

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Advanced Materials and Manufacturing Technologies Office

NATIONAL LABORATORY CALL FOR PROPOSALS
STRENGTHENING DOMESTIC CAPABILITIES IN SOLID-
STATE AND FLOW BATTERY MANUFACTURING

National Lab Funding for Fiscal Year 2023
DE-LC-0000027.0001

This Lab Call is being issued by the U.S. Department of Energy’s (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Advanced Materials and Manufacturing Technologies Office (AMMTO).

Modifications

Mod. No.	Date	Description of Modification
0001	4/28/2023	<p>Update the section for “Waiver Requests: Foreign Entities and Foreign Work (if applicable)” on page 27 as follows (yellow highlight):</p> <p><u>Waiver Requests: Foreign Entities and Foreign Work (if applicable)</u></p> <p>1. Foreign Entity Participation: All non-lab partners for this Lab Call must be incorporated (or otherwise formed) under the laws of a State or territory of the United State.</p>

*Questions about this Lab Call? Email BatManLabCall@ee.doe.gov.
Problems with EERE eXCHANGE? Email EERE-eXCHANGESupport@hq.doe.gov.
Include Lab Call name and number in subject line.*

KEY DATES AND INFORMATION	
Lab Call Release Date:	April 13, 2023
Means of Submission:	EERE eXCHANGE
Eligible Entity:	All DOE/National Nuclear Security Agency (NNSA) Federally Funded Research and Development Centers (FFRDCs), and all National Laboratories. To be eligible, the FFRDC or National Laboratory must be partnering with at least one domestic industry partner.
Cost-Share Requirement:	<ul style="list-style-type: none"> • Topic 1. Developing Innovative Solid-State Battery Manufacturing Capabilities: All Topic 1 projects require a cost share of at least 20% of the total project costs. • Topic 2. Developing Innovative Flow Battery Manufacturing Capabilities: All Topic 2 projects require a cost share of at least 50% of the total project costs.
Letter of Intent (LOI) Submission Deadline:	May 12, 2023, 5:00 PM ET <ul style="list-style-type: none"> • Applicants must submit a Letter of Intent (LOI) to express interest from the labs in the Lab Call. AMMTO will not provide any response or feedback on the LOI, but will use the LOI to identify reviewers and engage industry interest.
Phase I:	April 14, 2023 – May 12, 2023 <ul style="list-style-type: none"> • Applicants must identify what existing areas, facilities, and capabilities at the lab(s) will be leveraged, as well as any other equipment or expertise that will be required. • AMMTO plans to designate lab points of contact and publicize the results or findings of a lab or group of labs to industry stakeholders in order to raise awareness of the lab’s capabilities and Lab Call.
Phase II:	May 15, 2023 – June 23, 2023 <ul style="list-style-type: none"> • A lab or group of labs will develop full proposals with a domestic industry partner(s). • Domestic industry partners are encouraged to explore Cooperative Research and Development Agreement (CRADA) options with their lab partners. A CRADA between each lab and its partners will be required to govern the work responsibilities for the project, intellectual property, cost share and other applicable requirements for the project and the lab management and operating (M&O) contact. Failure to execute a CRADA within 6 months of project selection may result in cancellation of the project.
Full Application Submission Deadline:	June 23, 2023, 5:00 PM ET
Expected Decision Date:	July 28, 2023

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List of Topics

Topic 1: Developing Innovative Solid-State Battery Manufacturing Capabilities

Topic 2: Developing Innovative Flow Battery Manufacturing Capabilities

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I. Lab Call Description

A. Background and Context

i. Overview and Purpose

EERE National Laboratory Guiding Principles require all offices to pursue a merit review of direct-funded National Laboratory work. In line with these principles, AMMTO is issuing this Lab Call for fiscal year 2023 (FY 2023).

Some labs have continuing multi-year projects that have already gone through the merit review process. These will continue to be reviewed through the annual peer review process. Labs should work with AMMTO project and program managers to ensure that ongoing projects are included in the annual operating plans (AOP) to meet AOP deadlines. This Lab Call will only pertain to the new topic areas below.

