



**U.S. Department of Energy  
Advanced Research Projects Agency – Energy  
Announcement of Teaming Partner List  
for Upcoming Funding Opportunity Announcement:  
Converting UNF Radioisotopes Into Energy (CURIE)**

The Advanced Research Projects Agency-Energy (ARPA-E) is considering issuing a Funding Opportunity Announcement (FOA) for a new program entitled Converting UNF Radioisotopes Into Energy (CURIE). This new program will fund innovative technologies and approaches that will significantly improve the economics of commercial nuclear fuel reprocessing facilities, improve reprocessing material accountancy while decreasing materials attractiveness, and drastically reduce the volume of high-level waste (HLW) requiring permanent disposal. An ARPA-E workshop was held in July 2021 to help identify and refine metrics for this new program; presentations from that workshop can be found [here](#). The following paragraphs summarize the motivation for CURIE and the current planning for the CURIE FOA.

The U.S. currently uses a once-through fuel cycle in which approximately 4% of the uranium in nuclear fuel is consumed in a nuclear reactor before it is disposed of as HLW. After decades of using a once-through fuel cycle, the U.S. has accumulated nearly 86,000 metric tons (MT) of used nuclear fuel (UNF), an amount that increases by approximately 2,000 MT per year.<sup>1</sup> However, the use of nuclear fuel reprocessing, which is the recovery of valuable actinides from UNF, could close the fuel cycle by enabling the recycle of valuable actinides as new fuel for advanced reactors. Recycling UNF in this manner could greatly improve resource utilization, particularly when used in fast-spectrum advanced reactors, while dramatically reducing the volume of HLW requiring disposal. Reprocessing facility construction costs are currently estimated to range from \$250 million to \$20 billion,<sup>2</sup> but advances in separations chemistry and material accountancy technologies, front-end UNF treatment, advanced manufacturing, modularization, machine learning, and other relevant technological advances could be leveraged to drastically reduce the costs of constructing and operating a modern reprocessing facility in a safe and secure manner. The CURIE program aims to achieve this timely goal. It is part of a nearly \$90M ARPA-E strategy to manage and reduce the Nation's HLW waste inventory and complements ARPA-E's recently announced [ONWARDS](#) program, which focuses on minimizing the waste impact of advanced reactors.

The FOA will provide specific CURIE program goals, technical metrics and selection criteria; the terms of the FOA will be controlling but currently, ARPA-E anticipates that the CURIE FOA will target research and development in the following categories:

---

<sup>1</sup> Government Accountability Office, Report No. GAO-21-603, "Commercial Spent Nuclear Fuel: Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," published September 2021, available online at <https://www.gao.gov/products/gao-21-603>. Accessed November 12, 2021.

<sup>2</sup> Idaho National Laboratory, Report No. NTRD-FCO-2017-000265, "Advanced Fuel Cycle Cost Basis – 2017 Edition," Module F1: Spent Nuclear Fuel Aqueous Reprocessing Facility, published September 29, 2017.



- i) Category 1 – Reprocessing Technologies: This technical category includes front-end- and separations process improvements and innovative equipment designs that minimize waste volumes and streams, condense unit operations, improve intrinsic proliferation resistance of actinide separations, increase resource utilization efficiency, simplify off-gas management, and/or, enable repurposing and recovery of valuable products (e.g., noble metals, medical radioisotopes). Example technology improvements include, but are not limited to, process intensification, single-cycle solvent extraction, advanced voloxidation, and fluoride volatility.
- ii) Category 2 – Integrated Monitoring & Materials Accountancy: This technical category includes technologies that support online monitoring of UNF reprocessing operations and enable materials accountancy of fissile materials at accuracy and precision levels of <1% error. This could include improved sensor fusion, instrumentation to support automated collection of real-time monitoring training sets, or novel sensors.
- iii) Category 3 – Facility Design & Systems Analysis: This category is intended for proposals that focus on lowering construction and operations and maintenance costs for reprocessing facilities via approaches such as (but not limited to) modularization of unit operations, automation, development of digital twins, and the use of advanced manufacturing techniques. It also includes systems analysis proposals that optimize the footprint, throughput, and siting of reprocessing facilities; assess the impact of reprocessing on future repository disposal costs; evaluate risks associated with a reprocessing facility; and otherwise explore ways of dramatically improving the economics, licensing, and siting of reprocessing facilities.
- iv) Category 4 - Other: This category is provided for submissions which do not cleanly fall into the above three categories but can potentially meet overall programmatic objectives.

To meet the program metrics for these areas of research, expertise in the following Technical Areas may be useful in responding to the FOA:

- Separations Chemistry (e.g., solvent extraction, pyroprocessing, halide volatility, etc.)
- Head-End Processing (e.g., voloxidation, Kr/Xe capture, etc.)
- Process Intensification
- Material Accountancy/Online Monitoring
- Nuclear Fuel Reprocessing and Safeguards Regulations
- Digital Engineering
- Techno-Economic Analyses
- Systems Analysis and Risk Assessment
- Advanced Manufacturing and Construction, Including Modular Fabrication
- Sensors, Instrumentation, Controls, Autonomous Operation, and Robotics
- Artificial Intelligence, Machine Learning, and Digital Twins
- Project Engineering

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. Such collaboration is especially important for CURIE, as several of the technical and engineering advances (e.g., waste-minimizing separations processes, digital twins, and process intensification) that are crucial to the success of CURIE have been developed and optimized outside of the nuclear industry. To ensure a comprehensive, integrated approach to reaching CURIE's program goals, ARPA-E is encouraging teams from the sectors such as

- National Laboratories
- Universities
- Nuclear Fuel Cycle Industry
- Oil and Gas Industry
- Chemical and Biochemical Industry
- Industrial Waste Management Companies
- Mineral Processing Industry
- AI/Robotics R&D/Industry
- Project Engineering and Construction Firms

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 January 2022. 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 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 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.

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