessment of DAC Hub benefits and where they flow**. Applicants should describe in detail all anticipated DAC Hub benefits. This description should clearly enumerate: a) specific DAC Hub benefits including to the greatest extent possible metrics that will be used to track these benefits; b) where/to whom DAC Hub benefits are expected to flow with the greatest amount of specificity possible (e.g., census block group or census-tract

[39] Pursuant to E.O. 14008 and the Office of Management and Budget's Interim Justice40 Implementation Guidance M-21-28, DOE has developed a definition and tools to locate and identify disadvantaged communities. These resources can be located at https://energyjustice.egs.anl.gov/. DOE will also recognize disadvantaged communities as defined and identified by the White House Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST), which can be located at https://screeningtool.geoplatform.gov/

[40] https://www.epa.gov/ejscreen

level), and the extent to which these benefits flow to disadvantaged communities; and c) describe how well the anticipated project benefits and impacts align with community priorities ascertained through community engagement. Benefits could include measurable direct or indirect investments or positive project outcomes that contribute to the eight DOE Justice40 policy priorities in disadvantaged communities: (1) a decrease in energy burden; (2) a decrease in environmental exposure and burdens; (3) an increase in access to low-cost capital; (4) an increase in job creation, the clean energy job pipeline, and job training for individuals; (5) increases in clean energy enterprise creation and contracting (e.g., minority-owned or disadvantaged business enterprises); (6) increases in energy democracy, including community ownership; (7) increased parity in clean energy technology access and adoption; and (8) an increase in energy resilience.

- **Assessment of DAC Hub negative impacts and where they flow.** Applicants should describe all anticipated DAC Hub negative impacts at both initial and mature capacity levels. This description should clearly enumerate: a) specific DAC Hub negative impacts including, to the greatest extent possible, metrics that will be used to track these impacts; b) where/to whom impacts are expected to flow with the greatest amount of specificity possible, and whether disadvantaged communities will experience negative impacts disproportionately; and c) how additional project negative impacts will interact with existing cumulative burdens. Negative impacts could include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health impacts**.** Consider direct impacts, indirect impacts, and cumulative impacts. The CBP may refer to the impacts identified in the NEPA Environmental Considerations Summary which will also be submitted with the application rather than replicating the information/analysis.
- **Assessment of information gaps:** For elements of the Assessment where additional work is needed to fully assess or measure potential DAC Hub impacts or impacted communities, applicants can outline research and analytical goals to clarify the unknowns.

DAC Hub impacts and community assessments should be quantifiable, measurable, and trackable to the greatest extent possible; DOE expects applicants to include both qualitative and quantitative metrics. If no DAC Hub sites or related activities are located within or near a community and/or disadvantaged communities, applicants should provide a detailed explanation to support this conclusion.

Subsection 2: The Implementation Strategy subsection will outline concrete steps the applicant will take to maximize benefits; minimize negative impacts; and measure, track, and report project impacts. The Implementation Strategy subsection should include the following elements:

- **Background**: A brief narrative summary of the opportunities and risks related to EEJ in the proposed project.
- **Milestones and Timelines:** An Implementation Strategy schedule which includes when and how EEJ work will be conducted, both as capacity matures and at full-capacity operations. This includes DAC Hub milestones for maximizing benefits and minimizing

negative impacts; milestones to measure, track, and report DAC Hub impacts; updates to the EEJ assessment; and future work. The schedule should define its timeline on the same schedule as the IPS, and if selected for award, these should also be reflected in the Workplan and Project Management Plan.

- **Assessment of barriers to realizing benefits and minimizing negative impacts:** For items outlined in the Assessment, discuss potential barriers to realizing DAC Hub benefits, minimizing negative impacts, and plans for mitigating those risks.
- **Resource Summary**: Describe project resources dedicated to implementing the plan including staff, facilities, capabilities, and budget that will support implementing the plan.

APPENDIX G – WAIVER REQUESTS AND APPROVAL PROCESSES: 1. FOREIGN ENTITY PARTICIPATION ; AND 2. PERFORMANCE OF WORK IN THE UNITED STATES (FOREIGN WORK WAIVER)

1. Waiver for Foreign Entity Participation

Many of the technology areas DOE funds fall in the category of critical and emerging technologies (CETs). CETs are a subset of advanced technologies that are potentially significant to U.S. national and economy security.[41] For projects selected under this FOA, all recipients and subrecipients must be organized, chartered or incorporated (or otherwise formed) under the laws of a state or territory of the United States; have majority domestic ownership and control; and have a physical location for business operations in the United States. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Waiver Criteria

Foreign entities seeking to participate in a project funded under this FOA must demonstrate to the satisfaction of DOE that:

a. Its participation is in the best interest of the U.S. industry and U.S. economic development;
b. The project team has appropriate measures in place to control sensitive information and protect against unauthorized transfer of scientific and technical information;
c. Adequate protocols exist between the U.S. subsidiary and its foreign parent organization to comply with export control laws and any obligations to protect proprietary information from the foreign parent organization;
d. The work is conducted within the U.S. and the entity acknowledges and demonstrates that it has the intent and ability to comply with the U.S. Manufacturing Plan; and
e. The foreign entity will satisfy other conditions that may be deemed necessary by DOE to protect U.S. government interests.

Content for Waiver Request

A Foreign Entity waiver request must include the following:

a. Information about the entity: name, point of contact, and proposed type of involvement with the Institute;
b. Country of incorporation, the extent of the ownership/level control by foreign entities, whether the entity is state owned or controlled, a summary of the ownership breakdown of the foreign entity and the percentage of

[41] See Critical and Emerging Technologies List Update (whitehouse.gov).

ownership/control by foreign entities, foreign shareholders, foreign state or foreign individuals;

c. The rationale for proposing a foreign entity participate (must address criteria above);
d. A description of the project's anticipated contributions to the U.S. economy;
    - How the project will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
    - How the project will promote domestic American manufacturing of products and/or services;
e. A description of how the foreign entity's participation is essential to the project;
f. A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP; and
g. Countries where the work will be performed (Note: if any work is proposed to be conducted outside the U.S., the applicant must also complete a separate request foreign work waiver).

DOE may also require:

- A risk assessment with respect to IP and data protection protocols that includes the export control risk based on the data protection protocols, the technology being developed and the foreign entity and country. These submissions could be prepared by the project lead, but the prime recipient must make a representation to DOE as to whether it believes the data protection protocols are adequate and make a representation of the risk assessment – high, medium or low risk of data leakage to a foreign entity.
- Additional language be added to any agreement or subagreement to protect IP, mitigate risk or other related purposes.

DOE may require additional information before considering the waiver request.

The applicant does not have the right to appeal DOE's decision concerning a waiver request.

2. Waiver for Performance of Work in the United States (Foreign Work Waiver)

As set forth in Section IV.I.iii., **at least 100%** of the work under these funding agreements must be performed in the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit an explicit waiver request in the Full Application. A separate waiver request must be submitted for each entity proposing performance of work outside of the United States.

Overall, a waiver request must demonstrate to the satisfaction of DOE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to perform work outside of the United States. A request to waive the *Performance of Work in the United States* requirement must include the following:

- The rationale for performing the work outside the U.S. ("foreign work");
- A description of the work proposed to be performed outside the U.S.;
- An explanation as to how the foreign work is essential to the project;
- A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the US economy;
- The associated benefits to be realized and the contribution to the project from the foreign work;
- How the foreign work will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the foreign work will promote domestic American manufacturing of products and/or services;
- A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP;
- The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
- The countries in which the foreign work is proposed to be performed; and
- The name of the entity that would perform the foreign work.

DOE may require additional information before considering the waiver request.

The applicant does not have the right to appeal DOE's decision concerning a waiver request.

APPENDIX H – COST SHARE INFORMATION

Cost Sharing or Cost Matching

The terms "cost sharing" and "cost matching" are often used synonymously. Even the DOE Financial Assistance Regulations, 2 CFR 200.306, use both of the terms in the titles specific to regulations applicable to cost sharing. DOE almost always uses the term "cost sharing," as it conveys the concept that non-federal share is calculated as a percentage of the Total Project Cost. An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here "cost matching" for the non-federal share is calculated as a percentage of the federal funds only, rather than the Total Project Cost.

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. FFRDC costs must be included in Total Project Costs. The following is an example of how to calculate cost sharing amounts for a project with $1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

- Formula: Federal share ($) divided by federal share (%) = Total Project Cost
  Example: $1,000,000 divided by 80% = $1,250,000

- Formula: Total Project Cost ($) minus federal share ($) = Non-federal share ($)
  Example: $1,250,000 minus $1,000,000 = $250,000

- Formula: Non-federal share ($) divided by Total Project Cost ($) = Non-federal share (%)
  Example: $250,000 divided by $1,250,000 = 20%

What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under a DOE grant or cooperative agreement, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the federal government under another award unless authorized by federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though are generally the same for all types of entities. The specific rules applicable to:

- FAR Part 31 for For-Profit entities, (48 CFR Part 31); and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

In addition to the regulations referenced above, other factors may also come into play such as timing of donations and length of the project period. For example, the value of ten years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, DOE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, DOE generally does not allow pre-award costs prior to the signing of the Selection Statement by the DOE Selection Official.

General Cost Sharing Rules on a DOE Award

1. Cash Cost Share – encompasses all contributions to the project made by the recipient or subrecipient(s), for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project.

2. In-Kind Cost Share – encompasses all contributions to the project made by the recipient or subrecipient(s) that do not involve a payment or reimbursement and represent donated items or services. In-Kind cost share items include volunteer personnel hours, donated existing equipment, donated existing supplies. The cash value and calculations thereof for all In-Kind cost share items must be justified and explained in the Cost Share section of the project Budget Justification. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out the In-Kind cost share section of the Budget Justification.

3. Funds from other federal sources MAY NOT be counted as cost share. This prohibition includes FFRDC subrecipients. Non-federal sources include any source not originally derived from federal funds. Cost sharing commitment letters from subrecipients must be provided with the original application.

4. Fee or profit, including foregone fee or profit, are not allowable as project costs (including cost share) under any resulting award. The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

DOE Financial Assistance Rules 2 CFR Part 200 as amended by 2 CFR Part 910

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

(A) Acceptable contributions. All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the prime recipient's cost sharing if such contributions meet all of the following criteria:

(1) They are verifiable from the recipient's records.

(2) They are not included as contributions for any other federally-assisted project or program.

(3) They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.

(4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:

a. For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A–122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the FAR, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations; and

b. Other types of organizations. For all other non-federal entities, allowability of costs is determined in accordance with 2 CFR Part 200 Subpart E.

(5) They are not paid by the federal government under another award unless authorized by federal statute to be used for cost sharing or matching.

(6) They are provided for in the approved budget.

(B) Valuing and documenting contributions

(1) Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of

the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or

b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

(2) Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.

(3) Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

(4) Valuing property donated by third parties.

a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.

b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:

i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of

comparable space and facilities in a privately-owned building in the same locality.

ii. The value of loaned equipment must not exceed its fair rental value.

(5) Documentation. The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.

b. The basis for determining the valuation for personal services and property must be documented.

APPENDIX I – SAMPLE COST SHARE CALCULATION FOR BLENDED COST SHARE PERCENTAGE

The following example shows the math for calculating required cost share for a project with $2,000,000 in federal funds with four tasks requiring different non-federal cost share percentages:

Task	Proposed Federal Share	Federal Share %	Recipient Share %
Task 1 (R&D)	$1,000,000	80%	20%
Task 2 (R&D)	$500,000	80%	20%
Task 3 (Demonstration)	$400,000	50%	50%
Task 4 (Outreach)	$100,000	100%	0%

Federal share ($) divided by federal share (%) = Task Cost

Each task must be calculated individually as follows:

Task 1
$1,000,000 divided by 80% = $1,250,000 (Task 1 Cost)
Task 1 Cost minus federal share = non-federal share
$1,250,000 - $1,000,000 = $250,000 (non-federal share)

Task 2
$500,000 divided 80% = $625,000 (Task 2 Cost)
Task 2 Cost minus federal share = non-federal share
$625,000 - $500,000 = $125,000 (non-federal share)

Task 3
$400,000 / 50% = $800,000 (Task 3 Cost)
Task 3 Cost minus federal share = non-federal share
$800,000 - $400,000 = $400,000 (non-federal share)

Task 4
Federal share = $100,000
Non-federal cost share is not mandated for outreach = $0 (non-federal share)

The calculation may then be completed as follows:

Tasks	$ Federal Share	% Federal Share	$ Non-Federal Share	% Non-Federal Share	Total Project Cost
Task 1	$1,000,000	80%	$250,000	20%	$1,250,000
Task 2	$500,000	80%	$125,000	20%	$625,000
Task 3	$400,000	50%	$400,000	50%	$800,000
Task 4	$100,000	100%	$0	0%	$100,000
Totals	$2,000,000		$775,000		$2,775,000

Blended Cost Share %
Non-federal share ($775,000) divided by Total Project Cost ($2,775,000) = 27.9% (non-federal)
Federal share ($2,000,000) divided by Total Project Cost ($2,775,000) = 72.1% (federal)

APPENDIX J – REQUIRED USE OF AMERICAN IRON, STEEL, MANUFACTURED PRODUCTS, AND CONSTRUCTION MATERIALS BUY AMERICA REQUIREMENTS FOR INFRASTRUCTURE PROJECTS

A. Definitions

For purposes of the Buy America requirements, based both on the statute and OMB Guidance Document dated April 18, 2022, the following definitions apply:

Construction materials includes an article, material, or supply—other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives —that is or consists primarily of:

- non-ferrous metals;
- plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables);
- glass (including optic glass);
- lumber; or
- drywall.

Infrastructure includes, at a minimum, the structures, facilities, and equipment for, in the United States, roads, highways, and bridges; public transportation; dams, ports, harbors, and other maritime facilities; intercity passenger and freight railroads; freight and intermodal facilities; airports; water systems, including drinking water and wastewater systems; electrical transmission facilities and systems; utilities; broadband infrastructure; and buildings and real property. Infrastructure includes facilities that generate, transport, and distribute energy.

Moreover, according to the OMB guidance document:

> When determining if a program has infrastructure expenditures, Federal agencies should interpret the term "infrastructure" broadly and consider the definition provided above as illustrative and not exhaustive. When determining if a particular construction project of a type not listed in the definition above constitutes "infrastructure," agencies should consider whether the project will serve a public function, including whether the project is publicly owned and operated, privately operated on behalf of the public, or is a place of public accommodation, as opposed to a project that is privately owned and not open to the public. Projects with the former qualities have greater indicia of infrastructure, while projects with the latter quality have fewer. Projects consisting solely of the purchase, construction, or improvement of a private home for personal use, for example, would not constitute an infrastructure project.

The Agency, not the applicant, will have the final say as to whether a given project includes infrastructure, as defined herein. Accordingly, in cases where the "public" nature of the infrastructure is unclear, but the other relevant criteria are met DOE strongly recommends that applicants complete their full application with the assumption that Buy America requirements will apply to the proposed project.

Project means the construction, alteration, maintenance, or repair of infrastructure in the United States.

B. Buy America Requirements for Infrastructure Projects ("Buy America" requirements)

In accordance with Section 70914 of the BIL, none of the project funds (includes federal share and recipient cost share) may be used for a project for infrastructure unless:

(1) all iron and steel used in the project are produced in the United States--this means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;

(2) all manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation; and

(3) all construction materials are produced in the United States—this means that all manufacturing processes for the construction material occurred in the United States.

The Buy America requirements only apply to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does the Buy America requirements apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project, but are not an integral part of the structure or permanently affixed to the infrastructure project.

These requirements must flow down to all sub-awards, all contracts, subcontracts, and purchase orders for work performed under the proposed project, except where the prime recipient is a for-profit entity. Based on guidance from the Office of Management and Budget (OMB), the Buy America requirements of the BIL do not apply to DOE projects in which the prime recipient is a for-profit entity; the requirements only apply to projects whose prime recipient is a State, local government, Indian tribe, Institution of Higher Education, or nonprofit organization.

For additional information related to the application and implementation of these Buy America requirements, please see OMB Memorandum M-22-11, issued April 18, 2022: https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-11.pdf

Note that for all applicants—both non-Federal entities and for-profit entities—DOE is including a Program Policy Factor that the Selection Official may consider in determining which Full Applications to select for award negotiations that considers whether the applicant has made a commitment to procure U.S. iron, steel, manufactured products, and construction materials in its project.

C. Waivers

The DOE financial assistance agreement will require each recipient: (1) to fulfill the commitments made in its application regarding the procurement of U.S.-produced products and (2) to fulfill the commitments made in its

application regarding the procurement of other key component metals and manufactured products domestically that are deemed available in sufficient and reasonably available quantities or of a satisfactory quality at the time of award negotiation.

In limited circumstances, DOE may waive the application of the Buy America requirements where DOE determines that:

(1) applying the Buy America requirements would be inconsistent with the public interest;

(2) the types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality; or

(3) the inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent.

If an applicant or recipient is seeking a waiver of the Buy America requirements, it may submit a waiver request after it has been notified of its selection for award negotiations. A waiver request must include:

- A detailed justification for the use of "non-domestic" iron, steel, manufactured products, or construction materials to include an explanation as to how the non-domestic item(s) is essential to the project
- A certification that the applicant or recipient made a good faith effort to solicit bids for domestic products supported by terms included in requests for proposals, contracts, and nonproprietary communications with potential suppliers
- Applicant/Recipient name and Unique Entity Identifier (UEI)
- Total estimated project cost, DOE and cost-share amounts
- Project description and location (to the extent known)
- List and description of iron or steel item(s), manufactured goods, and construction material(s) the applicant or recipient seeks to waive from Domestic Content Procurement Preference requirement, including name, cost, country(ies) of origin (if known), and relevant Product Service Code (PSC) and North American Industry Classification System (NAICS) code for each
- Waiver justification including due diligence performed (e.g., market research, industry outreach) by the applicant or recipient
- Anticipated impact if no waiver is issued

DOE may require additional information before considering the waiver request.
Waiver requests are subject to public comment periods of no less than 15 days and must be reviewed by the Made in America Office. There may be instances where an award qualifies, in whole or in part, for an existing waiver.

DOE's decision concerning a waiver request is not appealable.

APPENDIX K – DAC HUB DATA TABLES (TA-2 AND TA-3 ONLY)

***Instructions for completing data tables*:** The tables that follow in this attachment shall be populated with data provided by the applicant. TA-2 and TA-3 Applicants shall complete the appropriate combinations of Table 1 and 2 (required for all applicants) and Tables 3-8 that relate to their proposed DAC Hub. If multiple DAC technologies are proposed in the DAC Hub, Table 2 must be completed for each DAC technology with a separated corresponding state point data table for the DAC material. *Merit scoring of application will correspond to the completeness of the data table and supporting information.*

At the time that the application is submitted, the Applicant should know the optimal performance for the DAC system material proposed. Applicants are required to provide the demonstrated performance data for their DAC technology(ies).

Key data or estimates provided in the table(s) shall be supported with short narratives in bullet form within the Technological Merit and DAC Hub Site Suitability section. These bullets shall describe the sources for the individual data provided. This may be measurements made directly by the applicant and shall identify the apparatus and methodology used in the measurement(s). Due to page limitations, citations may be utilized to describe the sources for the individual data provided by the applicant or others, or by example calculations for noncritical data. Other acceptable sources of data are the open literature (with citation and description), or estimated or extrapolated data (with description of method/model used for the estimate, or the procedure used for extrapolation). Arguments supported by theory/mechanisms shall be provided for projected performance for new, advanced DAC materials.

