U.S. Department of Energy
Advanced Research Projects Agency – Energy

Announcement of Teaming Partner List for Upcoming Funding Opportunity Announcement: New Program in Data Center Cooling

The Advanced Research Projects Agency Energy (ARPA-E) is considering issuing a Funding Opportunity Announcement (FOA) to develop transformational cooling systems for data centers. Data centers are estimated to consume around 3% of all generated electricity with up to 40% of that power used for cooling. Currently the cooling power and use of water for evaporation cooling used by data centers varies greatly depending on local climate.

ARPA-E seeks to dramatically increase the efficiency of cooling for current and future compute systems in data centers and edge computing systems by greatly lowering the thermal resistance between the chip and the coolant. This will allow heat rejection at a temperature much closer to the chip operating temperature, enabling cooling solutions with transformational lower energy usage that can operate efficiently at any location in the United States at any time of the year. This will have many benefits: increased cooling capacity to meet future high-powered computing demands, increased potential for waste heat recovery and reuse, reduced or eliminated water consumption for cooling of data centers, potential for increased chip efficiency, location independence, improved performance in hot humid climates, potential for a compact modular cooling system, and enabling current and future edge computing needs.

Integrating advanced cooling solutions in power dense electrical environment like data centers has traditionally been a challenge due to reliability concerns of the cooling system and components. Reliability of complex systems has been achieved in other technical areas such as aerospace, automotive and renewable energy platforms through dedicated system engineering approaches and reliability and controls network modeling. ARPA-E would be interested to explore advanced integrations of electronics and cooling systems that can reach high levels of reliability and performance.

To achieve these goals ARPA-E is considering a potential program to develop ***disruptive cooling technologies that would consume less than 5% of data center power in any geographic location at any time of the year for a very high power density compute system***. In addition, these technologies would be required to demonstrate the potential to be highly reliable as a system to allow data centers to maintain industry standard uptime levels. These technologies will also need to be cost competitive, environmentally friendly, and are encouraged to minimize or eliminate the need for water consumption for cooling. ARPA–E held a virtual workshop on this topic entitled "Cooling Compute Systems Efficiently, Anytime, Anywhere" on December 13 and 14, 2021. Information from this workshop can be found here: https://arpa-e.energy.gov/events/cooling-compute-systems-efficiently-anytime-anywhere-workshop.

In pursuit of this objective, the potential program envisions four different research tracks, each with specific scope of research and development, and metrics. One of the tracks will focus specifically on the

component development for secondary cooling loop that transfers heat from the chips and electronics in the data hall to the facility. A second track will focus on technology and system development that encompasses both the secondary loop and the primary loop that transfers heat from the facility water to the environment, with an emphasis on novel modular data centers.

Two other tracks will be support tracks, with one focusing on development of a modelling capability that can assess impact at the datacenter center level, and allow future operators and data center designers to analyze and design for cooling system reliability, energy consumption, carbon footprint and total cost of ownership, while the other support track is intended to focus on facilities for testing the new technologies developed under the first two tracks.

Historically, the industry has been operating in a siloed approach. ARPA-e seeks new and transformative solutions that can only be achieved by interdisciplinary teaming. Expertise in the following technical areas may be useful in responding to the potential FOA: heat transfer, fluid mechanics, material science, electronics cooling, reliability engineering, control theory, chemical engineering, advanced manufacturing, artificial intelligence, and machine learning, environmental engineering, cost analysis, industrial engineering, architecture, bio-heat transfer, expertise in data center operation, design and ownership.

As a general matter, ARPA-E strongly encourages outstanding scientists and engineers from different organizations, scientific disciplines, and technology sectors to form new project teams. Interdisciplinary 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. The Teaming Partner List will be available on ARPA-E eXCHANGE (http://arpa-e-foa.energy.gov), ARPA-E's online application portal, starting in May 2022. 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 this 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 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.

<u>This Notice does not constitute a FOA. No FOA exists at this time.</u> Applicants must refer to the final FOA, expected to be issued by August 2022, for instructions on submitting an application and for the terms and conditions of funding.