



**U.S. Department of Energy**  
**Advanced Research Projects Agency – Energy**  
**Announcement of Teaming Partner List**  
**for Upcoming Funding Opportunity Announcement:**  
**New Program in High Energy Density Energy Storage Systems**

The Advanced Research Projects Agency-Energy (ARPA-E) intends to issue a Funding Opportunity Announcement (FOA) to support the development of novel high energy density energy storage systems (ESS) for emissions-free planes, trains, and ships. Transformational targets including 1000 watt-hour per kilogram (Wh/kg) and 1000 watt-hour per liter (Wh/L), equivalent to 5x state-of-the-art (SOA), at the net system level, are required to achieve a meaningful impact in these heavy-duty applications.

Planes, trains, and ships require large ESS (e.g., 1 to 100 megawatt-hour [MWh]) and are required to perform both safely and reliably over decades in harsh operational environments. Moreover, they are expected to operate *continuously* since “idleness” translates directly into lost revenue. 1000 Wh/kg or 1000 Wh/L is considered transformational and expected to enable (1) electrification of regional aviation up to 1000 miles and 100 passengers, (2) 100% electrification of U.S. railroads, and (3) electrification of a majority of U.S. marine vessels that operate in territorial waters.

Strategies that may have merit, either individually or as part of a total solution, include the following:

- Swappable batteries/energy boxes that can be rapidly and seamlessly interfaced with vessels and vehicles;
- Mechanically rechargeable solutions;
- Platforms that separate energy and power;
- Pumpable electroactive slurries, “goops,” and metals;
- High temperature electrochemical systems;
- Systems that utilize external catholytes (air or seawater, for example);
- Revisiting the past (making primary battery chemistries rechargeable, for example);
- Combining electrochemical function with mechanical structure.

ARPA-E hosted a “Transformational Energy Storage Solutions for the Electrification of Planes, Trains & Ships (ESS-1K) Workshop” on May 10-11, 2023. Information from this workshop can be found at the ARPA-E events webpage (<https://arpa-e.energy.gov/events/transformational-energy-storage-solutions-electrification-planes-trains-ships-workshop>). In addition, ARPA-E issued a Request for Information (RFI) on Rethinking Energy Storage Technologies for Planes, Trains & Ships: “Battery 1K” (DE-FOA-002972, <https://arpa-e.foa.energy.gov/Default.aspx?foald=fb3ceb8e-8bf7-47ba-8dc3-93501610a927>). A slide deck on this subject was presented during the “Transportation Systems” Fast Pitch Panel at the 2022 ARPA-E Energy Innovation Summit and is posted online ([https://www.arpa-e.energy.gov/sites/default/files/5-Fast\\_Pitch\\_Final\\_CHEESEMAN.pdf](https://www.arpa-e.energy.gov/sites/default/files/5-Fast_Pitch_Final_CHEESEMAN.pdf)). Finally, a video of the entirety of the “Batteries & Storage” Fast Pitch Panel from the 2023 ARPA-E Energy Innovation Summit can be viewed online ([https://www.youtube.com/watch?v=ye\\_yZNcAj30](https://www.youtube.com/watch?v=ye_yZNcAj30)).



As described in more detail below, the purpose of this announcement is to facilitate the formation of new project teams to respond to a potential FOA for the development of high energy density energy storage systems for electrification of planes, trains, and ships. In this case, interdisciplinary collaboration is highly recommended. Expertise in the following areas may be useful in responding to a potential future FOA: advanced energy storage chemistries/materials/components research and development, computational modeling, system architecture, technoeconomic analysis (TEA), and safety, including Failure Modes and Effects Analysis (FMEA).

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, in July 2023. Once posted, the Teaming Partner List will be updated periodically, until the closing 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 at 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, you consent to the publication of the above-referenced information. **By facilitating and publishing this Teaming Partner List, ARPA-E is not endorsing, sponsoring, or otherwise evaluating the qualifications of the individuals and organizations that are self-identifying themselves for placement on this Teaming Partner List. ARPA-E reserves the right to remove any inappropriate responses to this Announcement (including lack of sufficient relevance to, or experience with, the technical topic of the Announcement).** 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 August 2023, for instructions on submitting an application, the desired technical metrics, and for the terms and conditions of funding.