Building a clean and equitable energy economy and addressing the climate crisis is a top priority of the Biden Administration. This Lab Call will advance the Biden Administration’s goals to achieve carbon pollution-free electricity by 2035 and to “deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050”¹ to the benefit of all Americans. The Department of Energy is committed to pushing the frontiers of science and engineering, catalyzing clean energy jobs through research, development, and demonstration (RD&D), and ensuring environmental justice and inclusion of underserved communities.²

The RD&D activities to be funded under this Lab Call will support the government-wide approach to the climate crisis by driving the innovation that can lead to the deployment of clean energy technologies, which are critical for climate protection. Specifically, the solid-state and flow battery manufacturing technologies in this Lab Call each have the potential to make a unique contribution to decarbonization of the grid, industry, and transportation. Generally, this Lab Call supports battery manufacturing innovation to enable the energy infrastructure needed for carbon pollution-free electricity by 2035 and net zero GHG emissions by 2050. In addition, this Lab Call will

¹ Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,” January 27, 2021.

² The term “underserved communities” refers to populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, as exemplified by the list in the definition of “equity.” E.O. 13985. For purposes of this Lab Call, as applicable to geographic communities, applicants can refer to economically distressed communities identified by the Internal Revenue Service as Qualified Opportunity Zones; communities identified as disadvantaged or underserved communities by their respective States; communities identified on the Index of Deep Disadvantage referenced at <https://news.umich.edu/new-index-ranks-americas-100-most-disadvantaged-communities/>, and communities that otherwise meet the definition of “underserved communities” stated above.

emphasize increasing diversity of research staff, increasing diversity of voices in research design, and or increasing quantification and emphasis on supporting underserved communities.

AMMTO supports innovation for advanced materials and manufacturing technologies that drive competitive domestic manufacturing for products needed to decarbonize the economy. AMMTO has three subprograms: 1) next-generation materials and processes; 2) secure and sustainable materials; and 3) energy technology manufacturing and workforce.

AMMTO plays a strategic role in building a strong, revitalized domestic manufacturing sector through investments in RD&D activities, as well as technical assistance and workforce development. AMMTO actively partners with the nation's manufacturing innovation community, including laboratories, companies (for-profit and not-for-profit), universities, individuals, state/local governments, and consortia.

This Lab Call also aligns with several initiatives that highlight the importance of accelerating domestic capabilities for battery manufacturing. For example, DOE's Energy Storage Grand Challenge (ESGC) addresses the importance of domestic manufacturing for energy storage technologies that can meet all U.S. market demands by 2030.³ The Long Duration Storage Shot (LDSS) sets targets towards developing the technology and manufacturing to reach its cost targets by establishing a new, U.S.-based manufacturing industry for storage products.⁴ The Federal Consortium for Advanced Batteries (FCAB), a federal interagency working group, released the National Blueprint for Lithium Batteries 2021–2030 to guide investments in the development of a domestic lithium-battery manufacturing value chain.⁵ Projects funded under this Lab Call will directly support domestic battery manufacturing as well as the goals of ESGC, LDSS, and the Blueprint. Specific attention will be given to Goal 2 (support the growth of a U.S. materials processing base able to meet domestic battery manufacturing demand) and Goal 5 (maintain and advance U.S. battery technology leadership by strongly supporting scientific research and development (R&D)).

This Lab Call is divided into two topics: Topic 1) Developing Innovative Solid-State Battery Manufacturing Capabilities, and Topic 2) Developing Innovative Flow Battery Manufacturing Capabilities.

This Lab Call will: 1) build confidence in the use of solid-state and flow battery manufacturing technologies; 2) develop best practices and technical standards to assess the scalability and manufacturability of battery/storage technologies; and 3)

³ Department of Energy, [Energy Storage Grand Challenge](#)

⁴ Department of Energy, [Long Duration Storage Shot: An Introduction](#), July 2021

⁵ Department of Energy, [National Blueprint for Lithium Batteries 2021-2030](#), June 2021

promote the use of manufacturing technologies by sharing knowledge through the innovation ecosystem.

Accomplishing this will strengthen all involved parties, such as domestic material/tool suppliers, researchers, manufacturers, and end-users (who will see improved resiliency and productivity with these new capabilities), and RD&D within battery manufacturing.

Leveraging the capabilities within our national labs and creating these partnerships will provide the surest path forward. Therefore, each proposal must focus on addressing gaps and challenges in flow and solid-state battery manufacturing; leveraging existing manufacturing capabilities; and solving the challenges with a focus on de-risking, scaling, and accelerating adoption of the technologies.

Applicants are required to submit a Letter of Intent (LOI) to express interest from the labs in this Lab Call. AMMTO will not provide any response or feedback on the LOI, but will use the LOI to identify reviewers and engage industry interest.

The application process consists of two phases.