Table 1. Data Table for the DAC Hub

	Units	Initial Capacity	Final Capacity (if applicable)
Scalability and DAC Technologies			
DAC Hub Proposed Scale (Net CO_2 captured from the atmosphere)	Net tonne CO_2/yr.		
DAC Hub Proposed Scale (Gross CO_2 captured from the atmosphere)	Gross tonne CO_2/yr.		
DAC Technology(ies) in DAC Hub and TRL[1]	Technology and TRL		
Carbon Potential			
CO_2 Conversion Offtakers Available	-		
CO_2 Conversion Capacity for DAC Hub	tonne CO_2/yr.		
CO_2 Storage Options for DAC Hub	-		
CO_2 Storage Capacity Available	tonne CO_2		
Resources			
CO_2 Storage Infrastructure Available	-		
CO_2 Transport Infrastructure Available	-		
CO_2 Pipeline needed for DAC Hub	miles		
Total Land Requirements for DAC Hub	m^2		
Total Water Requirements for DAC Hub	Tonnes/yr.		
Energy Sources Available	type		
Renewable and Low Carbon Energy Available[2]	type		
Total Energy Requirements for DAC Hub	GJ/tonne CO_2 removed from atmosphere		
Total Thermal Energy Requirements for DAC Hub	GJ/tonne CO_2 removed from atmosphere		
Total Electrical Energy Requirements for DAC Hub	GJ/tonne CO_2 removed from atmosphere		
Emissions			

Type of Emission related to Energy Source	Type (e.g. natural gas leakage, CO_2, etc.)		
Total Emissions related to Energy Source	CO_2e tonne/yr.		
Geographic Diversity - DAC Hub Region			
DAC Hub Area	Square miles		
DAC Hub Region States	State(s)		
DAC Hub Region counties	counties		
DAC Hub Region cities	Cities		
DAC Hub Region zip codes	Zip codes		
Hubs in Fossil-Producing Regions			
Coal production (current) in DAC Hub Region	Tonnes/yr.		
Coal Production (Retired last 10 years) in DAC Hub Region	Tonnes/yr.		
Oil Production (current) in DAC Hub Region	Thousand Barrels per Day		
Oil Production (Retired last 10 years) in DAC Hub Region	Thousand Barrels per Day		
Gas Production (current) in DAC Hub Region	Cubic meters		
Gas Production (Retired last 10 years) in DAC Hub Region	Cubic meters		
Carbon Intensity of Local Industry			
Carbon Intensity of Local Industry	Kg CO_2/million BTU		
Retired Carbon-Intensive Industrial Capacity	-		
Economic Distressed Area			
Economic Distressed Area(s) in DAC Hub Region	Yes/No		
Employment			
Employment Potential	Jobs (operating-full time)		
Employment Potential	Jobs (construction)		

[1] List all the DAC technologies proposed in the DAC Hub and their current TRL.

[2] List the renewable and low carbon energy available in the proposed DAC Hub region, such as wind, solar, geothermal, nuclear, and fossil fuel or biomass equipped with CCUS

Table 2. Data Table for Individual DAC Technology(ies)

	Units	Measured Performance	Projected Performance
DAC Technology			
DAC Technology and TRL	-		
Scale (Net CO_2 captured from the atmosphere)	Net tonne CO_2/yr.		
Scale (Gross CO_2 captured from the atmosphere)	Gross tonne CO_2/yr.		
Total Energy Requirements[1]	GJ/tonne CO_2 removed from atmosphere		
Total Thermal Energy Requirements	GJ/tonne CO_2 removed from atmosphere		
Required Temperature of Thermal Energy	°C		
Total Electricity Energy Requirements	GJ/tonne CO_2 removed from atmosphere		
Volumetric Productivity	gmol CO_2 / m^3 capture media / time		
CO_2 Capture Percentage from air	%		
System Pressure Drop	Pa		
Energy Source	-		
Emissions related to energy source	CO_2e tonne/yr.		

[1] Total thermal and electricity requirements encompass the entire process, including pre-treatment, process operation, capture media conditioning/regeneration/drying, etc.

Table 3. State-Point Data for Solvent Based Systems

	Units	Measured/ Estimated Performance	Projected Performance
Pure Solvent			
Molecular Weight	mol-1		
Standard Boiling Point	°C		
Standard Freezing Point	°C		
Vapor Pressure @ 15°C	bar		
Working Solution			
Concentration	kg/kg		
Specific Gravity (15 °C/15 °C)	-		
Specific Heat Capacity @ STP	kJ/kg·K		
Viscosity @ STP	cP		
Surface Tension @ STP	dyn/cm		
CO_2 Mass Transfer Rate [KL]	m/s		
CO_2 Reaction Rate	-		
Thermal Conductivity	W/(m·K)		
Absorption			
Pressure	bar		
Temperature	°C		
Equilibrium CO_2 Loading	gmol CO_2/kg		
Heat of Absorption	kJ/kg CO_2		
Solution Viscosity	cP		
Desorption			
Pressure	bar		
Temperature	°C		
Equilibrium CO_2 Loading	gmol CO_2/kg		
Heat of Desorption	kJ/kg CO_2		
Pilot Scale Data			
Location			
The following information should be provided for the longest steady-state duration test performed			
Scale	tCO_2/year		
Duration of Long-Term Test (consecutive hours)	hr.		

CO_2 concentration in the feed stream (e.g., flue gas, process stream)	Mol %		
Carbon Capture Efficiency	%		
Solvent Make-up rate	%/yr.		
Reboiler Duty	KJ/Kg CO_2		
Details on solvent reclamation or refreshing			
CO_2 Product Purity	Mol % dry		
CO_2 Product Oxygen Concentration	Mol% (or ppm)		

Definitions for Table 3:
STP – Standard Temperature and Pressure (15 °C, 1 atm)
Pure Solvent – Agent(s), working alone or as a component of a working solution, responsible for enhanced CO_2 absorption. For example: the amine monoethanolamine (MEA) in an aqueous solution.
Working Solution – The solute-free (i.e., CO_2-free) liquid solution used as the working solvent in the absorption/desorption process. For example: the liquid mixture of MEA and water.
Absorption – The conditions of interest for absorption are those that prevail at maximum solvent loading, which typically occurs at the bottom of the absorption column. Measured data are preferable to estimated data.
Desorption – The conditions of interest for desorption are those that prevail at minimum solvent loading, which typically occurs at the bottom of the desorption column. Operating pressure and temperature for the desorber/stripper are process dependent. Measured data are preferable to estimated data.
Pressure – The pressure of CO_2 in equilibrium with the solution. If the vapor phase is pure CO_2, this is the total pressure, and if it is a mixture of gases, this is the partial pressure of CO_2.
Concentration – Mass fraction of pure solvent in working solution.
Loading – The basis for CO_2 loading is moles of pure solvent.
Mass Transfer Rate – Overall liquid phase mass transfer coefficient.
CO_2 Reaction Rate – A characterization of the CO_2 absorption trend with respect to time, as complete in the range of time as possible.
Details on solvent reclamation or refreshing – Include information about reclamation rates or solvent replacement/refreshing during the long-term test
CO_2 Product Purity – Average purity of the CO_2 product from the capture system during the long-term testing
CO_2 Product Oxygen Concentration – Oxygen content of the CO_2 produced during the long-term testing

Table 4. State-Point Data for Sorbent Based Systems

	Units	Measured Performance (Powder form)	Projected or Measured Performance (structured material system)
Sorbent			
True Density @ STP	kg/m^3		
Bulk Density	kg/m^3		
Average Particle Diameter	mm		
Particle Void Fraction	m^3/m^3		
Packing Density	m^2/m^3		
Solid Heat Capacity @ STP	kJ/kg·K		
Crush Strength	kgf		
Attrition Index	-		
Thermal Conductivity	W/(m·K)		
Adsorption			
Pressure	bar		
Temperature	°C		
Equilibrium Loading	gmol CO_2/kg		
Heat of Adsorption	kJ/gmol CO_2		
CO_2 Adsorption Kinetics	gmol/time		
Desorption			
Pressure	bar		
Temperature	°C		
Equilibrium Loading	gmol CO_2/kg		
Heat of Desorption	kJ/gmol CO_2		
CO_2 Desorption Kinetics	gmol/time		
Pilot Scale Information			
Location			
The following information should be provided for the longest steady-state duration test performed			
Scale	tCO_2/year		
Duration of Long-Term Test (consecutive hours)	hrs.		
CO_2 concentration in feed stream (e.g., flue gas, process stream)	%		
Carbon Capture Efficiency	%		

Cycle Time	Hr.		
Sorbent Make-up rate	%/yr.		
Details on sorbent reactivation or refreshing			
Heat Duty	KJ/Kg CO_2		
CO_2 Product Purity	Mol % dry		
CO_2 Product Oxygen Concentration	Mol% (or ppm)		

Definitions for Table 4:
Attrition Index – For circulating sorbents, the attrition index includes the percentage and size of the fines generated
STP – Standard Temperature and Pressure (15 °C, 1 atm)
Sorbent – Adsorbate-free (i.e., CO_2-free) and dry material as used in adsorption/desorption cycle.
Adsorption – The conditions of interest for adsorption are those that prevail at maximum sorbent loading. Measured data are preferable to estimated data.
Desorption – The conditions of interest for desorption are those that prevail at minimum sorbent loading. Operating pressure and temperature for the desorber/stripper are process dependent. Measured data are preferable to estimated data.
Pressure – The pressure of CO_2 in equilibrium with the sorbent. If the vapor phase is pure CO_2, this is the total pressure, and if it is a mixture of gases, this is the partial pressure of CO_2.
Packing Density – Ratio of the active sorbent area to the bulk sorbent volume.
Loading – The basis for CO_2 loading is mass of dry sorbent.
Kinetics – A characterization of the CO_2 adsorption/desorption trend with respect to time, as complete in the range of time as possible.
Cycle Time – time for entire absorption and regeneration cycle utilized during long term testing
Details on sorbent reactivation or refreshing – Include information about reactivation process and rates or sorbent replacement during the long-term test
CO_2 Product Purity – Average purity of the CO_2 product from the capture system during the long-term testing
CO_2 Product Oxygen Concentration – Oxygen content of the CO_2 produced during the long-term testing

Table 5. State-Point Data for Membrane Based Systems

	Units	Measured/ Estimated Performance	Projected Performance
Materials Properties			
Materials of Fabrication for Selective Layer			
Materials of Fabrication for Support Layer (if applicable)			
Nominal Thickness of Selective Layer (mm)			
Membrane Geometry			
Max Trans-Membrane Pressure	bar		
Hours tested without significant degradation			
Membrane Performance			
Temperature	°C		
Pressure Standardized Flux for Permeate (CO_2)	GPU or equivalent		
CO_2/H_2O Selectivity	-		
CO_2/N_2 Selectivity	-		
Type of Measurement (Ideal or mixed gas)	-		
Proposed Module Design			
Flow Arrangement	-		
Packing Density	m^2/m^3		
Shell-Side Fluid	-		
Pilot Scale Information			
Location			
The following information should be provided for the longest steady-state duration test performed			
Scale	$tCO_2/yr.$		
CO_2 concentration in feed stream (e.g., flue gas, process stream)	%		
Duration of Long-Term Test (consecutive hours)	hrs.		
Average CO_2 capture Efficiency	%		
Starting CO_2 Capture Efficiency	%		

Ending CO_2 Capture Efficiency	%	
Membrane Performance Degradation	%/year	
CO_2 Product Purity	Mol % dry	
CO_2 Product Oxygen Concentration	Mol% (or ppm)	
Membrane Feed Pressure*	psia	
Permeate Pressure*	psia	

Definitions for Table 5:
Membrane Geometry – Flat discs or sheets, hollow fibers, tubes, etc.
Pressure Standardized Flux – For materials that display a linear dependence of flux on partial pressure differential, this is equivalent to the membrane's permeance.
GPU – Gas Permeation Unit, which is equivalent to 10-6 $cm^3/(cm^2 \cdot s \cdot cmHg)$ at 1 atm and 0 °C. For non-linear materials, the dimensional units reported shall be based on flux measured in $cm^3/(cm^2 \cdot s)$ (at 1 atm and 0 °C) with pressures measured in cm Hg. Note: 1 GPU = 3.3464×10-6 $kgmol/(m^2 \cdot s \cdot kPa)$ [SI units]
Type of Measurement – Either mixed or pure gas measurements; projected permeance and selectivities shall be for mixture of gases found in de-sulfurized flue gas.
Flow Arrangement – Typical gas-separation module designs include spiral-wound sheets, hollow-fiber bundles, shell-and-tube, and plate-and-frame, which result in either co-current, counter-current, cross-flow arrangements, or some complex combination of these.
Packing Density – Ratio of the active surface area of the membrane to the volume of the module.
Shell-Side Fluid – Either the permeate or retentate stream.
Details on membrane reactivation or replacement – Include information about reactivation process and rates or membrane replacement during the long-term test
Starting CO_2 Capture Efficiency – Capture efficiency achieved in the first hour of long-term testing
Ending CO_2 Capture Efficiency – Capture efficiency achieved in the last hour of long-term testing
CO_2 Product Purity – Average purity of the CO_2 product from the capture system during the long-term testing
CO_2 Product Oxygen Concentration – Oxygen content of the CO_2 produced during the long-term testing
Membrane Feed Pressure – Pressure of gas fed to the membrane for separation during the long-term test. *Repeat this parameter for each stage of membrane used during the long-term test
Permeate Pressure – Pressure of the corresponding permeate of the membrane that accounts for the trans membrane pressure drop and any vacuum used. * Repeat this parameter for each stage of membrane used during the long-term test

Table 6. Synthesis of Value-Added Organic Products: Technology Performance Data

	Units	Measured/Current Performance	Projected/Target Performance
Synthesis Pathway Steps[1]			
Step 1 (based on CO_2)	mol^{-1}	Balanced chemical equation	
Step 2	mol^{-1}	Balanced chemical equation	
Step n	mol^{-1}	Balanced chemical equation	
Source of external intermediate 1		(e.g., natural gas, oil, renewable energy, etc.)	
Source of external intermediate 2		(e.g., natural gas, oil, renewable energy, etc.)	
Source of external intermediate n		(e.g., natural gas, oil, renewable energy, etc.)	
Reaction Thermodynamics[2,3]			
Reaction[4]			
ΔH^o_{rxn}	KJ/mol	Calculated from standard enthalpies of formation	
ΔG^o_{rxn}	KJ/mol	Calculated from standard free energies of formation	
Conditions		(range)	(range)
CO_2 Source[5]			
Catalyst[6]			
Pressure	bar		
CO_2 Partial Pressure	bar		
Temperature	^oC		
Performance		(range)	(minimum)
Nominal Residence Time[7]	sec		
Selectivity to Desired Product[8]	%		
Product Composition[9]		(range)	(optimal)
Desired Product	mol%		
Desirable Co-Products	mol%		
" "	mol%		
Unwanted By-Products	mol%		
" "	mol%		
Grand Total	**mol%**	**--**	**100%**

Notes

[1] Balanced equations for each step in the synthesis pathway. Intermediates provided from externalsources (e.g., ethane, methane, hydrogen, etc.) should be shown in **BOLD** type. Intermediates generated as part of the synthesis pathway should be in standard type.

[2] *STP* – Standard Temperature and Pressure (25°C, 1 atm)

[3] If Standard Enthalpies and Gibbs Free Energies of Formation cannot be found for some chemical speciesin the proposed chemical reaction(s), they should be estimated; however, *the method used must be clearlyreferenced or described*.

[4] Identify the type reaction for example, thermochemical, electrochemical, photochemical, etc.

[5] Identify the CO_2 source for example, coal-fired flue gas, natural gas-fired flue gas, pure CO_2, etc.

[6] Identify the catalyst composition

[7] Reactor residence times are difficult to quantify, especially early in any laboratory-scale development effort. Definitions vary based on whether the reaction is being carried out in a batch or continuous reactorand whether a homogeneous, heterogeneous or no catalyst is being used. For the calculation of NominalResidence Time, the applicant should use the following equations:
For experimental systems involving batch reactors:
{Nominal Residence Time} = {Length of Time Reactor is Operated}For continuous reactors operated at steady state, employing a solid catalyst:
{Nominal Residence Time} = {Mass of Catalyst in Reactor} / {Total Mass Flowrate into Reactor}For continuous reactors operated at steady state, employing a homogenous or no catalyst:
{Nominal Residence Time} = {Volume of Reactor} / {Total Volume Flowrate into Reactor}
[8] Selectivity to Desired Product is the fraction of the carbon in the Desired Product (see definition below)to the total amount of available carbon reacted, expressed as mole-percent.
[9] Applicant should define the primary product of interest. Standardly, this is either the highest value or largest volume compound or material produced. Desirable co-products are any other reaction productsof sufficient value that they would be profitable for the producer to recover, purify, transport and market. Whether to maximize or minimize production of these co-products is an economic decision.
Unwanted by-products are produced from undesired side reactions, which may result from systemupsets or may be an unavoidable consequence of the current state of technology development.

Table 7. Production of Inorganic Materials (Solid Carbon Products): Technology Performance Data

	Units	Measured/Current Performance	Projected/Target Performance
***Reaction Thermodynamics*[1,2]**			
Reaction[3]			
Chemical Equation	mol^{-1}	Balanced chemical equation	
$\Delta H°_{rxn}$	kJ/mol	Calculated from standard enthalpies of formation	
$\Delta G°_{rxn}$	kJ/mol	Calculated from standard free energies of formation	
Reaction Conditions			
CO_2 Source[4]	-		
Catalyst[5]	-		
Pressure	bar		
CO_2 Partial Pressure	bar		
Temperature	°C		
Nominal Residence Time[6]	sec		
***Once-Through Performance*[7]**			
CO_2 Conversion[8]	%		
Selectivity to Desired Product[9]	%		
Yield of Desired Product[10]	%		
Product Composition			
Desired Product[11]	-		
Main Product Impurities[12]	-		
Purity of Finished Product[13]	%		
Product Production[14]	kg/hr.		
Co-Products[15]	-		
Co-Product Production[16]	kg/hr.		
***Product Properties*[17]**			
Density	kg/m^3		
Particle Size	(microns)		
Surface Area	m^2/g		
***Commercial Product Properties*[18]**		**Current**	
Density	kg/m^3		
Particle Size	microns		
Surface Area	m^2/g		
U.S. Market Size	Tonnes/yr.		
Global Market Size	Tonnes/yr.		
Market Price	$/kg		

Notes

[1] STP – Standard Temperature and Pressure (25°C, 1 atm)

[2] If Standard Enthalpies and Gibbs Free Energies of Formation cannot be found for some chemical species in the proposed chemical reaction(s), they should be estimated; however, the method usedmust be clearly referenced or described.

[3] Identify the type reaction for example, thermochemical, electrochemical, photochemical, etc.

[4] Identify the CO_2 source for example, coal-fired flue gas, natural gas-fired flue gas, pure CO_2, etc.

[5] Identify the catalyst composition

[6] For the calculation of Nominal Residence Time, the applicant should use the following equations:For experimental systems involving batch reactors:
{Nominal Residence Time} = {Length of Time Reactor is Operated}For continuous reactors operated at steady state, employing a solid catalyst:
{Nominal Residence Time} = {Mass of Catalyst in Reactor} / {Total Mass Flowrate into Reactor}For continuous reactors operated at steady state, employing a homogenous or no catalyst:
{Nominal Residence Time} = {Volume of Reactor} / {Total Volume Flowrate into Reactor}

[7] Once-Through Performance should be reported for the reaction(s) based on moles of CO_2 in the feed.[8] CO_2 Conversion is the quotient of the CO_2 reacted to the initial CO_2 in the feed, expressed as mole- percent.
CO_2 Conversion =100 x (moles CO_2 reacted) / (moles CO_2 in feed)

[9] Selectivity to Desired Product (as defined below) is the quotient of the moles of carbon from CO_2 in the Desired Product to the moles of CO_2 reacted, expressed as mole-percent.
Selectivity to Desired Product =100 x (moles of carbon from CO_2 in Desired Product) / (mols CO_2 reacted)

[10] Yield of Desired Product = (CO_2 Conversion) × (Selectivity to Desired Product) / 100

[11] Identify the desired product, for example graphene, carbon nanotubes, carbon black, etc. finished, commercial carbon products are defined by the performance specifications required for their specific uses. As used here, the term 'Desired Product' refers to the morphology of the carbon: nanotubes, graphene or graphitic sheets or flakes, etc., and does not include impurities left in the finished product.[12] Identify the main product impurities for the example byproducts contaminants, etc. that are not separated from the finished product.

[13] Purity of Desired Product = (mass of the desired product) / (Total mass of the finished product)
Where the 'Total mass of the product' is the mass of the desired product plus the mass of the product impurities or contaminants.

[14] Product Production is the mass flowrate of the desired product produced during the proposed testing.

[15] List the main Co-product, if applicable.

[16] Co-Product Production is the mass flowrate of the co-product produced during the proposed testing.

[17] Product Properties are the properties of the desired product produced during testing.

[18] Commercial Product Properties are the properties of the commercial product that the finishedproduct of the proposed technology plans to produce or compete against.

