



**U.S. Department of Energy
Advanced Research Projects Agency – Energy
Announcement of Teaming Partner List
for an upcoming Funding Opportunity Announcement:
FLExible Carbon Capture and Storage (FLECCS)**

The Advanced Research Projects Agency – Energy (ARPA–E) intends to issue a new Funding Opportunity Announcement (FOA) in late October 2019 for carbon dioxide capture and storage (CCS) technologies applied to fossil-fueled power generators, with a focus on the implications of changing patterns in the time-dependent value of electricity – as represented by a locational marginal price (LMP) – brought about by the increasing penetration of variable renewables such as wind and solar power. ARPA-E is interested in developing CCS technologies with cost and performance attributes that could enable a net-zero carbon electricity grid at a system levelized cost of electricity (LCOE) of \$75/MWh. The technology focus would be to develop CCS processes that enable fossil-fueled power plants to be responsive to a grid with a large share of renewables; this includes retrofits to existing power plants as well as greenfield systems with a fossil fuel input and low-carbon electricity as an output (i.e. a “black box” in which the nature of the fuel-to-electricity conversion process is not prescribed).

Based on trends in the electricity grid, especially the falling cost of variable renewable generators and energy storage, ARPA-E expects that compelling process attributes could include, but are not limited to:

- Lower CCS capital costs, even if that entails some increase in marginal cost including parasitic load (given general trends towards lower capacity factors for fossil fuel plants)
- CCS processes that enable maximal power plant flexibility such as ramp rate, turndown, and startup and shutdown time
- CCS systems that include additional processes that enable a power plant to shift the export of electricity to the grid, thereby allowing the power plant and CCS plant to operate under more steady-state conditions even when subjected to fluctuating LMPs. Examples include but are not limited to energy storage and hydrogen production; the latter would be constrained to a scale compatible with current combustion turbine and pipeline infrastructure
- CCS processes that can cost-effectively achieve high CO₂ capture rates from flue gas (e.g. greater than 90% removal) and/or vary their capture rate based on market conditions
- Designs that increase the utilization of a point-source CCS process, such as integration with direct air capture (DAC) systems
- Processes that are designed primarily to remove CO₂ from the atmosphere, but can change modes to export electricity to the grid in times of high demand

ARPA-E anticipates a two-phased program. Phase I would focus on designing innovative CCS processes that maximize the net present value (NPV) of a fossil-fueled power generator with CCS across several carbon pricing scenarios (e.g. \$100-300 per ton), given LMP price signals that reflect a grid with a deep penetration of renewables. These LMP signals would be provided as an input from ARPA-E.



Teams would develop steady-state and dynamic models of the power generator, CO₂ capture plant, and CO₂ compression system; validate those models; vary the process configuration and design and operational variables to optimize the NPV; and provide estimates for the capital cost, marginal cost, and fixed operations & maintenance costs. Teams would use LMP signals and carbon prices provided by ARPA-E and propose the dispatch of the power plant, thereby defining the capacity factor. Phase I would thus focus on process designs and computational modeling; experimental validation would be encouraged but not required.

At the end of Phase I, ARPA-E plans to hold an engineering design review with third-party reviewers to analyze the processes designed by awardees. In addition, ARPA-E intends to analyze the market potential of the proposed technologies with a capacity expansion modeling tool that estimates the build-out and utilization of each technology under a range of possible scenarios.

Based on the results of the capacity expansion modeling analysis and engineering design review, ARPA-E anticipates a Phase II that would build components, unit operations, and small systems to reduce the technical risk and cost associated with these CCS systems. Phase II projects would have a longer period of performance and larger budget than Phase I.

ARPA-E held a workshop on this topic in July 2019; information on this workshop can be found at the webpage (<https://arpa-e.energy.gov/?q=workshop/flexible-carbon-capture-workshop>)

In order to realize the goals of this program, expertise in the following areas may be useful:

- CCS technology development
- Innovative fuel-to-electricity conversion technologies that are inherently amenable to CCS
- Process modeling of power plants, CO₂ capture processes, and CO₂ compression systems
- System dynamics and controls
- Engineering cost modeling of capital and operational costs
- Advanced optimization techniques that allow for a wide range of process configurations and design and operational variables to be considered in a computationally-efficient manner
- Processes that enable a power plant to shift output with minimal capital expense, such as energy storage or hydrogen production at a scale compatible with existing power plant and pipeline infrastructure
- DAC systems that could be integrated with point-source CCS plants and/or export power to the grid

As a general matter, ARPA-E strongly encourages outstanding scientists, engineers and innovators from different organizations, scientific disciplines, and technology sectors to form new project teams. Multidisciplinary and cross-sector collaboration spanning organizational boundaries enables and accelerates the achievement of scientific and technological outcomes that were previously viewed as extremely difficult, if not impossible.

The Teaming Partner List is being compiled to facilitate the formation of new project teams. ARPA-E intends to make the Teaming Partner List available on ARPA-E eXCHANGE (<http://ARPA-E-foa.energy.gov>), ARPA-E's online application portal, in October 2019. Once posted, the Teaming Partner List will be updated periodically, until the close of the Full Application period, to reflect new Teaming Partners who have provided their information.

Any organization that would like to be included on the Teaming Partner list should complete all



required fields in the following link: <https://ARPA-E-foa.energy.gov/Applicantprofile.aspx>. Required information includes: Organization Name, Contact Name, Contact Address, Contact Email, Contact Phone, Organization Type, Area of Technical Expertise, and Brief Description of Capabilities.

By submitting a response to this Notice, you consent to the publication of the above-referenced information. **By facilitating this Teaming Partner List, ARPA-E does not endorse or otherwise evaluate the qualifications of the entities that self-identify themselves for placement on the Teaming Partner List.** ARPA-E will not pay for the provision of any information, nor will it compensate any respondents for the development of such information. Responses submitted to other email addresses or by other means will not be considered.

This Notice does not constitute a FOA. No FOA exists at this time. Applicants must refer to the final FOA, expected to be issued in late October 2019, for instructions on submitting an application and for the terms and conditions of funding.