- In the first phase,
 - Applicants who are interested in this opportunity must identify what existing areas, facilities, and capabilities at the lab(s) will be leveraged, as well as any other equipment or expertise that will be required.
 - AMMTO plans to designate lab points of contact and publicize the results or findings of a lab or group of labs to industry stakeholders in order to raise awareness of the lab’s capabilities and this Lab Call.
- In the second phase, applicants will meet the following expectations:
 - A lab or group of labs will develop full proposals with a domestic industry partner(s).
 - Domestic industry partners are encouraged to explore Cooperative Research and Development Agreement (CRADA) options with their lab partners. A CRADA between each lab and its partners will be required to govern the work responsibilities for the project, intellectual property, cost share and other applicable requirements for the project and the lab management and operating (M&O) contact. Failure to execute a CRADA within 6 months of project selection may result in cancellation of the project.

ii. Timeline and Process Logistics

Timeline

KEY DATES	
Lab Call Release Date:	April 13, 2023
Letter of Intent (LOI) Submission Deadline:	May 12, 2023, 5:00 PM ET

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Phase I:	April 14, 2023 – May 12, 2023
Phase II:	May 15, 2023 – June 23, 2023
PROPOSAL DEADLINE AND DECISION DATES	
Full Application Submission Deadline:	June 23, 2023, 5:00 PM ET
Expected Decision Date:	July 28, 2023
EXPECTED LAB CALL PROCESS	
Expected Funding Allocation:	August 25, 2023
Expected CRADA Signed:	November 17, 2023
Expected Project Execution:	December 2023- December 2026

Process Logistics

All communication to AMMTO regarding this Lab Call must use BatManLabCall@ee.doe.gov.

- **PROPOSAL SUBMISSIONS:** To apply to this Lab Call, lab personnel must register (and sign in) with their lab email address and submit application materials through EERE eXCHANGE. Application materials must be submitted through EERE eXCHANGE at <https://eere-eXCHANGE.energy.gov>, EERE's online application portal. Frequently asked questions for this Lab Call and the EERE Application process can be found at <https://eere-eXCHANGE.energy.gov/FAQ.aspx>.

Applicants are responsible for meeting the submission deadlines. DOE strongly encourages all applicants to submit the required information at least 24 hours in advance of the submission deadline. Applicants should not wait until the last minute—internet and data server traffic can be heavy in the last hours before the submission deadline, which may affect the applicants' ability to successfully submit the required information before the deadline.

- **QUESTIONS DURING OPEN LAB CALL PERIOD:** Specific questions about this Lab Call should be submitted via e-mail to BatManLabCall@ee.doe.gov. AMMTO will provide answers related to this Lab Call on EERE eXCHANGE at: <https://eere-eXCHANGE.energy.gov>. Please note that you must first select the specific opportunity number for this Lab Call in order to view the questions and answers specific to this Lab Call. EERE will attempt to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website.

Questions related to the registration process and use of the EERE Exchange website should be submitted to: EERE-eXCHANGESupport@hq.doe.gov. To

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ensure fairness for all lab participants, please do not ask individual AMMTO staff questions directly.

- **NOTIFICATION OF SELECTION:** When selections are finalized, lab leads will receive an email from BatManLabCall@ee.doe.gov.

B. Key Considerations and Topic Area(s)

i. Key Considerations

- **AVAILABLE FUNDING:** There is approximately **\$16 million in total federal funding** available to fund **all** projects solicited in this Lab Call pending appropriations and program direction considerations. The amount of federal funding given to fully awarded labs will be a maximum of **\$4 million per project for each topic**.
- **CRADA:** All projects will be governed by a CRADA executed by the lab and its industry partners. If approved by the cognizant DOE Contracting Officer (CO), a lab and its industry partners may use an existing CRADA between the parties under which the new project will be added. Under an existing CRADA, the cost share requirement set forth in this Lab Call must be satisfied based solely on the new project. If the parties failed to execute a CRADA that covers the project within 6 months of project selections, the project may be cancelled.
- **EXISTING PROJECTS:** Labs with existing projects addressing any of the topic areas below may incorporate that work in proposals they submit in response to this Lab Call to demonstrate existing capability and leverage existing partnerships with industry and other partners. If the proposal is not selected for funding under this Lab Call, the work under the existing projects will not be negatively impacted.
- **COST-SHARE:** CRADAs will include a cost-share to accomplish the goals of the project:
 - Topic 1) Developing Innovative Solid-State Battery Manufacturing Capabilities: The cost share requirement for each topic 1 project is at least 20% from non-federal sources of the total project costs. **The goal of a CRADA is to establish lab-industry partnerships.**
 - Topic 2) Developing Innovative Flow Battery Manufacturing Capabilities: The cost share requirement for each topic 2 project is at least 50% from non-federal sources of the total project costs. **The goal of a CRADA is to establish lab-industry-end user partnerships.**

Labs may contribute their own additional funding and/or resources to this project as they deem necessary and may leverage resources or funding contributions from project partners.