Table 8. Production of Inorganic Materials: Maximizing Carbon Uptake in Concrete and Cement Technology Performance Data

	Units	Measured/Current Performance	Projected/Target Performance
Reaction Thermodynamics [1,2]			
Chemical Equation	mol^{-1}	Balanced chemical equation	
$\Delta H°_{rxn}$	kJ/mol	Calculated from standard enthalpies of formation	
$\Delta G°_{rxn}$	kJ/mol	Calculated from standard free energies of formation	
Reaction Conditions			
CO_2 Source[3]			
Pressure	bar		
CO_2 Partial Pressure	bar		
Temperature	°C		
Nominal Residence Time[4]	sec		
Alkaline Reactant Source[5]			
Process Route[6]	(direct/ indirect)		
Once-Through Performance [7]			
CO_2 Conversion[8]	(%)		
CO_2 Uptake Potential[9]	(g-CO_2/g material)		
CO_2 Uptake Actual[10]	(g-CO_2/g material)		
Product Properties [11]			
Desired Product			
Compressive Strength[12]	(MPa)		
Density	(kg/m^3)		
Product Production	(kg/h)		
Commercial Product Properties [13]		**Current**	
Commercial Product			
Compressive Strength[12]	(MPa)		
Density	(kg/m^3)		
U.S. Market Size	(Tonnes/yr.)		
Global Market Size	(Tonnes/yr.)		
Market Price	($/kg)		

Notes

[1] STP – Standard Temperature and Pressure (25°C, 1 atm)

[2] If Standard Enthalpies and Gibbs Free Energies of Formation cannot be found for some chemical species in the proposed chemical reaction(s), they should be estimated; however, the method usedmust be clearly referenced or described.

[3] Identify the CO_2 source for example, coal-fired flue gas, natural gas-fired flue gas, pure CO_2, etc.

[4] For the calculation of Nominal Residence Time, the applicant should use the following equations:For experimental systems involving batch reactors:

{Nominal Residence Time} = {Length of Time Reactor is Operated}

For continuous reactors operated at steady state, employing a solid catalyst:

{Nominal Residence Time} = {Mass of Catalyst in Reactor} / {Total Mass Flowrate into Reactor}

For continuous reactors operated at steady state, employing a homogenous or no catalyst:

{Nominal Residence Time} = {Volume of Reactor} / {Total Volume Flowrate into Reactor}

[5] Identify the Alkaline Reactant Source for example, fly ash, slags, mine tailings, etc.

[6] Process Route: Identify the process as direct (carbonation of the feed occurs as a single step withoutextraction or dissolution of the mineral ions) or indirect (extraction or dissolution of mineral ions fromthe feed occurs in a separate step before carbonation)

[7] Once-Through Performance should be reported for the reaction(s) based on moles of CO_2 in the feed.

[8] CO_2 Conversion is the quotient of the CO_2 reacted to the initial CO_2 in the feed, expressed as mole- percent. CO_2 Conversion =100 x (moles CO_2 reacted) / (moles CO_2 in feed)

[9] CO_2 Uptake Potential is the mass of CO_2 that can theoretically be reacted per mass of the unreactedmaterial that produces the final product after carbonation

[10] CO_2 Uptake Actual is the actual mass of CO_2 reacted per mass of the unreacted material that producesthe final product after carbonation

[11] Product Properties are the properties of the desired product produced for during testing

[12] Compressive strength following 28 days of aging

[13] Commercial Product Properties are the properties of the current commercial product that theproposed technology plans to produce or compete against

APPENDIX L – PRE-FEED STUDY GUIDANCE

The integrated DAC system and DAC Hub balance-of-plant (BOP) pre-FEED studies shall result in equipment sizing fully substantiated with kinetic, heat and mass transfer data, as well as justification for choice of materials of construction. TA-1 Recipients must complete a pre-FEED study (i.e., Class 4 estimate with expected cost accuracy of +/- 30% and project definition maturity of at least 5%) for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required balance-of-plant (BOP) sited in the selected DAC Hub and designed for a minimum unit capacity of 50,000 tonnes CO_2 from the atmosphere annually (50 KTA), or up to the final DAC Hub capacity, depending on DAC Hub concept maturity. TA-2 and TA-3 Recipients must complete a pre-FEED study for the DAC Hub BOP, including utilities (e.g., sources for electricity, steam, water) and CO_2 transport, for the final DAC Hub capacity.

The pre-FEED shall cover both the DAC system and required BOP. BOP includes, but is not limited to, utilities such as compression, cooling water, water treatment, waste treatment, and the sources of energy, electricity, and/or steam that are necessary to power the DAC system. The BOP also includes CO_2 transport (see **Appendix W**), CO_2 conversion (if applicable), and may include integration of an external energy source (e.g., grid electricity, solar, wind, and geothermal). If the DAC system is designed to purchase renewable electricity or to generate it on site, then the plant must include a method of energy storage or back-up power purchase or generation to supply electricity when renewable electricity is not available. Otherwise, the DAC system design and cost should be reflective of the expected capacity factor of the power generating source. The energy sources used should be clearly defined, and the impact of the energy sources on the net air capture rate should be clearly provided.

To the extent information is available, Recipients should include a detailed description of the DAC Hub infrastructure in terms of major subsystems and their interconnection(s) and a description of how the DAC Hub is intended to operate. If available, high-level schematic, technical specifications, equipment supplier and vendor information for all technologies, systems, and connective infrastructure should be included in the application. The Applicant should also describe the mass and energy balance of any major supply chain elements or unit operations, relevant system capacities, and projected availabilities.

If available, equipment descriptions should include consideration of how equipment would be used dynamically within the system. The applicant should describe how the system design will address relevant needs for energy buffering, storage of or buffering for any intermediary, input, or waste products. Needs for and plans to balance variable supply and demand signals, as well as resiliency aspects necessary to handle maintenance outages and external system shocks should also be described.

Recipients will be expected to develop detailed cost estimates that meet industry standards for the size and complexity of the proposed DAC Hub. DOE expects that DAC Hubs will employ industry standard cost estimating methodologies and tools. Cost estimates should correspond to

the DAC Hub design maturity and reflect appropriate uncertainties. While DOE is not requiring its use, Applicants are encouraged to review DOE's Cost Estimating Guide.[42] The Table below is included in that guide and highlights examples of industry standard cost estimating approaches and use cases.

Table 1: Cost Estimate Classification for Process Industries

	Primary Characteristic	***Secondary Characteristic***		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

The cost estimate shall include preparation of a total project cost (TPC) estimate, and capital and operating cost estimates, including the cost in $/net tonne CO_2e removed and cost of the CO_2 conversion product (if applicable). The pre-FEED shall include, at a minimum: preliminary process flow diagrams; heat and material balances prepared based on a DAC process model scaled up for a minimum capture capacity of 50 KTA CO_2 facility; preliminary utility flow diagrams; preliminary piping and instrumentation diagrams; rough plot plan; draft layout drawings; draft engineered process and utility equipment lists; draft single line diagrams for electrical; vendor quotations; draft project execution plans; draft resourcing and work force plans; and a hazard and operability study (HAZOP) review.

Any costs associated with CBP activities should also be included in the TPC estimate. Narratives accompanying cost estimates should include an explanation of the estimate class and/or maturity, a description of the methodology employed, and the uncertainty or accuracy range. While DOE is not requiring specific escalation assumptions be used for the TPC, cost estimate narratives should explain what assumptions were used and why they were deemed appropriate. DOE may require use of standard cost estimating assumptions, including escalation assumptions in future phases.

[42] DOE G 413.3-21A *Cost Estimating Guide*: https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-21A

APPENDIX M – FEED STUDY GUIDANCE

The integrated DAC FEED study is a FOA deliverable required from projects selected under TA-2. TA-2 Recipients must complete a DAC FEED study for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required balance-of-plant (BOP) sited in the selected DAC Hub and designed for a minimum unit capacity of 50,000 tonnes of CO_2 removed from the atmosphere annually (50 KTA), or the final DAC Hub capacity, depending on DAC Hub concept maturity, include, but are not limited to, those listed below:

1. **Project Scope and Design** that includes business objectives and the summary of the proposed project. The roles and scope of work for the different parties involved in the project should be clearly delineated.

2. **Project Design Basis** including, but not limited to, site characteristics and ambient conditions, fuel feedstock characteristics (if applicable), and site environmental requirements. The operating ranges considered during the FEED study should be provided. The design basis shall clearly identify all local, state, federal permits and environmental reviews necessary to initiate construction. All approvals required to initiate construction shall be identified. Energy sources and their impact on the net air capture rate should be provided. If after completing the FEED, it is decided that a different plant configuration should be considered, and that the reported design is not viable, this information should be communicated clearly up front. If major design changes are required, this should be reflected in the project timeline, and a path forward clearly outlined.

3. **Engineering Design Package**. Design of the integrated DAC system shall result in equipment sizing fully substantiated with kinetic, heat and mass transfer data, as well as justification for choice of materials of construction. The cost estimate shall include preparation of a total project cost (TPC) estimate, and capital and operating cost estimates, including the cost in \$/net tonne CO_2e removed and cost of the CO_2 conversion product (if applicable). The FEED shall include, at a minimum: process flow diagrams; heat and material balances; plot plan; DAC process model scaled-up to the proposed capture capacity; piping and instrumentation diagrams; complete process and utility equipment lists with all major equipment with all major equipment (e.g. for a solvent-based system: direct contact cooler, absorber, solvent heat exchangers, stripper, CO_2 compressors etc.) specifications and sizing; single line diagrams for electrical; electrical equipment and motor schedules; control logic diagrams; vendor quotations and equipment drawings; detailed project execution plans; resourcing and work force plans; a hazard and operability study (HAZOP) review; and a constructability review. The FEED shall incorporate all engineering disciplines necessary to perform the final design and construction, which include, but are not limited to: process and equipment, civil, architectural, structural, mechanical, piping, electrical, and control systems engineering. A list of all referenced work should be provided.

Engineering design shall cover both the DAC system and balance-of-plant (BOP). BOP includes, but is not limited to, utilities such as compression, cooling water, water treatment, waste treatment, and the sources of energy, electricity, and/or steam that are necessary to power the DAC system. The BOP also includes CO_2 transport (see **Appendix W**), CO_2 conversion (if applicable), and may include integration of an external energy source (e.g., grid electricity, solar, wind, and geothermal). If the DAC system is designed to purchase renewable electricity or to generate it on site, then the plant must include a method of energy storage or back-up power purchase or generation to supply electricity when renewable electricity is not available. Otherwise, the DAC system design and cost should be reflective of the expected capacity factor of the power generating source. The energy sources used should be clearly defined, and the impact of the energy sources on the net air capture rate should be clearly provided.

To the extent information is available, Recipients should include a detailed description of the DAC Hub infrastructure in terms of major subsystems and their interconnection(s) and a description of how the DAC Hub is intended to operate. If available, high-level schematic, technical specifications, equipment supplier and vendor information for all technologies, systems, and connective infrastructure should be included in the application. The Applicant should also describe the mass and energy balance of any major supply chain elements or unit operations, relevant system capacities, and projected availabilities.

If available, equipment descriptions should include consideration of how equipment would be used dynamically within the system. The applicant should describe how the system design will address relevant needs for energy buffering, storage of or buffering for any intermediary, input, or waste products. Needs for and plans to balance variable supply and demand signals, as well as resiliency aspects necessary to handle maintenance outages and external system shocks should also be described.

Recipients will be expected to develop detailed cost estimates that meet industry standards for the size and complexity of the proposed DAC Hub. DOE expects that DAC Hubs will employ industry standard cost estimating methodologies and tools. Cost estimates should correspond to the DAC Hub design maturity and reflect appropriate uncertainties. While DOE is not requiring its use, Recipients are encouraged to review DOE's Cost Estimating Guide.[43] The Table below is included in that guide and highlights examples of industry standard cost estimating approaches and use cases.

[43] DOE G 413.3-21A *Cost Estimating Guide*: https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-21A

Table 1: Cost Estimate Classification for Process Industries

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
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Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Any costs associated with CBP (CBP) activities should also be included in the TPC estimate. Narratives accompanying cost estimates should include an explanation of the estimate class and/or maturity, a description of the methodology employed, and the uncertainty or accuracy range. While DOE is not requiring specific escalation assumptions be used for the application TPC, cost estimate narratives should explain what assumptions were used and why they were deemed appropriate. DOE may require use of standard cost estimating assumptions, including escalation assumptions in future phases.

Design of the DAC system shall support a capital cost estimate consistent with the Association of the Advancement of Cost Engineering (AACE) Class 3 (i.e., expected cost accuracy of +/- 15% and project definition maturity of 40%) for a minimum capacity of 50 KTA CO_2. Recipients will be required to submit the project cost estimate 90 days prior to project completion.

Successful projects will be required to submit the following during the FOA period of performance: (i) an initial engineering design package 180 days after the FOA project start that includes, at a minimum, process flow diagrams, the results of the heat and material balances, and sizing of the main pieces of equipment for the direct air capture plant and BOP based on a validated process model (prior to initiating design activities, the completeness of this data set must be verified by DOE), and (ii) the final integrated DAC FEED study package 90 days prior to project completion.

FEED Study – Requirements

It is understood that the content to be included in a FEED study package is tailored by the type of project and the needs of the owner. Often Engineering, Procurement, and Construction (EPC) firms will have an in-house standard in the absence or lack of owner definition. The goal of the FEED study is for the owner and EPC firm to collaboratively refine the project's scope, design, and cost estimate as much as possible to reduce risk and uncertainty prior to executing the project. Often, items 1–3 in the list below are provided by the owner to the EPC firm. **The following is a list of content to be included in the FEED study developed by the end of the project for this FOA. Recipients are encouraged to include additional materials outside this list that resulted from the uniqueness of their respective project or the needs of the owner. Recipients are also encouraged to integrate detailed design activities with CBP requirements and activities as appropriate for the project into an overall integrated project schedule. ALL sections of the report should be cross checked to ensure that the values agree between sections of the report(s). Missing appendices, section headings, and mislabeled figures should be avoided. Image quality should be checked; figures with unreadable text should not be included.**

1) Project Background
    a) Discusses project need or business objective
    b) Includes major aims and conclusions of each of the subsequent chapters
2) Project Scope
    a) Provides a summary of the proposed project, the project objective, and how it will meet the objective
    b) Delineates the roles and scope of work for the different parties involved in the project
    c) Provides the system boundaries, or battery limits, of the proposed project
3) Project Design Basis
    a) Site Characteristics
        i) Location, topography, available land, transportation access, available utilities, access to water, access to carbon dioxide piping or storage sites
        ii) Social characterization, including regional analysis of communities and disadvantaged communities, and whether those communities rely on limited resources (e.g., water) that could be impacted by the project. This information should be consistent with the CBP
    b) Site Ambient Conditions
        i) Elevation, prevailing wind, relative humidity, seismic data
        ii) Atmospheric pressure, temperature averages and extremes, air composition averages and extremes
    c) Fuel Feedstock: compositional analyses of any fuel used depicting the expected compositional range
    d) Environmental Requirements – as dictated by the authority(s) having jurisdiction (the state's Department of Environmental Protection [DEP] and the Environmental Protection Agency [EPA], etc.)

i) Air emission permitting limitations and required control technologies
ii) Water discharge permitting limitations and required control technologies
iii) Waste disposal (e.g., spent sorbents or solvents) permitting limitations and required control technologies
iv) Safety considerations – local fire department, community engagement

e) Site Specific Design Considerations: flood plain, soil conditions, rainfall/snowfall criteria, building/enclosure permitting, noise regulations, local community requirements for the proposed site
f) Modularization Design Requirements

4) Basic Contracting and Purchasing Strategy
a) Strategy for tracking cost and schedule performance, such as cost performance indicators from an earned value management system
b) Details about staffing/operation of the DAC plant and the BOP

5) Engineering Design Packages
a) Process Engineering
i) Process area descriptions
ii) Finalized block flow diagrams (BFDs), process flow diagrams (PFDs), and piping & instrumentation diagrams (P&IDs)
(1) Minimum Stream Requirements:
(a) Gas effluent from the absorber
(b) CO_2 product from the regenerator
(c) CO_2 product after compression (with detailed impurities)
iii) Process simulation output and heat and material balances (H&MB)
iv) Direct air capture technology specific design details. This includes capture fraction; pressure drop across the contactor; working capacity or solvent loading; adsorption, desorption, and cycle times; selectivity; vacuum pressure; regeneration energy; steam requirement; system auxiliary load; sorbent or solvent initial fill and make up rates
v) Equipment and instrumentation lists and vendor datasheets. Process equipment specifications should include sizing and key parameters used for equipment costing (e.g., height, diameter, heat duty, delta temperature, power, and materials of construction)
vi) HAZOP/Process Hazard Analysis (PHA) documentation
vii) Cause and Effect diagrams
viii) Overpressure Relief/Flare Study
b) Civil and Structural Engineering
i) Soil load analysis
ii) Soils resistivity assessment
iii) Storm water runoff plan
iv) Geologic assessment
v) Spill containment assessment
vi) Determination of type of foundation for various loads associated with process and balance of plant equipment

c) Structural Engineering
    i) Foundation design drawings (e.g., concrete sonotubes & slabs, helical pillars)
    ii) Structural and Architectural drawings (e.g., process equipment/piping structural supports, access gangways/ladders, building enclosures, etc.)
    iii) Structural steel support and its foundation
    iv) Material take-offs
d) Mechanical Engineering
    i) General site plan view(s)
    ii) 3-D model and/or equipment elevation sections & plan drawings
    iii) Piping/tracing/insulation line list and material specification
    iv) Piping isometrics
    v) Piping layout/routing drawings
e) Electrical Engineering
    i) Electrical load lists
    ii) One-line diagram(s)
    iii) Electrical equipment (e.g., substation, motor control centers, switchgear) specifications
    iv) Cable/cable tray routing drawings and specifications
    v) Lighting drawings
f) Instrumentation & Controls Engineering (System Integration)
    i) Control system architecture specification
    ii) Instrument/equipment lists, and specifications
    iii) Loop drawings
    iv) Communications infrastructure (e.g., remote SCADA ability, telephone, internet) specifications
g) Fire Protection Engineering
    i) Fire protection system (e.g., sprinkler, foam, and water cannons) design specifications and drawings
h) Facilities Engineering
    i) Building/Security Infrastructure Plans
        (1) Front office/administration
        (2) Control room(s)
        (3) Maintenance/shop area
    ii) HVAC
i) Project Security
    i) Site physical security
    ii) Cybersecurity and associated information protection systems
j) Transportation & Logistics Study
k) Constructability
    i) Construction access
    ii) Lay-down areas
    iii) Sequencing of construction work

l) Project Cost Estimate (+/− 15%) – Must specify year dollar basis and nominal vs. real
   i) Individual component capital cost, including quantity (weight, lengths, numbers, etc.), unit rate, process equipment cost, material cost, labor cost including unit labor rate for individual line items, and man-hours required to complete individual line item tasks. Details regarding what is included in the capital cost estimate (labor, materials, equipment, contingency, engineering fees, delivery, etc.) need to be provided.
   ii) Breakdown of variable operating costs, including quantity (weight, volume, etc.), per unit rate. The variable operation and maintenance (O&M) cost includes but not limited to consumable consumption rates and unit costs, catalyst cost, specialty chemicals, waste generation rates and disposal costs, and power and fuel costs. Justifications for the unit costs should be provided where appropriate (e.g., power purchase agreements and waste classified as hazardous/nonhazardous)
   iii) Detailed accounting of fixed O&M costs should be provided. This includes labor rates and personnel requirements for operating labor, maintenance assumptions including labor and material required for annual maintenance, and administrative labor such as office support staff and supervisors. Owner's Costs
   iv) Cost of capture ($/net tonne of CO_2e captured by DAC technology)
   v) Cost of the CO_2 conversion product (if applicable)
   vi) Overall cost of removal ($/net tonne of CO_2e removed by integrated DAC system)
   vii) Quantitative risk analysis and associated funding contingency requirements. Financial factors must be detailed. The methodology used to calculate the cost of CO_2 capture and removal must be clearly outlined. Requested details include:
      (1) Interest rate, project life, debt-equity arrangement, taxes, insurance, contingency and other cost escalation
      (2) Owner's cost calculation details
      (3) Annualization calculation details
      (4) Calculated costs should take into account expected capacity and utilization factors and operational mode
m) Integrated Project Schedule (see **Appendix Z** for additional guidance)
   i) Identification of the project critical path
   ii) A Level 3 schedule identifying associated milestones
   iii) Strategy for tracking schedule performance such as schedule performance indicators from an earned value management system

FEED Study Checklist

Based on prior experience with front end engineering design (FEED) study reporting, the following checklist is provided to emphasize key pieces of information that should be contained in the detailed design reports (as a minimum). The items shown in the checklist are all included in the above explanation but are identified in this chart for emphasis.

