Design Title: Commercial Direct Air Capture Pilot Award

Overview

U.S. Department of Energy (DOE) Office of Fossil Energy and Carbon Management launches“Made in the USA Commercial Direct Air Capture (DAC) Pilot Award”. The award is designed to support the construction of multiple first-of-its-kind direct air capture pilot systems with minimum annual capture500tons of carbon dioxide. The competition is divided into four phases and aims to promote theseDACThe pilot project goes from design to construction and operation.

summary

To achieve net-zero global CO2 emissions, carbon capture must occur at the gigaton level, as outlined in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.DOEof“Carbon Negative Tackling”Initiative works to find innovative carbon capture pathways, includingDACtechnology, the goal is to2032per ton per year below100USD cost to capture and store carbon dioxide. BusinessDACPilot awards are an important part of the initiative, with total awards amounting to5250million aimed at developing and commercializingDACtechnology.

Direct Air Capture Award

DACPilot Awards are multiple promotionsDACOne of the awards for technology maturity and commercialization. This award focuses on advancing technologies that have progressed beyond the innovation stage but require support to achieve commercial deployment. The award is administered through four stages, with competitors successfully designing, building and operatingDACAfter piloting the system, you are eligible to receive up to1200Thousand dollar reward.

General requirements

* **CO2 capture capacity**：DACThe system must be able to capture at least500tons of carbon dioxide.
* **Running time**: The system must be running at least2,000Hour.
* **Technology maturity level (TRL）**: Technology must reach at leastTRL 4, indicating its components and/or the system has been validated in a laboratory environment.

System design and performance

* **flow chart**：DACSystem design must include detailed flow diagrams highlighting key processes for capturing CO2, including any pre-treatment, absorption/Desorption cycle and post-capture treatment.
* **mass and energy balance**: A detailed mass and energy balance must be performed to ensure the efficiency of the system and identify areas for energy optimization.
* **Resource requirements**: System design must consider resource requirements, including:
  + **Energy consumption**: Quantify the energy required per ton of CO2 captured, with a focus on minimizing overall energy consumption.
  + **water consumption**: Evaluate and minimize water use.
  + **Material input**: Specify the type and quantity of materials required, including any chemical solvents or adsorbents.
* **absorb/desorption cycle**: For systems using solvents or adsorbents, the absorption must be clear/Desorption cycle, including:
  + **cycle time**: The duration of each cycle and the number of cycles planned during system operation.
  + **operating conditions**:absorb/Key operating parameters such as pressure and temperature during the desorption process.
* **Membrane system (if applicable)**: For membrane-basedDACsystem:
  + **membrane chemistry**: Describe the membrane materials used, including their carbon dioxide transport mechanisms.
  + **Membrane properties**: Provides membrane selectivity, permeability and durability data under operating conditions.

Environmental and safety requirements

* **environmental impact**：DACSystems must be designed to minimize their environmental footprint, including:
  + **greenhouse gas emissions**: Conduct a full life cycle assessment to ensure that the system achieves net negative emissions.
  + **waste stream**: Identify and reduce any hazardous waste generated by the system.
  + **water and air emissions**: Ensure emissions are within acceptable environmental limits and do not pose a risk to local ecosystems.
* **climate adaptability**：DACSystems must be able to withstand extreme weather conditions, including:
  + **strong wind**: The system should be able to withstand strong wind weather such as tornadoes and hurricanes.
  + **extreme temperatures**: The system must be able to operate in both high and low temperature environments without significantly affecting efficiency.
  + **Fight against floods and fires**: System design should include flood and fire protection measures.

Operational requirements

* **System efficiency**：DACThe system must be optimized to operate efficiently, with the goal of requiring the lowest amount of energy per ton of CO2 captured.
* **Scalability**: The design must demonstrate the potential to scale from a pilot system to a larger commercial operation.
* **Monitor and control**: The system must include advanced monitoring and control mechanisms to ensure stable and efficient operation, including:
  + **Real-time data monitoring**: Implement sensors and data collection systems to monitor key performance indicators in real time (KPI)。
  + **control system**: An automated control system must be in place to adjust operating parameters as needed to maintain optimal performance.

Materials and Equipment Specifications

* **key equipment**：DACThe system must list critical equipment such as:
  + **air contactor**: Specification of air contactor used to contact atmospheric air with carbon dioxide capture media.
  + **heat exchanger**:Details of the heat exchanger used to manage energy flow within the system.
  + **Compression and pumping systems**: The size of the compressor or pump used to move carbon dioxide through the system.
* **structural integrity**: Design must ensure that all structural components can withstand operating stresses, including mechanical loads, thermal expansion and potential seismic activity.

Scalability and future development

* **Next expansion plan**: The design should includeDACRoadmap for expansion beyond the technology pilot phase, including:
  + **Capacity expansion**: Plans to expand CO2 capture capacity to annual5,000tons or more.
  + **technological progress**: Identify key technology improvements that need to be made, such as more efficient materials or enhanced process integration.
  + **cost reduction strategy**: Suggest ways to reduce operating and capital costs as the system expands.