- **ELIGIBILITY:** All DOE/National Nuclear Security Agency (NNSA) Federally Funded Research and Development Centers (FFRDCs) and all DOE/NNSA National Laboratories are eligible to submit proposals, unless specified otherwise. To support statutory requirements for having a diverse portfolio of projects:
 - **Each National Lab may submit more than one letter of intent (LOI) under each topic.** In cases where an individual lab seeks to submit more than one LOI for a particular topic, they shall differentiate the facilities and capabilities for each submitted LOI.
 - **Proposals that involve more than one laboratory are also allowed.** In the case that labs want to partner with other labs, they must jointly submit a LOI that lists each lab that will be involved in the project. Labs that are listed in a joint LOI and that also seek to submit an additional LOI for that topic (joint or individual), shall differentiate the LOIs as outlined above.
 - **All proposals must include a domestic industry partner(s).**

Applicants must submit an eligible LOI to be qualified to submit a Final Application.

Applicants with currently active projects seeking additional funding to complete their original scope of work are excluded. Note, such applicants may apply as long as a new scope of work is proposed that meets the intent of this Lab Call. The intention is that applicants cannot use this Lab Call to ask for additional funding on an existing project (see [Sec. I.B.i.](#)).

Applicants must submit a Letter of Commitment from at least one domestic industry partner to be considered as a Final Application.

For a full proposal to be considered, it must include a letter of commitment from at least one domestic industry partner. The letter must indicate the willingness of the domestic industry partner to provide the required cost share. The domestic industry partner must be a for-profit entity; be organized and chartered or incorporated (or otherwise formed) under the laws of a state or territory of the United States; have majority domestic ownership and control; and have a physical location for business operations in the United States. In addition to the requirements of this lab call, each applicant must comply with all relevant laws, DOE directives, and contractual obligations, including the DOE Policy on Foreign Engagements.

- **DIVERSITY, EQUITY, INCLUSION, and ACCESSIBIITY (DEIA):**

It is the policy of the Biden Administration that:

[T]he Federal Government should pursue a comprehensive approach to advancing equity⁶ for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality. Affirmatively advancing equity, civil rights, racial justice, and equal opportunity is the responsibility of the whole of our government. Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity.

By advancing equity across the Federal Government, we can create opportunities for the improvement of communities that have been historically underserved, which benefits everyone.⁷

As part of this whole of government approach, this Lab Call seeks to encourage the participation of underserved communities and underrepresented^{8,9} groups. Applicants are highly encouraged to include

⁶ The term “equity” means the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality. E.O. 13985.

⁷ Executive Order 13985, “Advancing Racial Equity and Support for Underserved Communities Through the Federal Government” (Jan. 20, 2021).

⁸ According to the National Science Foundation’s 2019 report titled, “Women, Minorities and Persons with Disabilities in Science and Engineering”, women, persons with disabilities, and underrepresented minority groups—blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives—are vastly underrepresented in the STEM (science, technology, engineering, and math) fields that drive the energy sector. That is, their representation in STEM education and STEM employment is smaller than their representation in the U.S. population. <https://nces.nsf.gov/pubs/nsf19304/digest/about-this-report> For example, in the U.S., Hispanics, African Americans and American Indians or Alaska Natives make up 24 percent of the overall workforce, yet only account for 9 percent of the country’s science and engineering workforce. DOE seeks to inspire underrepresented Americans to pursue careers in energy and support their advancement into leadership positions. <https://www.energy.gov/articles/introducing-minorities-energy-initiative>

⁹ Note that Congress recognized in section 305 of the American Innovation and Competitiveness Act of 2017, Public Law 114-329:

(1) [I]t is critical to our Nation’s economic leadership and global competitiveness that the United States educate, train, and retain more scientists, engineers, and computer scientists; (2) there is currently a disconnect between the availability of and growing demand for STEM-skilled workers; (3) historically,

individuals from groups historically underrepresented, in STEM on their project teams. As part of the application, applicants are required to describe how diversity, equity, inclusion, and accessibility objectives will be incorporated in the project. Specifically, applicants are required to reference, if available, the existing laboratory Diversity, Equity, Inclusion, and Accessibility Plan and describe within the technical volume the actions the applicant will take to foster a welcoming and inclusive environment, support people from underrepresented groups in STEM, advance equity, and encourage the inclusion of individuals from these groups in the project; and the extent the project activities will be located in or benefit underserved communities.