Reporting Guidelines

Category	Topic	Description
Reporting	Report organization	The FOA gives an outline for important sections to be included in the FEED report, and this outline should be followed. The executive summary should include a summary of all pertinent information and major aims and conclusions of each of the subsequent chapters upfront.
	Quality control	There should be no inconsistencies in reported values in different sections of the report. Missing appendices, section headings, and mislabeled figures should be avoided. Image quality should be checked; figures with unreadable text should not be included.

General Guidelines

Category	Topic	Description	Location in Text/ Page #
General	Potential changes to design	If after completing the FEED it is decided that a different plant configuration should be considered, and that the reported design is not viable, this information should be communicated clearly up front. If major design changes are required, this should be reflected in the project timeline, and a path forward clearly outlined.	
	Definition of roles	The roles and scope of work for the different parties involved in the project should be clearly delineated.	
	Sources used	A list of sources should be provided.	

Performance Guidelines

Category	Topic	Description	Location in Text/ Page #
	DAC process configuration	1 - The overall process flow diagram with main input and output streams should be highlighted. 2 - Detailed P&ID should be included. 3 - An equipment list with all major equipment specifications and sizing should be provided.	
	DAC system details	The process design and operation should be clearly described. DAC system details allowing comparison with other technologies are requested. These details include, but are not limited to: 1 - Initial sorbent/solvent fill, and sorbent/solvent make up rates 2 - Performance metrics: capture fraction; pressure drop across the contactor; working capacity or solvent loading; adsorption, desorption, and cycle times; selectivity; vacuum pressure; regeneration energy; steam requirement; system auxiliary load	
	Compression system details	Compression technology details allowing comparison with other technologies are requested. These details include: 1 - Compressor type 2 - Number of stages 3 - Intercooling and/or aftercooling requirements 4 - Electricity or steam requirement details 5 - Output pressure, CO_2 purity, and justification for product CO_2 stream purity and pressure	
Performance	Stream tables	Energy and mass balance details should be provided. At a minimum this includes the flow rate, composition, temperature, pressure, density, and enthalpy for the following streams: 1 - Ambient air 2 - Process effluent and emissions streams 3 - Effluent from any air conditioning steps 4 - CO_2 product stream from the contactor 5 - CO_2 product after compression (with detailed impurities)	

Category	Topic	Description	Location in Text/ Page #
	Steam requirement	The source, quality, and quantity of steam required by the process must be specified for each application, including: 1 - Solvent/sorbent regeneration steam 2 - Compression system steam (if applicable) 3 - Other miscellaneous applications such as triethylene glycol (TEG) drying	
	Auxiliary power	1 - Auxiliary power requirements for different sub-systems of the direct air capture system and balance of plant systems must be specified. A detailed electrical load list should be provided. 2 - The power source should also be specified (e.g., purchased from grid, dedicated renewable energy source, and auxiliary combined heat and power [CHP] with carbon capture). The impact of the power source on the net air capture rate should be detailed.	
	Justification of design	Justification for all major design decisions should be provided. This includes: 1 - Results from any case studies performed when deciding on the specific configuration 2 - DAC system (and any non-commercially available system at scale) modeling details including model basis and validation, system modeling results, and justification for any design decisions that deviate from the modeled system 3 - Justification for product CO_2 stream purity and pressure	

Cost Guidelines

Category	Topic	Description	Location in Text/ Page Numbers
Cost	Dollars	The year dollar must be provided and nominal vs. real dollars specified for clarity. The capital cost estimate should be consistent with AACE Class 3 accuracy (+15%/−15%).	

Category	Topic	Description	Location in Text/ Page Numbers
	Cost details	Detailed costs should be provided. This includes: 1 - Capital cost: preferably includes costs for individual pieces of equipment, but at a minimum provides totals for the DAC system, compression system, and BOP. Details regarding what is included in the capital cost estimate (labor, materials, equipment, contingency, engineering fees, delivery, etc.) need to be provided. 2 - O&M costs: a detailed accounting of O&M costs should be provided. This includes labor rates and personnel requirements, maintenance assumptions, insurance, property taxes, consumable consumption rates and unit costs, waste generation rates and disposal costs, and power and fuel costs. Justifications for the unit costs should be provided where appropriate (e.g., power purchase agreements and waste classification as hazardous/nonhazardous) 3 - Owner's costs 4 - Cost of capture ($/net tonne of CO_2e captured by DAC technology) 5 - Cost of the CO_2 conversion product (if applicable) 6 - Overall cost of removal ($/net tonne of CO_2e removed by integrated DAC system)	
	Costing methodology	Financial factors must be detailed. The methodology used to calculate the cost of CO_2 capture must be clearly outlined. See NETL's Quality Guidelines for Energy Systems Studies: Cost Estimation Methodology for NETL Assessments of Power Plant Performance, Department of Energy, Pittsburgh, Pa, 2021 for an example of the detail requested. Requested details include: 1 - Expenditure period, operating period, capital escalation during expenditure, assumed inflation rate, O&M escalation, O&M	

Category	Topic	Description	Location in Text/ Page Numbers
		levelization factor, sales tax rates, debt-equity arrangement, interest rate on debt, return on equity, fixed charge factor etc. 2 - Owner's cost calculation details 3 - Annualization calculation details	

FEED Value Template

Based on prior experience with FEED study reporting, it is REQUIRED that this template is completed and submitted with the detailed design report. This facilitates review of the final design parameters. The values in this table should agree with the values throughout the report. All parameters relevant to the specific DAC technology should be reported. Additional relevant entries, not included in this table, should be added.

Parameter	Units	Value		Pages in Text Discussing Parameter
DAC Plant Design Basis and Performance				
Ambient Air Design Basis Range Note: If air is comingled with any streams or pretreated upstream of the CO_2 removal step, this information must be provided for all streams prior to the CO_2 removal step	°F			
	psia			
	ppmv CO_2			
	mol% H_2O			
	mol% N_2			
	mol% O_2			
	Other notable constituents/ pollutants			
Auxiliary Load of DAC	MW			
Auxiliary Load of CO_2 Compression	MW			
Auxiliary Load of BOP equipment	MW			
Electrical Auxiliary Boiler Load (if applicable)	MW			
Heat Requirement (if applicable)	MW			
Heat source	--			
Auxiliary Boiler Steam Generation	lb/hr			
	psia			
Steam for Sorbent/Solvent Regeneration	lb/hr			
	psia			

Parameter	Units	Value	Pages in Text Discussing Parameter
	direct/indirect		
Capacity Factor of Power/Heat Source	%		
Utilization Factor of DAC	%		
Air Inlet to DAC Process	lb/hr		
Contactor CO_2 Capture Fraction	%		
Gross DAC CO_2 Capture Capacity	tonnes/yr.		
Gross Plant CO_2 Capture Capacity	tonnes/yr.		
Net CO_2 Capture Capacity	tonnes/yr.		
CO_2 Stream Leaving the DAC Contactor, or for Multistage Processes, CO_2 Stream Leaving Each Stage	lb/hr		
	mol% CO_2		
	mol% H_2O		
	mol% O_2		
	°F		
	psia		
	lb/mol		
CO_2 Product after Compression	lb/hr		
	°F		
	psia		
	mol% CO_2		
	ppm_v H_2O		
	ppm_v O_2		
Pressure Drop Across the Air Contactor	psi		
Air Superficial Velocity	ft/s		
Contactor depth	ft		
Water Consumption of the DAC Facility	lb/hr		
Number of Contactor Modules			
Initial Solvent Fill	tonne		
Solvent Make-up Rate	tonne/yr.		
Solvent Loading	mol/mol		
Solvent Regeneration Energy	Btu/lb CO_2		
Sorbent Initial Fill	tonne		
Sorbent Life	years		
Sorbent Working Capacity	mol/kg		
Sorbent Bulk Density	lb/ft^3		
Sorbent Void Fraction			

Parameter	Units	Value	Pages in Text Discussing Parameter
Sorbent Selectivity	CO_2/N_2		
	CO_2/O_2		
	CO_2/H_2O		
Sorbent Vacuum Pressure	psia		
Specific Sorbent Regeneration Energy	Btu/mol CO_2		
Adsorption time	s		
Desorption time	s		
Cycle time	s		
Costs			
Dollar Basis	Year		
	Real or nominal		
Capital Cost Accuracy	+/– %		
DAC System Capital Cost			
Equipment	$		
Material	$		
Direct and indirect labor for installation and construction	$		
Engineering Contracting	$		
Process Contingencies	$		
Project Contingencies	$		
CO_2 Compression System Capital Cost			
Equipment	$		
Material	$		
Direct and indirect labor for installation and construction	$		
Engineering Contracting	$		
Process Contingencies	$		
Project Contingencies	$		
BOP and Modifications Capital Cost			
Equipment	$		
Material	$		
Direct and indirect labor for installation and construction	$		
Engineering Contracting	$		
Process Contingencies	$		
Project Contingencies	$		

Parameter	Units	Value	Pages in Text Discussing Parameter
Solvent Costs			
Initial Fill	$		
Solvent Make-up	$/yr.		
Unit price	$/tonne		
Sorbent Cost			
Initial Cost Per Module	$		
Initial Fill Cost (Sorbent)	$		
Replacement Cost	$/yr.		
Unit Cost	$/tonne		
Solvent or Sorbent Waste Disposal	$/tonne		
	$/yr.		
Natural Gas (if applicable)	$/MMBtu		
	$/yr.		
Electricity	$/MWh		
	$/yr.		
Other Consumables/Waste Disposal	$/yr.		
Maintenance Allowance	$/yr.		
Operating and Maintenance Labor Costs	$/yr.		
Property Taxes/Insurance	$/yr.		
Expenditure Period	years		
Operating Period	years		
Inflation	%		
Capital Escalation During Expenditure	%		
O&M Escalation	%		
O&M Levelization Factor	%		
Effective Sales Tax Rate (State and Federal)	%		
Debt-to Equity Ratio			
Interest Rate on Debt	%		
Return on Equity	%		
Fixed Charge Factor			

APPENDIX N – UNDERGROUND INJECTION CONTROL (UIC) CLASS VI PERMIT TO CONSTRUCT

TA-2 Recipients and TA-3 Applicants shall submit a complete application(s) for an Underground Injection Control (UIC) Class VI permit to the relevant state or federal regulatory authority to construct an injection well and participate in good faith in the permitting process. A UIC Class VI permit(s) to construct will specify that the applicant is authorized to construct the injection wells (or convert existing wells).

The U.S. Environmental Protection Agency's (USEPA) guidance documents and the regulatory requirements for submission of the application for a UIC Class VI permit(s) to construct will help guide successful applicants' activities under this FOA. For a complete listing of the requirements for permit applications, see the USEPA website at https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-co2. The activities for preparing an application for a Class VI permit to construct include, at a minimum:

- Site Characterization
- Determination of Area of Review and Corrective Action
- Injection Well Construction Plan
- Plans for Pre-Operational Testing
- Proposed Injection Well Operations
- Proposed Monitoring Plan
- Proposed Mechanical Integrity Testing
- Proposed Injection Well Plugging
- Proposed Post-Injection Site Care (PISC) and Site Closure Plan
- Emergency and Remedial Response Plan
- Demonstration of Volume Containment
- Demonstration of Financial Responsibility
- Public Participation
- CO_2 Source(s) and Chemical Makeup of CO_2 Stream(s)

APPENDIX O – BASIS FOR TECHNOLOGY EH&S RISK ANALYSIS

Environmental Health and Safety is critical to enabling the successful commercialization of DAC Hub technologies. It is important to maintain a continued focus on a safety culture across all aspects of demonstration, deployment, and commercialization. Fostering a strong safety culture must be a priority for the entire scope of a DAC Hub – for every component, piece of equipment, integrated system, and all connective infrastructure. Each DAC Hub must develop a comprehensive Safety Program that encompasses all sites, technologies, and end-uses. The DAC Hub must identify a lead (individual or team) for their Safety Program through which all safety plans are coordinated and submitted.

TA-2 and TA-3 applications must include an initial technology EH&S risk analysis. Teams should include a detailed description of safety culture, including a five-year construction/operations safety performance history (such as an OSHA 300A form or Experience Modification Rating) of the entities and management involved in the DAC Hub. For those DAC Hub teams who may not have an extensive history, a detailed description of their intended safety culture for the DAC Hub should be provided. Teams must also discuss site and cybersecurity considerations for the DAC Hub.

The Safety Program Lead will coordinate the development of comprehensive safety plans for all relevant sites,[44] to be reviewed by DOE or third-party consultants representing DOE interests. These plans should address appropriate OSHA and local safety requirements for each relevant site and should be updated regularly through the life of the project.

DAC Hubs must perform a hazard and operability analysis (HAZOP) for each site and include the results in their safety plans that will be developed and refined during the project. DAC Hubs should document their operational safety procedures for each site and are encouraged to obtain an audit of those procedures by an appropriately credentialed body. This documentation should include plans for staff safety, maintenance, and operation training.

DAC Hubs are encouraged to provide or direct local first responders and authorities having jurisdiction (AHJs) to relevant training materials, including those for the safe handling of process chemicals and other industrial activities at each site in a DAC Hub. DAC Hubs are encouraged to provide relevant training to local first responders, which should take place prior to the end of Phase 3.

DAC Hubs will be required to collect and submit safety related data (e.g., component failure) during the period of DOE project funding. In addition, recipients will be encouraged to voluntarily

[44] For safety planning purposes, a "Site" may contain one or more different DAC, CO_2 storage, or conversion technologies that may be covered under a single safety plan. For example, all components of a DAC technology where on-site capture and conversion are co-located can be considered as part of a single site. Safety plans may be subdivided across several sites at the discretion of the DAC Hub, but all elements of the DAC Hub must be included in a safety plan.

provide safety-related data for a period of five (5) years from the end date of the DOE award. This data requirement contributes to a future safety culture by encouraging open communication about safety and lessons learned. It will also enable advancements in risk assessment and codes and standards development. DAC Hubs will be required to notify DOE of any safety event (e.g., leak events, fires) within 14 days and submit a report which includes a root cause analysis and steps taken to prevent future events within 60 days of the event.

Teams must also complete a permitting workflow overview that identifies the relevant and applicable federal, state, and local codes, regulations, and permitting requirements anticipated to site, construct, implement, and operate the DAC Hub. As DAC Hubs will likely span multiple site locations, the overview should be organized by site location and should identify the Authority Having Jurisdiction (AHJ) and relevant regulatory bodies that may have approval authority during the course of the project (e.g., U.S. Nuclear Regulatory Commission for DAC Hubs involving commercial nuclear power plants). DOE recognizes that the material in this overview document will likely change during the award and, as such, will require that it be revised and updated during project execution. DOE encourages DAC Hubs to conduct outreach to AHJs and submit any written confirmation from AHJs regarding the project, if received. Frequent communication with AHJs through the life of the project is encouraged as a means of mitigating permitting delays.

The purpose of the EH&S activity is to assess the environmental friendliness and safety of any future process based on the materials and process being proposed under the subject DOE FOA. This is the major concern for solvents in use today. Exposure to nanoparticles is also coming under increasing scrutiny by the U.S. Environmental Protection Agency (EPA), National Institute for Occupational Safety and Health (NIOSH) and others. The EH&S risk assessments shall be conducted by qualified and experienced organizations and professionals (*e.g.,* environmental scientists, industrial hygienists, safety engineers). *Unanticipated or uncontrolled EH&S risks will impede commercialization of CO_2 capture technologies, and the EH&S assessment is a critical element of the development project.*

Required elements for the EH&S Analysis are:

1) All potential ancillary or incidental air and water emissions, and solid wastes produced from the proposed technology shall be identified and their magnitude estimated. In addition to solvents or sorbents used, researchers shall consider possible by-products of side reactions that might also occur in the system, accumulated waste products, and the fate of contaminants from the feed gas stream. Environmental degradation products shall be addressed. Bioaccumulation, soil mobility, and degradability shall be considered. Conditions at the point of discharge shall be examined.

2) If possible, a concise but complete and comprehensible description of the various toxicological effects of the substances identified in (1) above shall be provided. A thorough literature search shall be conducted to examine potential human health effects and ecotoxicity. Where information is lacking for a particular material, it shall be compared to similar substances or classes of substances.

3) Properties related to volatility, flammability, explosivity, other chemical reactivity, and corrosivity shall also be collected from existing databases or if necessary, through direct measurement in cases where the substance is not in common use.

4) The compliance and regulatory implications of the proposed technology shall be addressed with reference to applicable U.S. EH&S laws and associated standards including the Comprehensive Environmental Response and Liability Act of 1980 (CERCLA), Toxic Substances Control Act (TSCA), Clean Water Act (CWA), Clean Air Act (CAA), Superfund Amendments and Reauthorization Act (SARA) Title III, and the Occupational Safety and Health Act (OSHA).

5) An engineering analysis shall be conducted for any potentially hazardous materials identified to look for ways their use can be eliminated or minimized. Less hazardous materials should be substituted where possible. For any new materials being proposed, synthetic options shall be examined that may lead to similar, less-hazardous compounds with the required functionality. Possible engineering controls and other mitigation strategies shall be described as appropriate.

6) Precautions for safe handling and conditions for safe storage shall be identified, including any incompatibilities with other materials that may be used in the process. Waste treatment and offsite disposal options shall be examined. Accidental release measures shall also be discussed.

APPENDIX P – STATEMENT OF PROJECT OBJECTIVES

STATEMENT OF PROJECT OBJECTIVES
Title of Project
(Insert the title of the work to be performed. Be concise and descriptive)

This should be a standalone document that states the work to be conducted and should not include any proprietary/confidential information.

Note: Text highlighted in yellow is required for TA-1 (Phase 0) applications.

A. OBJECTIVES

Include one paragraph on the overall objective(s) of the work. Note: if the project will be performed in phases, include specific objective(s) for each phase of the work.

B. SCOPE OF WORK

This section should not exceed one-half page and should summarize the effort and approach to achieve the objective(s) of the work. Note: if the project will be performed in phases, includes specific scope statement(s) for each phase.

C. TASKS TO BE PERFORMED

This section provides a brief summary of the planned approach to this project. Tasks/subtasks, concisely written, should be provided in a logical sequence and should be divided into the phases of the project, as appropriate. In writing the Statement of Project Objectives (SOPO), avoid 1) the use of proper nouns to minimize SOPO modifications in the event of changes to the project team, facilities, etc.; 2) figures and equations; 3) references to other documents and publications; and 4) details about past work and discussion of technical background (which should be covered elsewhere in the application narrative).

Task 1.0 - Project Management and Planning (REQUIRED; APPLICANT INSERT THIS TASK) THE LANGUAGE PROVIDED BELOW IN QUOTES)

Subtask 1.1 – Project Management Plan (REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES. SEE **APPENDIX Q** FOR FORMAT)
"The Recipient shall manage and direct the project in accordance with a Project Management Plan to meet all technical, schedule and budget objectives and requirements. The Recipient will coordinate activities in order to effectively accomplish the work. The Recipient will ensure that

project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

The Recipient shall update the Project Management Plan 30 days after award and as necessary throughout the project to accurately reflect the current status of the project. Examples of when it may be appropriate to update the Project Management Plan include: (a) project management policy and procedural changes; (b) changes to the technical, cost, and/or schedule baseline for the project; (c) significant changes in scope, methods, or approaches; or (d) as otherwise required to ensure that the plan is the appropriate governing document for the work required to accomplish the project objectives.

Management of project risks will occur in accordance with the risk management methodology delineated in the Project Management Plan in order to identify, assess, monitor and mitigate technical uncertainties as well as schedule, budgetary and environmental risks associated with all aspects of the project. The results and status of the risk management process will be presented during project reviews and in quarterly progress reports with emphasis placed on the medium- and high-risk items."

The Recipient is also required to implement the project in accordance with the negotiated CBP package. In addition, it is expected that key milestones associated with these plans will be incorporated into the milestone log as part of the overall Project Management Plan and that there will be at least one milestone per year associated with each plan. The quarterly progress reports and the final technical report shall include updates on the progress and challenges throughout the course of the award.

Subtask 1.2 – Business Plan (REQUIRED; SEE **APPENDIX S** FOR FORMAT)

(TA-1 APPLICANTS INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES.)
"The Recipient shall develop a Business Plan for the project." The Business Plan shall encompass Commercial Feasibility and Business Case Analysis; Key Contracts, Permits, and Agreements; Preliminary Site Selection; Market Analysis; Feedstock, Supplies, and Offtake Arrangements, and the DAC Hub Capacity Build-Out Plan."

(TA-2 AND TA-3 APPLICANTS INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES.)
"The Recipient shall update the Business Plan as necessary throughout the project to accurately reflect the current status of the project."

Subtask 1.3 – Financial Plan (REQUIRED; SEE **APPENDIX T** FOR FORMAT)

(TA-1 APPLICANTS INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES.)
"The Recipient shall develop a Financial Plan that presents a viable plan to obtain funding for the entire non-DOE share of the total project cost and identifies all sources of project funds."

(TA-2 AND TA-3 APPLICANTS INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES.)

"The Recipient shall update the Financial Plan as necessary throughout the project to accurately reflect the current status of the project."

Subtask 1.4 – Technology Maturation Plan (REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES. SEE **APPENDIX V** FOR FORMAT)

"The Recipient shall develop a Technology Maturation Plan (TMP) that describes the current technology readiness level (TRL) of the proposed technology/technologies, relates the proposed project work to maturation of the proposed technology, describes the expected TRL at the end of the project, and describes any known post-project research and development necessary to further mature the technology. For TA-1, the initial TMP is due with the Phase 0a "Decision Point Application" and should be updated as needed throughout the project period of performance. For TA-2 and TA-3, the initial TMP is due 90 days after award and should be updated as needed throughout the project period of performance. A final TMP should be submitted within 90 days of completion of the project."

Subtask 1.5 – Community Benefits Plan (REQUIRED; SEE SECTION I.B.iv.. and **APPENDICES E and F** FOR SUGGESTED FORMATS)

(TA-1 APPLICANTS INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES.)
"The Recipient shall develop a CBP Development Proposal during Phase 0a. The Recipient shall develop a CBP during Phase 0b."

(TA-2 AND TA-3 APPLICANTS INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES.)
"The Recipient will implement, evaluate, and update CBPs throughout the life of the project."

APPLICANT continue with tasks/sub-tasks as necessary. If the project is structured in Phases, clearly delineate which tasks/subtasks are in each Phase.

Budget Period 1 (Phase 0a – Pre-Feasibility)

Task 2.0 - (Title)
Task descriptions should include a concise description of the work to be conducted for each task. If the task includes subtasks, provide a general description of how each subtask is related to the overall scope of the task.

Subtask 2.1 - (Title)
Subtask descriptions should include a concise description of the work to be conducted for each subtask.

Subtask 2.2 - (Title)

DECISION POINT 1 – Phase 0a – Pre-Feasibility

In accordance with the "DECISION POINT" provision in this Cooperative Agreement, the Recipient is not authorized to proceed beyond Phase 0a – Pre-Feasibility without written approval by the Contracting Officer for continuation into Phase 0b – Feasibility. The Recipient shall prepare and submit a "Decision Point Application" directly to the DOE Project Officer and the DOE Contract Specialist no later than forty-five (45) days prior to the end of Phase 0a – Pre-Feasibility. In addition, a Topical Report documenting the results of work completed to date shall be submitted as a separate document along with the Decision Point Application. The Decision Point Application shall include the following information:

1. A report on the Recipient's progress towards meeting the objectives of the project, including any significant findings, conclusions, or developments.
2. DAC and CO_2 conversion (if applicable) Technology Maturation Plan(s)
3. Preliminary Life Cycle Analysis
4. CBP Development Proposal (CBPDP)
5. A detailed budget and supporting justification for the upcoming Phase 0b – Feasibility. The budget should confirm a previously submitted and negotiated budget, or shall be a revised budget if a reduction of funds is anticipated, or if a budget for the upcoming phase was not approved at the time of award.
6. A description of the Recipient's plans for the conduct of the project during the upcoming scope of work.

At a minimum, the Phase 0a Topical Report must document the following activities and deliverables:

- ✓ Description of the selected DAC Hub owner and team, site location, CO_2 transport routes, CO_2 storage sites, and CO_2 conversion technologies (if applicable) for the pre-FEED study to be completed in Phase 0b.
- ✓ Discuss the current status of the CO_2 storage site(s), including development, characterization, and permitting activities conducted to date.
- ✓ Discuss the current status of, and plans for submitting, the UIC Class VI permit to construct application. Recipients must provide an initial design for the DAC Hub BOP.
- ✓ Selection of the anchoring DAC technology(ies) (i.e., minimum capacity of at least 50,000 tonnes CO_2 captured from the atmosphere (50 KTA)) for the pre-FEED study to be completed in Phase 0b.
- ✓ Conceptual design for the initial DAC Hub capacity (minimum 50 KTA CO_2) integrated with required CO_2 storage and/or CO_2 conversion (if applicable).
- ✓ If applicable, selection of the CO_2 conversion technology(ies) for the pre-FEED study to be completed in Phase 0b.
- ✓ Data tables with preliminary estimates for the DAC Hub, and the selected DAC and CO_2 conversion (if applicable) technologies.
- ✓ Description of safety culture, discussion of security considerations, a permitting workflow overview.

Budget Period 2 (Phase 0b – Feasibility)

(Continued task numbering)

Task X.0 - (Title)

D. DELIVERABLES (Required: Applicant insert the Language provided below in quotes and continue to complete.)

"The periodic and final reports shall be submitted in accordance with the "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist. In addition to the reports specified in the "Federal Assistance Reporting Checklist", the Recipient must provide the following to the NETL Project Manager (identified in Block 15 of the Assistance Agreement as the Program Manager)**."**

Task / Subtask Number	Deliverable Title	Due Date
1.1	Project Management Plan	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the NETL Project Manager.
x.x	Environmental Health and Safety (EH&S) Risk Analysis	Due 90 days prior to project completion
Additional TA-1 Deliverables		
x.x	Phase 0a Topical Report	Due 45 day prior to Phase 0a completion
1.4	Technology Maturation Plan(s) (TMP)	Initial TMP(s) is due 45 day prior to Phase 0a completion and should be updated as needed throughout the project period of performance. Final TMP(s) should be submitted within 90 days of completion of the project.
1.5	CBP Development Proposal	Due 45 day prior to Phase 0a completion
x.x	Preliminary LCA	Due 45 day prior to Phase 0a completion. Update due 90 days prior to project completion
1.2	Business Plan	Due 90 days prior to project completion
1.3	Financial Plan	Due 90 days prior to project completion
1.5	CBP	Due 90 days prior to project completion
x.x	Integrated DAC System pre-FEED Study	Due 90 days prior to project completion
x.x	DAC Hub BOP Conceptual Design	Due 90 days prior to project completion
Additional TA-2 Deliverables		
1.2	Business Plan	Updated as needed throughout the project period of performance, and submitted 90 days prior to project completion.

1.3	Financial Plan	Updated as needed throughout the project period of performance, and submitted 90 days prior to project completion.
1.4	Technology Maturation Plan(s) (TMP)	Initial TMP(s) is due 90 days after award and should be updated as needed throughout the project period of performance. Final TMP(s) should be submitted within 90 days of completion of the project.
1.5	Update CBP for Phases 2-4 based on Phase 1 activities	Due 90 days prior to project completion
x.x	Integrated DAC System FEED Study	Due 90 days prior to project completion
x.x	DAC Hub BOP pre-FEED Study	Due 90 days prior to project completion
x.x	Storage Field Development Plan (if applicable)	Due 90 days prior to project completion
x.x	UIC Class VI Permit to Construct Application (if applicable)	Due 90 days prior to project completion
x.x	Environmental Information Volume (EIV)	Due 90 days prior to project completion
x.x	Life Cycle Analysis (LCA)	Due 90 days prior to project completion
Additional TA-3 Deliverables		
1.2	Business Plan	Updated as needed throughout the project period of performance, and submitted 90 days prior to project completion.
1.3	Financial Plan	Updated as needed throughout the project period of performance, and submitted 90 days prior to project completion.
1.4	Technology Maturation Plan(s) (TMP)	Initial TMP(s) is due 90 days after award and should be updated as needed throughout the project period of performance. Final TMP(s) should be submitted within 90 days of completion of the project.
1.5	Update CBP for Phases 3-4 based on Phase 1 activities	Due 90 days prior to project completion
x.x	Environmental Information Volume (EIV)	Due 120 days after award
x.x	Integrated DAC System Detailed Design	Due 90 days prior to Phase 2 completion
x.x	DAC Hub BOP pre-FEED Study	Due 90 days prior to Phase 2 completion
x.x	Permit Summary	Due 90 days prior to Phase 2 completion
x.x	Refined LCA	Due 90 days prior to Phase 2 completion

APPLICANT continue to identify deliverables (other than those identified on the "Federal Assistance Reporting Checklist") that will be delivered using the format provided in the table above. Ensure the delivery date to NETL is also identified. For examples: Delivery to NETL X months after completion of task/subtask X.

NOTE: If the application is selected for award, DOE may require the Recipient to include additional deliverables, provided that such deliverables are consistent with the budget, schedule, and scope of the project.

E. BRIEFINGS/TECHNICAL PRESENTATIONS (Required: Applicant insert the language provided below in quotes and continue to complete.)

"The Recipient shall prepare detailed briefings for presentation to the NETL Project Manager at their facility located in Pittsburgh, PA, Morgantown, WV, Albany, OR, or via WebEx. The Recipient shall make a presentation to the NETL Project Manager at a project kick-off meeting held within ninety (90) days of the project start date. At a minimum, annual briefings shall also be given by the Recipient at an annual NETL review meeting to explain the plans, progress, and results of the technical effort and a final project briefing at the close of the project shall also be given."

At the Applicant's discretion, other briefings/presentations may be added to Section E of the SOPO.

NOTE: If the application is selected for award, DOE may require the Recipient to include additional briefings/presentations, provided that such briefings/presentations are consistent with the budget, schedule, and scope of the project.

APPENDIX Q – PROJECT MANAGEMENT PLAN

A Project Management Plan (PMP) for implementing the proposed project and achieving the objectives of the Announcement. The PMP establishes the baseline for the scope, schedule, and budget for the project and shall include the information given below.

- A Work Breakdown Structure (to at least four levels for TA-2 and TA-3) identifying tasks to be performed;
- A Project Schedule for the entire project at the task level of detail. The Project Schedule shall follow the task structure of the Work Breakdown Structure. The schedule should include technical, business, financial, permitting and other factors to substantiate that the project will achieve the objectives of the Announcement in a timely manner. The schedule should include milestones and decision points; including a Milestone Plan to serve as the baseline for tracking performance of the project and will identify critical path project milestones [no less than 2 Specific, Measurable, Achievable, Relevant, and Timely (SMART) per calendar year] for the entire project;
- An Integrated Project Schedule (IPS) that reflects all elements of the overall project should be included in the application (as part of the Workplan in the technical volume, see Section IV.D.iv). The initial IPS should include all major project activities and milestones, including technology maturation, engineering, design, permitting, procurement construction, and CBP activities. A minimum Level 2 IPS for proposed Phase 0 activities should be provided with the application. For a description of IPS Levels, see **Appendix Z**. This IPS will be revised, expanded, and updated in future DAC Hub phases. By the end of Phase 2, it is expected that the IPS will be execution ready and reflect comprehensive schedule risk and uncertainty analyses. During each phase, DAC Hubs will report actual progress against their execution schedule or schedules as part of regular project management reporting requirements. The IPS should clearly identify and incorporate timelines for application and expected completion or receipt of all required federal, state or local permits, approvals, or reviews.
- A Baseline Cost Plan to establish the budget for accomplishing the planned work. The Baseline Cost Plan should identify the planned cost for each task on a monthly basis. The Baseline Cost Plan should follow the task structure of the Work Breakdown Structure;
- A description of the project management system to be used for monitoring and control of scope, schedule, and cost including the methodology and implementation of reporting earned value;
- Project Communication Protocol, to establish the frequency and type of communication between the Recipient and DOE, dependent on the complexity, value, and program significance of the project, to ensure the team has the information necessary to affect timely and effective project management;
- A Risk Management Plan (RMP) that includes a summary description of the proposed approach to identify, analyze, and respond to perceived risks associated with the proposed project. Project risk events are uncertain future events that, if realized, impact the success of the project. As a minimum, include the initial identification of significant

technical, resource, and management issues that have the potential to impede project progress and strategies to minimize impacts from those issues (see below for additional guidance); and

- An Environmental Management Plan (EMP) to establish a protocol for managing the potential environmental impacts of the project. The EMP shall monitor the potential impacts to air, land, and water resources, and waste production in terms of compliance monitoring, unregulated pollutant monitoring, and NEPA monitoring. The EMP shall establish a protocol for reporting the results of the monitoring effort.

The PMP should include key success metrics and milestones to be completed during each phase, with detailed metrics and milestones established for the current phase, such as signing key contracts and agreements, securing permits, completing NEPA reviews, executing financial close, commencing site preparation and construction, achieving commercial operations (i.e., near or full design capacity), and evaluating/analyzing markets for CO_2 and other products, if appliable. The PMP should also describe 1) the Applicant's and project partners' organizational structure, capabilities, and operations plan; 2) the financial strength of the Applicant and any major project partners in the DAC Hub; and 3) prior experience of the senior/key personnel in similar or related undertakings to the proposed DAC Hub. Senior/key personnel includes the DAC Hub leadership/management team and other project personnel who contribute in a substantive, meaningful way to the successful execution of the DAC Hub (e.g., DAC Hub Program/Project Manager).

Risk Management Plan: The RMP should provide a narrative that analyzes the commercial, technical, construction, schedule, regulatory, permitting, safety, security (e.g., site, cyber, etc.), scale-up, infrastructure, financial, management, organizational, and market related risks. Each identified risk in the RMP should be clearly described, including its probability of realization, potential impacts, and proposed mitigations. As appropriate, identified risks should be incorporated into other project documentation, such as execution schedules, cost estimate maturity, and contingency. The risk management plan and risk register will be revised and updated as needed throughout the project life cycle. At a minimum, they will be reviewed and assessed for accuracy and adequacy as part of each transition between phases. Where and when appropriate, quantitative risk analyses may be required and subsequently incorporated into relevant risk management plans and contingency evaluations and will be used to inform negotiations with DOE.

Organizational Structure: As part of the PMP, the Applicant should provide an organizational chart of key entities and senior/key personnel for the DAC Hub. The organizational chart and related description should show the Applicant and any major project partners, subsidiaries, affiliates, parent organizations, or joint ventures associated with the DAC Hub as well as an explanation of the legal structure (e.g., corporation, partnership, LLC). The application should describe the Applicant and any major project partners' business relationship(s) and the various roles and responsibilities held by each organization. The Applicant should also identify any foreign owned entities involved in the DAC Hub and how the Applicant will request a waiver, if needed, per Section III.A.iii.

DOE encourages a range of entities to apply for DAC Hubs, including state/local governments, non-profit organizations, and private corporations. DOE encourages innovative DAC Hub ownership structures tailored to support underserved communities, such as a utility model, or community- or publicly-owned organizations.

Management: The Applicant should provide a description of the management and operations strategies to be employed in executing on the DAC Hub activities. The application should list the names of senior/key personnel as well as their positions or titles and the percentage of their time dedicated to executing on the DAC Hub. If any key management and staff are not expected to spend 100 percent of their time executing on the DAC Hub, the PMP should provide a brief description of their other responsibilities or other activities outside of the DAC Hub.

Experience: The PMP should describe in detail the unique capabilities and expertise of the Applicant and any major project partners or subrecipients, debt or equity sponsors, contractors/vendors (if known), and every other counterparty that the Applicant believes will enable the DAC Hub to be successful. In addition, the PMP should summarize the prior experience of the Applicant and any major project partners in similar undertakings to the proposed DAC Hub (in both technical scope and financial size) and current or previous projects.

Pending Investigations: The PMP should provide a summary of any pending or threatened (in writing) action, suit, proceeding, or investigation, including any action or proceeding by or before any governmental authority, that relates to the DAC Hub senior/key personnel, and the status of any appeals.

APPENDIX R – DATA MANAGEMENT PLAN

A Data Management Plan ("DMP") explains how data generated in the course of or work performed under an assistance award will be shared and preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate.

DMP Requirements

A DMP will be received as part of the application and will be evaluated as part of the merit review. The DMP will be negotiated and incorporated as an attachment to the award. A Data Management Plan (if applicable) describing how all research data displayed in publications resulting from the proposed work will be digitally accessible at the time of publication. Each applicant whose Full Application is selected for award negotiations will be required to submit a DMP during the award negotiations phase. A DMP explains how, when appropriate, data generated in the course of the work performed under a DOE award will be shared and preserved to validate the results of the proposed work or how the results could be validated if the data is not shared or preserved. The DMP must provide a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publications. The types of data and the rights and protections of such data will be determined during the award negotiation process upon agreement of the DAC Hub owner, DOE Project Manager, and Contract Specialist (CS). The determination will be assisted by the initial submission of the DMP.

For a DMP to be considered acceptable, the DMP must address the following:

- The plan should provide detail on how project data will be passed on to DOE and to the public. **At a minimum, the DMP must describe how data sharing and preservation will enable validation of the results from the proposed work.**
- **The DMP must provide a plan for making all relevant technical, operational, financial, and CBP related data displayed in publications resulting from the proposed work digitally accessible at the time of publication.**
- The DMP must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all laws (i.e., export control laws), and DOE regulations, orders, and policies.

Data Determination for a DMP

For data that will be generated through the course of the proposed work, the DAC Hub owner should indicate what types of data should be protected from immediate public disclosure by DOE (referred to as "protected data") and what types of data that DOE should be able to release. Any use of limited rights data or labeling of data as "protected data" must be consistent with the DMP Requirements noted above.

APPENDIX S – BUSINESS PLAN

The business plan should address the items listed below and any other pertinent information to understand the DAC Hub business plans.

Commercial Feasibility and Business Case Analysis: The plan should describe the commercial feasibility of the proposed technologies and related infrastructure and how the applicant intends to employ such technologies and related infrastructure in the DAC Hubs. See **Appendix AA** for guidance on the Business Case Analysis.

Key Contracts, Permits, and Agreements: The plan should provide a top-level description, schedule, and status, of all critical path contracts and agreements relevant to the DAC Hubs, encompassing permits, NEPA, design, engineering, technology licensing, financing, construction, startup, commissioning, shakedown, operation, and maintenance of the DAC Hub. **TA-2 Recipients** must secure a DAC Hub owner letter of commitment with plans for executing the landowner and/or host site agreement(s) needed for the initial DAC Hub capacity (minimum 50 KTA CO_2), including the DAC, storage and/or conversion sites by the end of Phase 1. **TA-3 Applicants** must submit commitment letters for the DAC Hub owner, other Team members, and the CO_2 storage site (see section IV.D for Application Requirements).

Preliminary Site Selection: The plan should describe the rationale for selection of the DAC Hub site(s) and contain evidence of control over the DAC Hub site(s) or the plan to establish control over the DAC Hub site(s).

Market Analysis: Applicants must submit a market analysis for the CO_2 conversion product(s) produced as part of the Regional DAC Hub, if applicable. Applicants should include an initial assessment of the product market potential, including current and projected market volume and value, as well as the estimated quantity of CO_2 converted to durable products that have a lower GHG life cycle compared to incumbent products. At a minimum, the Applicant should provide an initial estimate of the required selling price (RSP) of their primary product relative to existing markets (co-products should be valued at no more than their current market value). The current value and RSP should be reported on a USD/unit product basis. The Applicant should use assumptions for the required rate of return on investment, capital and operating costs, other co-feeds (if applicable), etc., consistent with the products and markets that they are targeting. The assumed purchase price of CO_2 and possibly other waste streams processed should be clearly stated, along with any potential tipping fees assumed. A thorough description of how the RSP estimate was derived should be clearly and completely described, with all key assumptions stated.

Feedstock, Supplies, and Offtake Arrangements: The plan should provide a detailed description of plans for ensuring an adequate supply of feedstock and other major raw materials or supplies, as needed for successful operation of the DAC Hub. If available, the Applicant should provide letters of commitment or term sheets (including power purchase agreements) for prospective

feedstocks and other suppliers. The Applicant should also provide letters of commitment or term sheets from prospective customers and/or offtakers, if available. The letters of commitment should be submitted in a separate attachment (see Section IV.D.ix "Team Commitment Letters" for more information).

DAC Hub Capacity Build-Out Plan: The plan should describe the potential for expanding the proposed DAC Hub both during and beyond the award performance period. The plan should also discuss how the proposed DAC Hub will achieve market liftoff and contribute to building out a DAC Hub and CDR industry, including the ability to attract follow-on private sector investments beyond the award performance period. Applicants must provide their plan for the DAC Hub to have capacity to capture and geologically store, utilize, or store and utilize at least 1,000,000 metric tons (tonnes) of CO_2 from the atmosphere annually (1 MTA) from a single unit or multiple interconnected units with each unit capable of capturing a minimum of 50,000 tonnes CO_2 from the atmosphere annually (50 KTA). An initial assessment on how the DAC Hub is scalable to 1 MTA CO_2. Anticipated benefits, as well as challenges for the DAC Hub should also be discussed in detail. The plan should include how the DAC Hub will be connected regionally or inter-regionally to secure geologic storage sites and/or carbon conversion systems. If applicable, an initial schedule, cost estimate, and plans to integrate new team members and technologies is required.

APPENDIX T – FINANCIAL PLAN

The Financial Plan must present a viable plan to obtain funding for the entire non-DOE share of the total project cost that identifies all sources of project funds. The plan should provide a description of the following elements for the proposed DAC Hub:

- Plan and schedule to achieving long-term financial viability, beyond DOE and other funding;
- Plan and schedule to achieving long-term financial viability, beyond DOE and other funding;
- The amount of expected traditional equity investments (identify participants and level of participation, if applicable);
- The timing of expected equity contributions and/or debt funding;
- The timing of repayment of expected debt funding;
- If debt is contemplated, provide a plan for managing potential interest rate risk and default risk;
- If tax equity or other non-traditional equity investments are contemplated, highlight any structural requirements that might arise from such investments; and
- Contingency funding including the source should also be detailed in the **Phase 3 through 4 Financial Plan**.

Applicants must provide a plan for financing the proposed effort. The **Financial Plan** shall address the Applicant's financial commitment to the project by including a commitment letter for the required non-federal cost share. A commitment letter should state the amount and timing of the funds to be made available for the project; and should provide information on the source(s) of the funds along with the authority of the signor of the letter to commit such funds to the project. Any existing approvals, such as minutes from a board of directors meeting, should be included in the application materials. Limitations, restrictions, contingencies, or the like on the commitment must be disclosed in the letter.

If other parties are to provide non-federal cost share, such parties must also provide commitment letters including the same information as above. In addition, other parties must disclose their relationship to the Applicant, or other interests in the project.

For non-federal cost share commitments that are in the form of cash, each provider must present audited financial statements for the prior year and all unaudited interim financial statements for the current year. If audited financial statements are not available, the financial statements presented must be certified by the Chief Financial Officer of the organization that the statements were prepared on the basis of U.S. Generally Accepted Accounting Principles (US GAAP). Each provider must describe how the financial statements evidence the capacity of the provider to supply their committed cost share.

For non-federal cost share commitments that are not in cash, provide a full description of the commitment and justification for the qualification of such commitment as non-federal cost share. Provide supporting evidence regarding the value of the non-cash commitment.

Applicant must certify in writing that all non-federal cost share will come from qualified sources.

Project Parties. A description of the main parties (developers, owners, investors) to the project, including background, ownership and experience, proposed financial contribution to project, and expected financial benefit to each party of the project. In line with the Organization Structure in the PMP, the application should describe the financial relationship of the Applicant to major project partners, including any Foreign Owned Entities,[45] who are contributing cost share and/or performing work. It should include a table that identifies the name of the organization or entity that are expected to contribute debt or equity financing and any person, organization, or entity who owns or will own five percent (5%) or more of the DAC Hub. The plan should indicate the Applicant, project partners, and other debt or equity contributors by listing the organization or entity name, website address, mailing address, city and state, and postal code.

Financial Strength: The plan should describe the Applicant's and major project partner's financial strengths, as well as the DAC Hub's strategic significance to the Applicant and major project partner involved.

Project Assumptions. A description and explanation for each of the financial, economic, and operating assumptions for the project. The assumptions should be consistent with and supported by other documents in the application materials.

Contracts and Agreements. A description of all contracts, agreements, permits, licenses, etc., that will need to be established or obtained to finance the project. Also describe agreements to be entered into regarding the operation of the project and any related responsibilities of the Project Parties.

Financial Projections. Financial projections should be presented on an annual basis, commence with the initial project Phase, and extend to the end of the life of the facility. Projections should include a statement of revenues and expenses (income statement), balance sheet, and cash flow statement (sources and uses of funds). In addition, a cashflow waterfall schedule should be included as well as projections of annual net cash flows (for purposes of calculating net present value (NPV) and internal rate of return (IRR)). The projections should be adequately supported. The statements and schedules should be prepared using software and the model should be provided in electronic format including cell formulas so that review of the model assumptions and calculations may be facilitated. The financial model should be included in the application as an attachment named "FP.pdf".

[45] Foreign investment in projects may be subject to Committee on Foreign Investment in the United States (CFIUS) review: https://home.treasury.gov/policy-issues/international/the-committee-on-foreign-investment-in-the-united-states-cfius

Financial Commitments. The Applicant must discuss the priority placed by their teams' respective management on financing the project. This should include a discussion of management's decision to: (1) allocate internal resources, (2) obtain recourse financing, or (3) obtain limited or non-recourse project financing. The degree of commitment to the project will be measured in part by the level of financial commitment assumed by project team members. The project team can also demonstrate its commitment by: (A) sharing in project costs above the Government's minimum requirements and (B) agreeing to cover potential project cost increases.

Limited Recourse Project Financing. For projects employing non-recourse or limited recourse debt financing, provide a description of the Applicant's approach to, and the status of, such financing. Include copies of available funding commitments, draft Term Sheets, or expressions of interest from funding sources.

Equity. If tax credit equity is part of the financial plan, provide a description of the structure of the legal arrangements either in place or contemplated. Project when tax equity contributions to pay project costs will be made. List prospects for other equity investors and include progress to date in gaining interest in the project by such investors.

> The Applicant should include commitment letters to provide funds in accordance with the terms of this funding opportunity announcement. Commitment letters must be issued by each organization that is slated to provide funding. The funds must be committed in accordance with the terms of this funding opportunity announcement and consistent with the application. The commitments should state the amount of funds to be provided, the fact that the funds are non-federal cost share, the relationship of the funding source to the Applicant, the timing of funding, and any caveats, restrictions, limitations or the like. Commitments to provide funds shall be submitted in a letter signed by an officer of the corporation or other entity that is qualified to commit the funding to the proposed project.
>
> Commitment letters must identify the type of proposed cost sharing (e.g., cash, services, and/or property) to be contributed. If property or services are proposed, the Applicant should provide support for their valuation and explain how valuation was determined. If a property appraisal is used, the Applicant should provide a copy and an explanation of whether the property values used are acquisition, book, or replacement costs.

Cost Share Commitment letters from the Applicant and third parties should be provided should be provided in an attachment named "CSCL.pdf"(see section IV.D.vi).

Other Federal Funding. Identify any other federal funding sources such as DOE Loan Program Office, CO_2 Infrastructure Finance and Innovation Act (CIFIA) program credit subsidy, etc. Federal financing, such as grants or loan guarantees from federal agencies, cannot be leveraged by Applicants to provide the required DAC Hub cost share or to otherwise support the same scope

of the DAC Hub. However, other federal support may be used for activities that fall outside of the DAC Hub scope/budget. The financial plan should identify whether the DAC Hub will benefit directly or indirectly from other forms of federal support, such as grants, loan guarantees, tax credits, having federal agencies or entities as a customer or offtaker of the DAC Hub's products or services, or other federal contracts, including acquisitions, leases, and other arrangements, that may indirectly support the DAC Hub.

Non-Federal Support. The plan should identify other non-federal governmental (including state or local) incentives or other assistance on which the proposed DAC Hub relies, including grants, tax credits and loan guarantees to support the financing, construction, and operation of the DAC Hub. It should indicate the terms of such support which could result in termination or reduction of anticipated/actual non-Federal support, and whether any such incentives or assistance are subject to clawback and the circumstances under which a clawback could occur.

45Q. If project finances are expected to include benefits from IRC Section 45Q federal income tax credits, describe the way value from the credits will be derived. In particular state whether the credits will be used by the Applicant or an affiliate or if tax equity will be engaged to monetize the tax benefits for the benefit of the project. State whether any 45Q tax credits are planned to be allocated to the CO_2 storage site operator. Ensure the financial model appropriately shows the projected financial impacts of 45Q tax credits and other tax benefits through at least the end of the 45Q tax credit earning period, or the life of the project, whichever is longer.

Contract Bonding Practices. For proposed construction contracts or subcontracts, the Applicant must explain its contract bonding and/or surety/guarantor practices and how they will be applied if their application is accepted for Federal funding.

Financing Schedule. A tentative schedule of dates and events that comprise the financing efforts must be provided. The schedule shall include, to the extent possible, key project dates such as signing of the EPC contract, negotiating Purchase and Sale agreements, finalizing the Operations and Maintenance Agreement, and the target date for financial closing for construction.

Detailed requirements for the **Phase 3 through 4 Financial Plan** will be included in the down-selection application specifications to be included in the **TA-3** Phase 2 awards.

APPENDIX U – STORAGE FIELD DEVELOPMENT PLAN

The Storage Field Development Plan should: (1) explain the strategy for developing the storage field to maximize its potential utility; (2) describe all elements of the proposed storage field facilities and establish a logical order and timing for the development of all anticipated facilities, accounting for changing needs for monitoring and use of pore space and changing CO_2 delivery rates over time; and (3) present a cost plan over the proposed life of the project. It is expected that the facilities description within the Storage Field Development Plan would be based on information associated with the relevant permits (e.g., UIC or OCS permit application and associated permit terms and conditions, NPDES permit, monitoring well permits, site access road permit), along with regulatory rules and guidance. The Plan should include, if relevant, the assessment and repurposing or plugging of legacy wells and other existing infrastructure. It is understood that this Plan will be only a draft or preliminary until after relevant permits are received, financing is arranged, and other considerations are settled.

There are several major cost categories related to the development of a CO_2 storage site, including wells, infrastructure, and monitoring deployment. Each of these will bring their own cost uncertainty due to outside influences such as oilfield contractor demand, steel price, supply chain disruptions, and inflation. To set the correct expectations, each Plan is required to include a project cost breakdown with a P-10, P-50 and P-90 project cost analysis. Project risks and their effect on cost should be clearly explained. In addition, each proposed well should have a full Authorization for Expenditures (AFEs) with cost uncertainty ranges defined for each line item.

The Storage Field Development Plan should additionally report the progression of the storage resource status through Prospective, Contingent, and Capacity based on the SRMS guidelines described at SPE CO_2 Storage Resource Management System (SRMS). Projects should follow the SRMS process to classify the status of the storage resource(s) from prospective through contingent to capacity. The estimated classification of the resource(s) and capacity(ies) will be used by DOE to demonstrate how BIL-funded projects are increasing secure geologic storage capabilities in the U.S.

Additionally, it is important to understand the plan for commercialization and how the storage field would be built and evolve over time (at least 30 years). A description and diagram of the fully developed field with clear delineation as to the immediate portion that makes up the current project, should be used in the Storage Field Development Plan and in business plan description.

Suggested contents of the Storage Field Development Plan are described below. Please note however that DOE will accept the Plan in whatever format is company standard for the Recipient, assuming that the Plan has all needed information to understand the build-out, operations and costs for the planned storage of CO_2.

Suggested contents of the Field Development Plan:

1. Executive Summary
2. Storage Development Description and Rationale for Development Plan
    - Field Characterization Results
    - Seismic Interpretation and Structural Configuration
    - Geological Interpretation and Reservoir Description
    - Volumetrics
    - Reservoir Pressure and Reservoir Fluids
    - Reservoir Units and Modelling Approach
    - Injection Rate and Mass Over Time
    - Area of Review Calculation
    - Legacy Well Evaluation
3. Development and Management Plan
    - Development Plan
    - Well Construction and Legacy Well Mitigation Plans
    - Injection Facilities
    - Monitoring Plan
    - Injection Operations
    - Decommissioning & PISC Plan
    - Costs
        - Pre-Project Costs (Seismic, Exploration Drilling, Appraisal Drilling, Studies)
        - Drilling and completion of wells
        - Assessment and repurposing or plugging of legacy wells, pipelines and other existing infrastructure
        - Facilities
        - Field OpEx, excluding tariffs
        - Decommissioning & PISC costs
    - Project Risks & Mitigations
    - Storage Management Plan

APPENDIX V – TECHNOLOGY MATURATION PLAN

TECHNOLOGY MATURATION PLAN
for *{insert project title}*
{Date Prepared}

SUBMITTED UNDER FUNDING OPPORTUNITY ANNOUNCEMENT

DE-FOA-#######

SUBMITTED BY

{Organization Name}
{Organization Address}
{City, State, Zip Code}

PRINCIPAL INVESTIGATOR

{Name}
{Phone Number}
{E-mail}

SUBMITTED TO

U.S. Department of Energy
National Energy Technology Laboratory

This plan should be formatted to include the following sections with each section to include the information as described below:

A. TECHNOLOGY READINESS LEVEL

- Using the Technology Readiness Levels (TRL) **Appendix AB**, specify the current TRL of the proposed technology. Note, to be at a certain TRL, all of the description must be met. The application must provide a clear technical write-up describing the state of the proposed technology and use TRL description-based activities to justify the TRL score assigned.
- Provide a one-paragraph description of the target commercial application(s).

B. PROPOSED WORK

- Relate the proposed project work to the maturation of the proposed technology.
- List known performance attributes and their performance requirements to the extent possible. Explain how the performance requirements were determined (i.e., from FOAs;

program plans; technology roadmaps; need to surpass the current state of the art). Be as specific as practical on any supporting technical/economic assessments.

- Define the TRL that is anticipated at the end of the project and describe how the project objectives will meet the TRL description if the project is successful.

C. POST-PROJECT PLANS

- Describe known post-project work needed to attain the next TRL. Explain why that work is not part of the proposed project, and why the project end point sets the best foundation practical for the next phase of work. To the extent practical, include market assessments and deployment strategies.

APPENDIX W – PIPELINE CONCEPT AND FEED GUIDANCE

DOE is working with our partners including the U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) to ensure a safe and reliable CO_2 transport network that supports the deployment of CCUS and CDR. As part of these study deliverables, additional critical safety and risk requirements may support future regulatory development processes.

Pipeline Concept Study

If applicable, TA-1 (integrated DAC system pre-FEED study), and TA-2 and TA-3 (DAC Hub BOP pre-FEED study) projects will perform the scope of work needed to produce deliverables including, but not limited to, those listed below:

- Pipeline sizes, hydraulic study, compression/pumping needs, power requirements, facilities, and major pipeline appurtenances.
- Maps identifying the pipeline route or alternative routes, including whether project considers existing pipelines for potential service conversion and whether alternative routes take into consideration disadvantaged community designation.
- Basic technical design parameters and system schematic such as a process flow diagram (PFD).
- Desktop review of environmentally, ecologically, and culturally sensitive areas, geotechnical hazards, other significant areas of concern, and proposed mitigation methods.
- Identification of project's major impacts to critical resources including but not limited to water, air, minerals, forests, wildlife, farmland, navigable waterways, and vulnerable communities subject to social and environmental injustice including disadvantaged communities.
- Permits required and preliminary permitting procedures, list of agencies, and review timeline.
- Major crossings, field reconnaissance information, and preliminary constructability review.
- Basic pipeline safety risk assessment plans and procedures.
- Project management plan including a preliminary risk register.
- Identification of major land ownership parcels and market appraisal along the pipeline route.
- A preliminary AACE parametric or itemized Class 4 cost estimate, basis of estimate, and a benchmarking study.
- Integrated Project Schedule.
- Status of any existing project-specific studies to date.

Pipeline FEED Study

If applicable, TA-2 (integrated DAC system FEED study) projects will perform the scope of work needed to produce deliverables including, but not limited to, those listed below:

1. Project Scope and Design that includes business objectives and a summary of the proposed project. This document must describe whether the pipeline(s) will be an open access or common carrier pipeline and how the proposed pipeline system(s) can help accelerate CCUS/CDR development.

2. Project Parameters including, but not limited to:
    a. Site characteristics and ambient conditions;
    b. Product gas compositions;
    c. Permit list and review and approval agencies;
    d. Land use, right-of-way, utility corridors, property boundaries, and title research;
    e. Project Environmental, Health, and Safety (EH&S) criteria including pipeline construction and operational impacts to communities and the environment, as well as pipeline failure risk analysis and risk acceptance criteria for pipeline operations;
    f. Project management plan and risk register; and
    g. Overall integrated project schedule in a Gantt chart.

3. Engineering Design Package including, but not limited to:
    a. A Proposed Route Report and Maps, complete with:
        i. A Geographic Information Systems (GIS) database to house all route and survey information;
        ii. Pipeline route map incorporating aerial photography, right-of-way and workspace, environmental features, topography, elevation profiles, hydrological data, pipeline materials, foreign crossings, and others;
        iii. Crossing and right-of-way investigation or survey including elevation, crossing methods, constructability, proposed mitigation, land use, access, workspace configuration, and other relevant information at key locations;
        iv. Geotechnical and hydrotechnical investigations (desktop or field) that consider extreme weather scenarios and other ground movement force considerations aligned with DOT PHMSA's Integrity Management Program and relevant advisory bulletins for all pipelines such as the June 2022 bulletin (Docket PHMSA-2022-0063) titled "Pipeline Safety: Potential for Damage to Pipeline

Facilities Caused by Earth Movement and Other Geological Hazards;"[1]

v. Wetland and environmental survey or investigation information;
vi. Cultural and archeological survey or investigation information;
vii. Population density study including major roads and waterway crossings and preliminary High Consequence Area (HCA) determination; and
viii. Site selection for aboveground facilities including booster stations, meter stations, launchers and receivers, and mainline block valves.

b. A Design Basis document that covers:
   i. Operating philosophy;
   ii. All applicable codes, regulations, standards, specifications, and procedures;
   iii. Design criteria including metallurgical requirements to address ductile fracture propagation;
   iv. Route selection process;
   v. Material and pipe coating specifications including specifications for fracture arrest (maximum arrest distance) and selection;
   vi. Crossing design including waterways, roads, interstate highways, and railroads including horizontal directional drilling requirements;
   vii. Corrosion control including location of ground beds;
   viii. Integrity management including inline inspection of the pipeline;
   ix. Location of mainline valves for isolation including public safety, waterbody crossings and rupture isolation and detection;
   x. Supervisory Control and Data Acquisition (SCADA) System and Leak Detection System with pressure and flow monitoring;
   xi. Determination of Maximum Operating Pressure and Minimum Operating Pressure including placement of overpressure safety devices;
   xii. Pipeline "venting design" and location options at pump stations, mainline valves, and laterals for public safety and minimizing gashouse gas protection; and
   xiii. Building monitoring designs and equipment to detect and notify personnel of unsafe conditions.

c. Key Design Calculations and Drawings that cover:
   i. Pressure design and Maximum Operating Pressure (MOP) determination;

[1] PHMSA Land Movement Advisory Bulletin.pdf (dot.gov) - https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2022-05/PHMSA%20Land%20Movement%20Advisory%20Bulletin.pdf

ii. Hydraulic analysis;
iii. Pipeline and equipment sizing;
iv. Material take-off;
v. Process flow diagram (PFD) and Preliminary Piping and Instrumentation diagram (P&ID); and
vi. Power requirements, sources, costs, and timing.

d. Technical Specifications for major materials and activities, including but not limited to pipe, valves, facilities, rotating or static equipment, construction, surveying, and others.
e. Preliminary Hazard and Operability Analysis (HAZOP).
f. If converting a pipeline to CO_2 service, a preliminary conversion-to-service plan for DOT PHMSA regulatory compliance that includes an integrity assessment plan to demonstrate fitness for service.
g. Additional critical safety and risk assessments:
    i. Conducting an Air Dispersion and Potential Impact Radius (PIR) study including terrain and overland flow considerations for determining the effect on any populated areas. It may be required to consider pipeline set-back distances from dwellings for human occupancy;
    ii. Providing an Emergency Response Plan (ERP) including training and outreach for emergency responders and local communities, as appropriate;
    iii. Consideration of additional safety critical equipment and redundant safety design such as crack arrestors (or pipe toughness (Charpy Impact Value) and enhanced shut off capabilities in the event of a catastrophic failure;
    iv. Consideration of odorant additives for CO_2; and
    v. Consideration of additional distance for pipeline setback in populated areas.
h. Construction Specifications to meet 49 CFR Part 195:
    i. Right of way clearing, grading, and ditching;
    ii. Depth of soil cover;
    iii. Welding Requirements;
    iv. 100% Non-Destructive Testing of pipeline girth weld;
    v. Pressure testing at a minimum of 1.25 times Maximum Operating Pressure (MOP) for 8 hours;
    vi. Coating;
    vii. Backfill to protect the pipe and coating;
    viii. Pipe Bending requirements; and
    ix. Clean-up of the right of way.
i. Environmental Specifications:
    i. Monitoring;

ii. Structures, such as for waterbody crossings, to minimize construction damage to the environment;
iii. Wetland crossings and horizontal directional drills; and
iv. Soil erosion mitigation measures and structures.

j. Commissioning

4. **Project cost estimate.** Design of the pipeline system shall support an itemized capital cost estimate consistent with AACE (Association of the Advancement of Cost Engineering) Class 3 with an expected accuracy range of +/-15%. The cost estimate should include a basis of estimate for each item. Successful applicants should provide a benchmark study for the overall cost estimate, if available. Each recipient is required to submit a pipeline buildout plan with a P-10, P-50 and P-90 project cost analysis based on the acquisition and installation of CO_2 transport pipeline networks that fulfill the Build America, Buy America Act provisions in the BIL.

APPENDIX X – NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

All federally funded projects are subject to review in accordance with the National Environmental Policy Act (NEPA; 42 U.S.C. 4321, *et seq.*), which requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see Section VI.B.vi of this FOA and DOE's NEPA website.[46]

Recipients will be requested to submit to the NEPA process a wide array of information about the proposed DAC Hub project, options under consideration for the proposed project, reasonable alternatives to the proposed project for achieving similar objectives, the affected environment (to include both the natural environment and the human environment), the socio-economic setting of the proposed project and affected area surrounding the site, trends regarding changes in the surrounding environment (natural, socio-economic, human) and the potential impacts (both positive and negative) for the proposed project, its options and its reasonable alternatives. The Recipient will also be expected to cooperate fully with those who prepare the NEPA documents and implement the NEPA process.

Information may be submitted in the form of an Environmental Information Volume (EIV) that provides all initial environmental data and details about the proposed actions to take place at the host site(s). **An EIV for the DAC Hub project is due 90 days prior to project completion for TA-2 Recipients. An EIV is due 120 days after award for TA-3 Recipients.**

Based on DOE's review of the environmental questionnaire (submitted with the Application) and EIV, and the sensitivity of the proposed work area, an Environmental Assessment/Finding of No Significant Impact or Environmental Impact Statement/Record of Decision may need to be prepared and issued by DOE during Phase 2 (TA-3). The target CO_2 storage formation and confining zone(s) should not contain drinking waters as defined by the Safe Drinking Water Act.

[46] https://www.energy.gov/nepa

APPENDIX Y – INTEGRATED DAC SYSTEM DETAILED DESIGN GUIDANCE (TA-3 ONLY)

The integrated direct air capture (DAC) system detailed design is a FOA deliverable required from projects selected under TA-3. Recipients shall complete 90% of the engineering such that the main contractors and all the sub-contractors can provide construct details (shop fabrication drawings) of all sub-systems and construction bids that will result in +/-5% capital cost estimate. TA-3 Recipients must complete an integrated DAC System Detailed Design study for the anchoring integrated DAC system (i.e., DAC, CO_2 pipeline, CO_2 conversion (if applicable)) and required balance-of-plant (BOP) sited in the selected DAC Hub sited in the DAC Hub and designed for a minimum unit capacity of 50,000 tonnes of CO_2 removed from the atmosphere annually (50 KTA), or up to the final DAC Hub capacity, depending on DAC Hub concept maturity. Activities include, but are not limited to, those listed below:

1. **Project Scope and Design** that includes business objectives and the summary of the proposed project. The roles and scope of work for the different parties involved in the project should be clearly delineated.

2. **Project Design Basis** including, but not limited to, site characteristics and ambient conditions, fuel feedstock characteristics (if applicable), and site environmental requirements. The operating ranges considered during detailed design should be provided. The design basis shall clearly identify all local, state, federal permits and environmental reviews necessary to initiate construction. All approvals required to initiate construction shall be identified. Energy sources and their impact on the net air capture rate should be provided.

3. **Engineering Design Package**. Detailed design of the integrated DAC system shall result in equipment sizing fully substantiated with kinetic, heat and mass transfer data, as well as justification for choice of materials of construction. The cost estimate shall include preparation of a total project cost (TPC) estimate, construction bids that will result in +/-5% capital cost estimate, and operating cost estimates, including the cost in $/net tonne CO_2e removed and cost of the CO_2 conversion product (if applicable). The detailed design shall include, at a minimum: process flow diagrams; detailed heat and material balances; plot plan and elevation drawings; DAC process model scaled-up to the proposed capture capacity; piping and instrumentation diagrams; instrument list; valve list; piping list, final layout drawings, and isometrics; mechanical design drawings; detailed three dimensional model; complete process and utility equipment lists with all major equipment specifications and sizing; single line diagrams for electrical; electrical equipment and motor schedules; control logic diagrams; construct details (shop fabrication drawings) of all sub-systems; vendor quotations and equipment drawings; detailed project execution plans; resourcing and work force plans; a full team process hazard analysis (PHA) review; storm water management plan; permitting plan; and a geotechnical report with foundation design recommendations. The detailed design shall incorporate all engineering disciplines necessary to perform the final design and construction, which include, but are not limited to: process and equipment, civil,

architectural, structural, mechanical, piping, electrical, and instrumentation and control systems engineering. A list of all referenced work should be provided.

Engineering design shall cover both the direct air capture system and balance-of-plant (BOP). BOP includes, but is not limited to, utilities such as compression, cooling water, water treatment, waste treatment, and the sources of energy, electricity, and/or steam that are necessary to power the DAC system. The BOP also includes CO_2 transport (see **Appendix W**), CO_2 conversion (if applicable), and may include integration of an external energy source (e.g., grid electricity, solar, wind, and geothermal). If the DAC system is designed to purchase renewable electricity or to generate it on site, then the plant must include a method of energy storage or back-up power purchase or generation to supply electricity when renewable electricity is not available. Otherwise, the DAC plant design and cost should be reflective of the expected capacity factor of the power generating source. The energy sources used should be clearly defined, and the impact of the energy sources on the net air capture rate should be clearly provided.

To the extent information is available, Recipients should include a detailed description of the DAC Hub infrastructure in terms of major subsystems and their interconnection(s) and a description of how the DAC Hub is intended to operate. If available, high-level schematic, technical specifications, equipment supplier and vendor information for all technologies, systems, and connective infrastructure should be included in the application. The Applicant should also describe the mass and energy balance of any major supply chain elements or unit operations, relevant system capacities, and projected availabilities.

If available, equipment descriptions should include consideration of how equipment would be used dynamically within the system. The applicant should describe how the system design will address relevant needs for energy buffering, storage of or buffering for any intermediary, input, or waste products. Needs for and plans to balance variable supply and demand signals, as well as resiliency aspects necessary to handle maintenance outages and external system shocks should also be described.

Recipients will be expected to develop detailed cost estimates that meet industry standards for the size and complexity of the proposed DAC Hub. DOE expects that DAC Hubs will employ industry standard cost estimating methodologies and tools. Cost estimates should correspond to the DAC Hub design maturity and reflect appropriate uncertainties. While DOE is not requiring its use, Recipients are encouraged to review DOE's Cost Estimating Guide.[47] The Table below is included in that guide and highlights examples of industry standard cost estimating approaches and use cases.

[47] DOE G 413.3-21A *Cost Estimating Guide*: https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-21A

Table 1: Cost Estimate Classification for Process Industries

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Any costs associated with CBP activities should also be included in the TPC estimate. Narratives accompanying cost estimates should include an explanation of the estimate class and/or maturity, a description of the methodology employed, and the uncertainty or accuracy range. While DOE is not requiring specific escalation assumptions be used for the application TPC, cost estimate narratives should explain what assumptions were used and why they were deemed appropriate. DOE may require use of standard cost estimating assumptions, including escalation assumptions in future phases.

Detailed design of the DAC system shall support a capital cost estimate consistent with the Association of the Advancement of Cost Engineering (AACE) Class 1 (i.e., expected cost accuracy of +/- 5% and project definition maturity of 90%) for a minimum capacity of 50 KTA. Recipients will be required to submit the project cost estimate 90 days prior to project completion.

Successful projects will be required to submit the following during the FOA period of performance: (i) an initial engineering design package 180 days after the FOA project start that includes, at a minimum, process flow diagrams, the results of the heat and material balances, and sizing of the main pieces of equipment for the direct air capture plant and BOP based on a validated process model (prior to initiating design activities, the completeness of this data set must be verified by DOE), and (ii) the final integrated DAC detailed design study package 90 days prior to project completion.

Detailed Design Study – Requirements

It is understood that the content to be included in a detailed design package is tailored by the type of project and the needs of the owner. Often Engineering, Procurement, and Construction (EPC) firms will have an in-house standard in the absence or lack of owner definition. The goal of the detailed design is for the owner and EPC firm to collaboratively refine the project's scope, design, and cost estimate as much as possible to reduce risk and uncertainty prior to executing the project. Often, items 1–3 in the list below are provided by the owner to the EPC firm. **The following is a list of content to be included in the detailed design package developed by the end of the project for this FOA. Recipients are encouraged to include additional materials outside this list that resulted from the uniqueness of their respective project or the needs of the owner. Recipients are also encouraged to integrate detailed design activities with CBP requirements and activities as appropriate for the project into an overall level 3 integrated project schedule. ALL sections of the report should be cross checked to ensure that the values agree between sections of the report(s). Missing appendices, section headings, and mislabeled figures should be avoided. Image quality should be checked; figures with unreadable text should not be included.**

6) Project Background
    a) Discusses project need or business objective
    b) Includes major aims and conclusions of each of the subsequent chapters
7) Project Scope
    a) Provides a summary of the proposed project, the project objective, and how it will meet the objective
    b) Delineates the roles and scope of work for the different parties involved in the project
    c) Provides the system boundaries, or battery limits, of the proposed project
8) Project Design Basis
    a) Site Characteristics
        i) Location, topography, available land, transportation access, available utilities, access to water, access to carbon dioxide piping or storage sites
        ii) Social characterization, including regional analysis of communities and disadvantaged communities, and whether those communities rely on limited resources (e.g., water) that could be impacted by the project. This information should be consistent with the CBP
        iii) Archaeology and culture studies
    b) Site Ambient Conditions
        i) Elevation, prevailing wind, relative humidity, seismic data
        ii) Atmospheric pressure, temperature averages and extremes, air composition averages and extremes
    c) Fuel Feedstock: compositional analyses of any fuel used depicting the expected compositional range

d) Environmental Requirements – as dictated by the authority(s) having jurisdiction (the state's Department of Environmental Protection [DEP] and the Environmental Protection Agency [EPA], etc.)
    i) Air emission permitting limitations and required control technologies
    ii) Water discharge permitting limitations and required control technologies
    iii) Waste disposal (e.g., spent sorbents or solvents) permitting limitations and required control technologies
    iv) State- and federal-specific fish and wildlife permitting
    v) Safety considerations – local fire department, community engagement
e) Site Specific Design Considerations: flood plain, soil conditions, rainfall/snowfall criteria, building/enclosure permitting, noise regulations, local community requirements for the proposed site
f) Modularization Design Requirements

9) Basic Contracting and Purchasing Strategy
    a) Strategy for tracking cost and schedule performance, such as cost performance indicators from an earned value management system
    b) Approved vendors list
    c) Approved subcontractors list
    d) Work breakdown structure
    e) Procurement and inspection plan
    f) Quality Plan
10) Engineering Design Packages
    a) Process Engineering
        i) Process area descriptions
        ii) Finalized block flow diagrams (BFDs), process flow diagrams (PFDs), utility flow and distribution diagrams, and piping & instrumentation diagrams (P&IDs)
        iii) Detailed heat and material balances (H&MBs)
        iv) Effluent and emissions summary
        v) Chemical summary
        vi) Process design calculations and process simulation report
        vii) DAC technology specific design details. This includes capture fraction; pressure drop across the contactor; working capacity or solvent loading; adsorption, desorption, and cycle times; selectivity; vacuum pressure; regeneration energy; steam requirement; system auxiliary load; sorbent or solvent initial fill and make up rates
        viii) Equipment and instrumentation lists and vendor datasheets. Process equipment specifications should include sizing and key parameters used for equipment costing (e.g., height, diameter, heat duty, delta temperature, power, and materials of construction)
        ix) Performance guarantees
        x) Pre-commissioning, commissioning, operating and maintenance procedures
        xi) Full team PHA documentation and process safety management documentation
        xii) Full pressure relief and flare study finalizing header/flare size

xiii) Finalized cause and effect diagrams
xiv) 3D piping drawings for inlet/outlet, valving & piping

b) Civil and Structural Engineering
   i) Soil load analysis
   ii) Soils resistivity assessment
   iii) Storm water runoff plan
   iv) Geologic assessment
   v) Spill containment assessment
   vi) Determination of type of foundation for various loads associated with process and balance of plant equipment
   vii) Construction quality civil layout, earthworks specifications and grading drawings
   viii) Construction quality structural and architectural drawings (e.g., steel, building enclosures, and weather proofing)
      (1) Foundation design drawings (concrete sonotubes and slabs, helical pillars, etc.)
      (2) Process equipment/piping structural support steelwork specifications, layouts and drawings
      (3) Buildings and weatherproofing specifications and drawings
      (4) Fireproofing requirements
      (5) Underground services and cable trench specifications, layouts and drawings
      (6) Maintenance access drawings (e.g., gangways, ladders, platforms, handrails, and stairs)
      (7) Site fencing, paving and road plan layout
   ix) Material take-offs
   x) Reinforced concrete specifications, piling specification and layout, foundation and concrete structure details
   xi) All drawings shall be construction ready

c) Mechanical Engineering
   i) General site plan view(s)
   ii) Detailed 3D model
      (1) Ensure necessary platforms and chain wheels for access to valves (both process and control) and instrumentation
      (2) Consider weatherproofing for personnel and equipment
   iii) Thermal and acoustical piping reviews
   iv) Piping/tracing/insulation line list and material specification
   v) Piping isometrics
   vi) Piping layout/routing drawings for 1” diameter and larger pipes

d) Electrical Engineering
   i) Electrical load lists. Auxiliary power requirements for different sub-systems of the direct air capture system and balance of plant systems must be specified
   ii) Load flow analysis
   iii) Key one-line diagram, and one-line diagrams for emergency power

iv) Cable/cable tray routing and underground duct bank layout drawings and specifications. Hanger design drawing and structural steel support drawing ready for construction
v) Lighting layout drawings
vi) Grounding layout drawings
vii) Electrical bulk material list and equipment list (substation, motor control centers, switchgear, transformers, power supplies, chargers, generators, control panels, packaged equipment, etc.), datasheets, drawings, front and interior layout, specification, sizing calculation, and maintenance and instruction manuals
viii) Motor operated valve control schematic
ix) Motor datasheets and schematic
x) Substation and switchgear building equipment layout drawings
xi) Inter connection drawing between panels, and electrical installation details
xii) Electrical wiring drawing
xiii) Heat tracing calculation and isometrics

e) Instrumentation & Controls Engineering (System Integration)
   i) Control system architecture specification
   ii) Instrument/equipment lists, valve lists, datasheets and specifications
   iii) Control logic and loop diagrams
   iv) Instrument and control system schematics, hook up diagrams (electric, pneumatic, etc.), and location drawings
   v) Communications infrastructure (e.g., remote SCADA ability, telephone, and internet) specifications
f) Fire Protection Engineering
   i) Fire protection system (e.g., sprinkler, foam, and water cannons) design specifications and drawings
   ii) P&ID for fire water ring main
   iii) Firefighting equipment list and layout, and extinguishing systems design
g) Facilities Engineering
   i) Building/Security Infrastructure Plans
      (1) Front office/administration
      (2) Control room(s)
      (3) Maintenance/shop area
   ii) HVAC
h) Project Security
   i) Site physical security
   ii) Cybersecurity and associated information protection systems
i) Transportation & Logistics Study
j) Constructability
   i) Construction access
   ii) Lay-down areas
   iii) Sequencing of construction work

k) Project Cost Estimate (+/− 5%) – Must specify year dollar basis and nominal vs. real
   i) Individual component capital cost, including quantity (weight, lengths, numbers, etc.), unit rate, process equipment cost, material cost, labor cost including unit labor rate for individual line item, and man-hours required to complete individual line item tasks. The cost should be closest to $1,000. Details regarding what is included in the capital cost estimate (labor, materials, equipment, contingency, engineering fees, delivery, etc.) need to be provided.
   ii) Breakdown of variable operating costs, including quantity (weight, volume, etc.), per unit rate. The variable operation and maintenance (O&M) cost includes but not limited to consumable consumption rates and unit costs, catalyst cost, specialty chemicals, waste generation rates and disposal costs, and power and fuel costs. Justifications for the unit costs should be provided where appropriate (e.g., power purchase agreements and waste classified as hazardous/nonhazardous)
   iii) Detailed accounting of fixed O&M costs should be provided. This includes labor rates and personnel requirements for operating labor, maintenance assumptions including labor and material required for annual maintenance, and administrative labor such as office support staff and supervisors. Owner's Costs
   iv) Cost of capture ($/net tonne of CO_2e captured by DAC technology)
   v) Cost of the CO_2 conversion product (if applicable)
   vi) Overall cost of removal ($/net tonne of CO_2e removed by integrated DAC system)
   vii) Quantitative risk analysis and associated funding contingency requirements. Financial factors must be detailed. The methodology used to calculate the cost of CO_2 capture must be clearly outlined. Requested details include:
      (1) Interest rate, project life, debt-equity arrangement, taxes, insurance, contingency and other cost escalation
      (2) Owner's cost calculation details
      (3) Annualization calculation details
      (4) Calculated costs should take into account expected capacity and utilization factors and operational mode
l) Integrated Project Schedule (see **Appendix Z** for additional guidance)
   i) Identification of the project critical path
   ii) A Level 4 schedule identifying associated milestones, including integration between engineering, procurement, construction, and startup and commissioning activities
   iii) Strategy for tracking schedule performance such as schedule performance indicators from an earned value management system

Detailed Design Study Checklist

Based on prior experience with front end engineering design (FEED) study reporting, the following checklist is provided to emphasize key pieces of information that should be contained in the detailed design reports (as a minimum). The items shown in the checklist are all included in the above explanation but are identified in this chart for emphasis.

Reporting Guidelines

Category	Topic	Description
Reporting	Report organization	The FOA gives an outline for important sections to be included in the detailed design report, and this outline should be followed. The executive summary should include a summary of all pertinent information and major aims and conclusions of each of the subsequent chapters upfront.
	Quality control	There should be no inconsistencies in reported values in different sections of the report. Missing appendices, section headings, and mislabeled figures should be avoided. Image quality should be checked; figures with unreadable text should not be included.

General Guidelines

Category	Topic	Description	Location in Text/ Page #
General	Project feasibility	An assessment of the feasibility of the project, as outlined in the detailed design, should communicated clearly up front. If major design changes are required, this should be reflected in the project timeline with a path forward clearly outlined. Lessons learned should be highlighted.	
	Definition of roles	The roles and scope of work for the different parties involved in the project should be clearly delineated.	
	Sources used	A list of sources should be provided.	

Performance Guidelines

Category	Topic	Description	Location in Text/ Page #
Performance	Overall	1 - Comprehensive P&IDs for the facility should be provided. 2 - A 3D model with foundation, insulation, valves, and platforms for operator and maintenance access should be completed.	
	DAC process configuration	1 - The overall process flow diagram with main input and output streams should be highlighted. 2 - Detailed P&ID should be included. 3 - An equipment list with all major equipment specifications and sizing should be provided.	
	DAC system details	The process design and operation should be clearly described. DAC system details allowing comparison with other technologies are requested. These details include, but are not limited to: 1 - Initial sorbent/solvent fill, and sorbent/solvent make up rates 2 - Performance metrics: capture fraction; pressure drop across the contactor; working capacity or solvent loading; adsorption, desorption, and cycle times; selectivity; vacuum pressure; regeneration energy; steam requirement; system auxiliary load	
	Compression system details	Compression technology details allowing comparison with other technologies are requested. These details include: 1 - Compressor type 2 - Number of stages 3 - Intercooling and/or aftercooling requirements 4 - Electricity or steam requirement details 5 - Output pressure, CO_2 purity, and justification for product CO_2 stream purity and pressure	
Performance	Stream tables	Energy and mass balance details should be provided. At a minimum this includes the flow rate, composition, temperature, pressure, density, and enthalpy for the following streams: 1 - Ambient air 2 - Process effluent and emissions streams 3 - Effluent from any air conditioning steps	

Category	Topic	Description	Location in Text/ Page #
		4 - CO_2 product stream from the contactor 5 - CO_2 product after compression (with detailed impurities)	
	Steam requirement	The source, quality, and quantity of steam required by the process must be specified for each application, including: 1 - Solvent/sorbent regeneration steam 2 - Compression system steam (if applicable) 3 - Other miscellaneous applications such as triethylene glycol (TEG) drying	
	Auxiliary power	1 - Auxiliary power requirements for different sub-systems of the DAC system and balance of plant systems must be specified. A detailed electrical load list should be provided. 2 - The power source should also be specified (e.g., purchased from grid, dedicated renewable energy source, and auxiliary combined heat and power [CHP] with carbon capture). The impact of the power source on the net air capture rate should be detailed.	
	Justification of design	Justification for all major design decisions should be provided. This includes: 1 - Results from any case studies performed when deciding on the specific configuration 2 - DAC system (and any non-commercially available system at scale) modeling details including model basis and validation, system modeling results, and justification for any design decisions that deviate from the modeled system 3 - Justification for product CO_2 stream purity and pressure	

Cost Guidelines

Category	Topic	Description	Location in Text/ Page Numbers
Cost	Dollars	The year dollar must be provided and nominal vs. real dollars specified for clarity. The capital cost estimate should be consistent with AACE Class 1 accuracy (+5%/−5%).	
	Cost details	Detailed costs should be provided. This includes: 1 - Capital cost: preferably includes costs for individual pieces of equipment, but at a minimum provides totals for the DAC system, compression system, and BOP. Details regarding what is included in the capital cost estimate (labor, materials, equipment, contingency, engineering fees, delivery, etc.) need to be provided. 2 - O&M costs: a detailed accounting of O&M costs should be provided. This includes labor rates and personnel requirements, maintenance assumptions, insurance, property taxes, consumable consumption rates and unit costs, waste generation rates and disposal costs, and power and fuel costs. Justifications for the unit costs should be provided where appropriate (e.g., power purchase agreements and waste classification as hazardous/nonhazardous) 3 - Owner's costs 4 - Cost of capture ($/net tonne of CO_2e captured by DAC technology) 5 - Cost of the CO_2 conversion product (if applicable) 6 - Overall cost of removal ($/net tonne of CO_2e removed by integrated DAC system)	
	Costing methodology	Financial factors must be detailed. The methodology used to calculate the cost of CO_2 capture must be clearly outlined. See NETL's Quality Guidelines for Energy Systems Studies: Cost Estimation Methodology for NETL Assessments of Power Plant Performance, Department of Energy, Pittsburgh, Pa, 2021 for	

Category	Topic	Description	Location in Text/ Page Numbers
		an example of the detail requested. Requested details include: 1 - Expenditure period, operating period, capital escalation during expenditure, assumed inflation rate, O&M escalation, O&M levelization factor, sales tax rates, debt-equity arrangement, interest rate on debt, return on equity, fixed charge factor, etc. 2 - Owner's cost calculation details 3 - Annualization calculation details	

Detailed Design Value Template

Based on prior experience with FEED study reporting, it is REQUIRED that this template is completed and submitted with the detailed design report. This facilitates review of the final design parameters. The values in this table should agree with the values throughout the report. All parameters relevant to the specific DAC system should be reported. Additional relevant entries, not included in this table, should be added.

Parameter	Units	Value	Pages in Text Discussing Parameter
DAC System Design Basis and Performance			
Ambient Air Design Basis Range	°F		
Note: If air is comingled with any streams or pretreated upstream of the CO_2 removal step, this information must be provided for all streams prior to the CO_2 removal step	psia		
	ppmv CO_2		
	mol% H_2O		
	mol% N_2		
	mol% O_2		
	Other notable constituents/ pollutants		
Auxiliary Load of DAC	MW		
Auxiliary Load of CO_2 Compression	MW		
Auxiliary Load of BOP equipment	MW		
Electrical Auxiliary Boiler Load (if applicable)	MW		
Heat Requirement (if applicable)	MW		
Heat source	--		

Parameter	Units	Value	Pages in Text Discussing Parameter
Auxiliary Boiler Steam Generation	lb/hr		
	psia		
Steam for Sorbent/Solvent Regeneration	lb/hr		
	psia		
	direct/indirect		
Capacity Factor of Power/Heat Source	%		
Utilization Factor of DAC	%		
Air Inlet to DAC Process	lb/hr		
Contactor CO_2 Capture Fraction	%		
Gross DAC CO_2 Capture Capacity	tonnes/yr.		
Gross Plant CO_2 Capture Capacity	tonnes/yr.		
Net CO_2 Capture Capacity	tonnes/yr.		
CO_2 Stream Leaving the DAC Contactor, or for Multistage Processes, CO_2 Stream Leaving Each Stage	lb/hr		
	mol% CO_2		
	mol% H_2O		
	mol% O_2		
	°F		
	psia		
	lb/mol		
CO_2 Product after Compression	lb/hr		
	°F		
	psia		
	mol% CO_2		
	ppm_v H_2O		
	ppm_v O_2		
Pressure Drop Across the Air Contactor	psi		
Air Superficial Velocity	ft/s		
Contactor depth	ft		
Water Consumption of the DAC System	lb/hr		
Number of Contactor Modules			
Initial Solvent Fill	tonne		
Solvent Make-up Rate	tonne/yr.		
Solvent Loading	mol/mol		
Solvent Regeneration Energy	Btu/lb CO_2		
Sorbent Initial Fill	tonne		
Sorbent Life	years		
Sorbent Working Capacity	mol/kg		
Sorbent Bulk Density	lb/ft^3		
Sorbent Void Fraction			

Parameter	Units	Value	Pages in Text Discussing Parameter
Sorbent Selectivity	CO_2/N_2		
	CO_2/O_2		
	CO_2/H_2O		
Sorbent Vacuum Pressure	psia		
Specific Sorbent Regeneration Energy	Btu/mol CO_2		
Adsorption time	s		
Desorption time	s		
Cycle time	s		
Costs			
Dollar Basis	Year		
	Real or nominal		
Capital Cost Accuracy	+/– %		
DAC System Capital Cost			
Equipment	$		
Material	$		
Direct and indirect labor for installation and construction	$		
Engineering Contracting	$		
Process Contingencies	$		
Project Contingencies	$		
CO_2 Compression System Capital Cost			
Equipment	$		
Material	$		
Direct and indirect labor for installation and construction	$		
Engineering Contracting	$		
Process Contingencies	$		
Project Contingencies	$		
BOP and Modifications Capital Cost			
Equipment	$		
Material	$		
Direct and indirect labor for installation and construction	$		
Engineering Contracting	$		
Process Contingencies	$		
Project Contingencies	$		
Solvent Costs			
Initial Fill	$		

Parameter	Units	Value	Pages in Text Discussing Parameter
Solvent Make-up	$/yr.		
Unit price	$/tonne		
Sorbent Cost			
Initial Cost Per Module	$		
Initial Fill Cost (Sorbent)	$		
Replacement Cost	$/yr.		
Unit Cost	$/tonne		
Solvent or Sorbent Waste Disposal	$/tonne		
	$/yr.		
Natural Gas (if applicable)	$/MMBtu		
	$/yr.		
Electricity	$/MWh		
	$/yr.		
Other Consumables/Waste Disposal	$/yr.		
Maintenance Allowance	$/yr.		
Operating and Maintenance Labor Costs	$/yr.		
Property Taxes/Insurance	$/yr.		
Expenditure Period	years		
Operating Period	years		
Inflation	%		
Capital Escalation During Expenditure	%		
O&M Escalation	%		
O&M Levelization Factor	%		
Effective Sales Tax Rate (State and Federal)	%		
Debt-to Equity Ratio			
Interest Rate on Debt	%		
Return on Equity	%		
Fixed Charge Factor			

APPENDIX Z – INTEGRATED PROJECT SCHEDULES

All schedules provided as part of the application or during later phases should include and clearly identify:

- Project Critical Path and key sub- or non-critical paths if relevant
- Anticipated project baseline schedule
- Major project milestones and deliverables associated with all project areas, including but not limited to, technology maturation, business development, engineering, procurement, construction, CBP implementation, permitting, safety, and regulatory
- Activities supporting completion of those milestones and deliverables
- Schedule dependencies, including predecessors and successors as well as parallel and sequential activities

For purposes of the Full Application, Table 1 may be used to guide schedule development. Please note that the below descriptions should be considered indicative of expectations and non-exhaustive.

Table 1. Integrated Project Schedule Level of Detail Examples

Level 1	Summary schedule including major project milestones, deliverables, and related activities.
Level 2	A more detailed version of the Level 1 schedule that should include a breakdown into major project categories such as engineering, design, construction, procurement, permitting and regulatory, CBP implementation, and others as appropriate.
Level 3	Integrated roll up of Level 4 schedules. Should reflect breakout of activities underlying elements of the Level 2 schedule including anticipated start and finish dates for each activity. Often developed by the executing contractor using detailed information from project and/or construction managers and is used for project progress reporting.
Level 4	Detailed working schedule used to manage day-to-day activities or other near term work plans. Should be resource loaded. Often called Execution or Working schedule or similar.

APPENDIX AA – BUSINESS CASE ANALYSIS

The Business Case Analysis, included in the Business Plan (see **Appendix S**), demonstrates an understanding of the current and projected landscapes of the proposed DAC Hub and the potential utilization of tax credits including their projected revenue and duration.

The first section of the business case analysis should identify the potential market size of a technology option proposed by the applicant. The analysis will contain a Business Case Analysis, Technical overview; Market analysis; Future deployment projection; and Quantification of potential benefits of the technology.

An outline of each of the five major pieces of the analysis are as follows:

Business Case Analysis

a. A *pro forma* which quantifies the projected financial parameters such as operating costs, operating revenues, financing cash flows, EBITDA, tax credits/liabilities, and ROI over the project lifespan. The Business Case Analysis should also include a list of key economic/financial assumptions.

Technical overview

a. Description of the technology and potential applicability across the DAC Hub

Market Analysis

a. Survey of energy, water and land resources
b. Applicability of technology to these sources
c. Financial analysis of application of the technology to these sources
d. Discussion of potential financing structures and partnerships for deployment of the technology
e. Discussion of the potential utilization of tax credits and other incentives, including projected revenue and duration

Future deployment projection

a. Provide the potential deployment scale of the technology
b. Identify and compare competing technology options
c. Discussion of potential barriers to large scale deployment

Quantify Potential Benefits of the technology

a. Provide estimates of the potential benefits of large-scale deployment in terms of metrics such as manufacturing jobs, revenue, emissions reductions, etc.

APPENDIX AB – DEFINITION OF TECHNOLOGY READINESS LEVELS

The following is a description of the DOE Technology Readiness Levels.

Relative Level of Technology Development	TRL	TRL Definition	Description
System Operations	**9**	Actual system operated over the full range of expected mission conditions.	The technology is in its final form and operated under the full range of operating mission conditions. Examples include using the actual system with the full range of wastes in hot operations.
System Commissioning	**8**	Actual system completed and qualified through test and demonstration.	The technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental testing and evaluation of the system with actual waste in hot commissioning. Supporting information includes operational procedures that are virtually complete. An Operational Readiness Review (ORR) has been successfully completed prior to the start of hottesting.
	7	Full-scale, similar (prototypical) system demonstrated in relevant environment	This represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Examples include testing full-scale prototype in the field with a range of simulants in cold commissioning (1). Supporting information includes results from the full-scale testing and analysis of the differences between the test environment, and analysis of what the experimental results mean for the eventual operating system/environment. Final design is virtually complete.
Technology Demonstration	**6**	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering scale prototypical system with a range of simulants.(1)Supporting information includes results from the engineering scale testing and analysis of the differences between the engineering scale, prototypical system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. TRL 6 begins true engineering development of the technology as an operational system. The major difference between TRL 5 and 6 is the step up from laboratory scale to engineering scale and the determination of scaling factors that will enable design of the operating system. The prototype should be capable of performing all the functions that will be required of the operational system. The operating environment for the testing should closely represent the actual operating environment.

Relative Level of Technology Development	TRL	TRL Definition	Description
Technology Development	**5**	Laboratory scale, similar system validation in relevant environment	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory scale system in a simulated environment with a range of simulants (1) and actual waste (2). Supporting information includes results from the laboratory scale testing, analysis of the differences between the laboratory and eventual operating system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. The major difference between TRL 4 and 5 is the increase in the fidelity of the system and environment to the actual application. The system tested is almost prototypical.
Technology Development	**4**	Component and/or system validation in laboratory environment	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of ad hoc hardware in a laboratory and testing with a range of simulants and small scale tests on actual waste (2). Supporting information includes the results of the integrated experiments and estimates of how the experimental components and experimental test results differ from the expected system performance goals. TRL 4-6 represent the bridge from scientific research to engineering. TRL 4 is the first step in determining whether the individual components will work together as a system. The laboratory system will probably be a mix of on hand equipment and a few special purpose components that may require special handling, calibration, or alignment to get them to function.
Research to Prove Feasibility	**3**	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development (R&D) is initiated. This includes analytical studies and laboratory-scale studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative tested with simulants.(1) Supporting information includes results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. At TRL 3 the work has moved beyond the paper phase to experimental work that verifies that the concept works as expected on simulants. Components of the technology are validated, but there is no attempt to integrate the components into a complete system. Modeling and simulation may be used to complement physical experiments.
	2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies. Supporting information includes publications or other references that outline the application being considered and that provide analysis to support the concept. The

Relative Level of Technology Development	TRL	TRL Definition	Description
Basic Technology Research			step up from TRL 1 to TRL 2 moves the ideas from pure to applied research. Most of the work is analytical or paper studies with the emphasis on understanding the science better. Experimental work is designed to corroborate the basic scientific observations made during TRL 1 work.
	1	Basic principles observed and reported	This is the lowest level of technology readiness. Scientific research begins to be translated into applied R&D. Examples might include paper studies of a technology's basic properties or experimental work that consists mainly of observations of the physical world. Supporting Information includes published research or other references that identify the principles that underlie the technology.

[1] Simulants should match relevant chemical and physical properties.

[2] Testing with as wide a range of actual waste as practicable and consistent with waste availability, safety, ALARA, cost and project risk is highly desirable.

Source: U.S. Department of Energy, "Technology Readiness Assessment Guide". Office of Management. 2011.

APPENDIX AC – LIST OF ACRONYMS

AACE	Advancement of Cost Engineering
AD	Associate Director
AFE	Authorization for Expenditures
AHJ	Authorities having Jurisdiction
AOR	Authorized Organizational Representative
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
BECCS	Bioenergy with Carbon Capture and Storage
BFD	Block Flow diagram
BIL	Bipartisan Infrastructure Law
BOP	Balance-of-Plant
BP	Business Plan
CAA	Clean Air Act
CAP	Criteria Air Pollutants
CBP	Community Benefits Plan
CBPDP	Community Benefits Plan Development Proposal
CCS	Carbon Capture and Storage
CDR	Carbon Dioxide Removal
CEJST	Climate and Economic Justice Screening Tool
CERCLA	Comprehensive Environmental Response and Liability Act of 1980
CET	Critical and Emerging Technologies
CFO	NETL Chief Financial Officer
CFR	Code of Federal Regulations
CHP	Combined Heat and Power
CIFIA	Carbon Dioxide Transportation Infrastructure Finance and Innovation Act
CO	Contracting Officer
COI	Conflict of Interest
CRADA	Cooperative Research and Development Agreement
CRO	NETL Chief Research Officer
CS	Contract Specialist
CTO	NETL Chief Technology Officer
CWA	Clean Water Act
CX	Categorical Exclusion
DAC	Direct Air Capture
DBA	Davis-Bacon Act
DEC	Determination of Exceptional Circumstances
DEIA	Diversity, Equity, Inclusion, and Accessibility
DEP	Department of Environmental Protection
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier

DOL	Department of Labor
DOT	Department of Transportation
EA	Environmental Assessment
E-Biz	E-Business
EBiz POC	Electronic Business Point of Contact
EEJ	Energy and Environmental Justice
EH&S	Environmental Health and Safety
EIS	Environmental Impact Statement
EIV	Environmental Information Volume
EMP	Environmental Management Plan
EPAct	Energy Policy Act
EPC	Engineering, Procurement, and Construction
EPCO	Engineering, Procurement, Construction, and Operations
ERP	Emergency Response Plan
FAC	NETL Finance and Acquisition Center
FAR	Federal Acquisition Regulation
FE or FECM	DOE Office of Fossil Energy and Carbon Management
FEED	Front-end Engineering Design
FFATA	Federal Funding and Transparency Act of 2006
FFRDC	Federally Funded Research and Development Center
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FONSI	Finding of No Significant Impact
FP	Financial Plan
FPD	FOA Planning Document
FY	Fiscal Year
GAAP	Generally Accepted Accounting Principles
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GMS	Grants Management Specialist
GO	Grants Officer
GWP	Global Warming Potential
H&MB	Heat and Material Balances
HAZOP	Hazard and Operability
HBCUs	Historically Black Colleges and Universities
HCA	High Consequence Area
HSRD	Human Subjects Research Database
HQ	DOE Headquarters
IAW	Investing in the American Workforce
INVESTOR	INvesting in Vital Emerging Strategic Technologies and Objective Research Tool
IP	Intellectual Property
IPCC	Intergovernmental Panel on Climate Change
IPMP	Intellectual Property Management Plan
IPS	Integrated Project Schedules
IRB	Institutional Review Board

ISO	International Organization for Standardization
LCA	Life Cycle Analysis
LCI	Life Cycle Inventory
M&O	Management and Operating
MA	DOE HQ Office of Management
MOP	Maximum Operating Pressure
MOUs	Memorandums of Understanding
MPIN	Marketing Partner ID Number
MRPC	Merit Review Panel Chairperson
MRV	Monitoring, Reporting, and Verification
MSI	Minority-Serving institution
MYPP	Multi-Year Program Plan
NAICS	North American Industry Classification System
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NGCC	Natural Gas Combined Cycle
NGO	Non-Governmental Organization
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Agency
NOI	Notice of Intent
NPV	Net Present Value
O&M	Operation and Maintenance
OCED	Office of Clean Energy Demonstrations
OCR	Office of Civil Rights
OFCCP	Office of Federal Contractor Compliance Programs
OHRP	Office of Human Research Protection
OMB	Office of Management and Budget
OMIs	Other Minority Institutions
OSHA	Occupational Safety and Health Act
OSTI	Office of Scientific and Technical Information
OTS	Organizational Timelining System
P&IDs	Piping & Instrumentation Diagrams
PFD	Process Flow Diagrams
PHA	Process Hazard Analysis
PDP	Plan Development Proposal
PHMSA	Pipeline and Hazardous Materials Safety Administration
PII	Personal Identifiable Information
PISC	Proposed Post-Injection Site Care (PISC)
PM	HQ Program Manager
PMP	Project Management Plan
PPA	Power Purchase Agreement
PSC	Product Service Code
QA/QC	Quality Assurance/Quality Control
QER	Quadrennial Energy Review
QJ	Quality Jobs

QOZ	Qualified Opportunity Zone
QTR	Quadrennial Technology Review
R&D	Research and Development
RFI	Request for Information
RFP	Request for Proposal
RMP	Risk Management Plan
ROD	Record of Decision
RSP	Required Selling Price
RTIC	DOE Research and Technology Investment Committee
S&T	NETL Science and Technology Strategic Plans and Programs
S4	DOE Under Secretary
SAM	System for Award Management
SARA	Superfund Amendments and Reauthorization Act
SCADA	Supervisory Control and Data Acquisition
SCI	Societal Considerations and Impacts
SMART	Specific, Measurable, Achievable, Relevant and Timely
SO	Selection Official
SOPO	Statement of Project Objectives
SPE	Society of Petroleum Engineers
SPOC	Single Point of Contact
SRMS	Storage Resource Management System
SSNs	Social Security Numbers
STEM	Science, Technology, Engineering, and Mathematics
TA	Topic Area
TEA	Techno-Economic Analysis
TEG	Triethylene glycol
TIA	Technology Investment Agreement
TM	NETL Technology Manager
TMP	Technology Maturation Plan
TPC	Total Project Costs
TRL	Technology Readiness Level
TSCA	Toxic Substances Control Act
UCC	Uniform Commercial Code
UEI	Unique Entity Identifier
UIC	Underground Injection Control
USEPA or EPA	U.S. Environmental Protection Agency
V&V	Verification and Validation
WBS	Work Breakdown Structure
WP	Work Proposal