Because a diverse set of voices at the table in research design and execution has an illustrated impact on innovation, this implementation strategy for the lab-wide plan will be evaluated as part of the technical review process.

Further, to the extent the proposed project will include external partners, the applicant is encouraged to include Minority Serving Institutions¹⁰, Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or entities located in an underserved community. The Selection Official may consider the inclusion of these types of entities as part of the selection decision.

- **EERE NATIONAL LABORATORY GUIDING PRINCIPLES:** To ensure continued alignment with EERE lab engagement principles, applicants should consider the following when developing their proposals:
 - AMMTO strongly encourages projects that bring together multiple labs in a consortia-based approach to meet a high-level strategic goal, leveraging multiple lab capabilities with strong, centralized leadership.
 - To the extent possible and appropriate, AMMTO seeks lab projects that involve industry engagement or industry partners.

ii. Topic Area Descriptions

Addressing the issues of decarbonizing the economy requires multiple energy storage solutions for the diverse situations. DOE has had a robust program in energy storage

underrepresented populations are the largest untapped STEM talent pools in the United States; and (4) given the shifting demographic landscape, the United States should encourage full participation of individuals from underrepresented populations in STEM fields.

¹⁰ Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities/Other Minority Institutions) as educational entities recognized by the Office of Civil Rights (OCR), U.S. Department of Education, and identified on the OCR's Department of Education U.S. accredited postsecondary minorities' institution list. See <https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>.

that spans decades, resulting in world-leading core capabilities at the National Labs and numerous innovations that have been successfully demonstrated.¹¹ Notably, despite such progress, the success has yet to fully translate beyond the lab due to the lack of strong coupling between applied R&D efforts and manufacturing RD&D associated with enhanced manufacturing processes. The battery industry still suffers from a lack of U.S. R&D and pilot scale line capacity for the commercialization of new technology and limited domestic suppliers of key manufacturing equipment.¹²

AMMTO finds it imperative to help push nascent methods from the lab to industrial readiness in a timely manner and to accelerate manufacturing RD&D in order to meet commercialization and cost targets. It is important to ensure that new technologies are rapidly scaled and integrated into large-format devices for commercialization.

Existing commercial battery manufacturing techniques for solid-state and flow batteries suffer from the following gaps/weaknesses, which AMMTO believes will need support in order to advance new technologies to a high Manufacturing Readiness Level (MRL) for commercialization:

- Need for advanced tooling to manufacture the high-performance components at scaled commensurate with large volume production;
- Need for precision manufacturing technologies to assemble battery cells and systems; and
- Need for processing technologies to deliver promising battery materials, components, and/or systems in the volumes and throughput required for pilot scale.

Through this Lab Call, AMMTO aims to achieve the following:

- Create manufacturing RD&D capabilities that are beyond the current solid-state and flow battery capabilities;
- Build community-wide confidence in the use of solid-state and flow battery manufacturing technologies; and
- Promote the use of manufacturing technologies and standards by sharing knowledge through the innovation ecosystem.

Topic 1: Developing Innovative Solid-State Battery Manufacturing Capabilities

- Estimated DOE Funding Available: \$4M per project
- Estimated Number of Projects Expected: 2
- Estimated Project Duration: 24-36 months

Higher specific energy and improved safety over current lithium-ion batteries are primary concerns of electric vehicles (EVs) and other portable devices. To meet these

¹¹ One of the successful examples is the Advanced Manufacturing Office (AMO)-Vehicle Technologies Office (VTO)'s [FY20 Joint Battery Manufacturing Lab Call](#).

¹² [Li-Bridge Industry Report — Building a Robust and Resilient U.S. Lithium Battery Supply Chain](#), February 2023.

challenges, interest in solid-state batteries has expanded dramatically in recent years due to the potential to nearly double the specific energy compared to current liquid-electrolyte lithium-ion batteries (LiBs).¹³ By eliminating the liquid electrolyte, solid-state batteries offer an energy-dense alternative that is safer, reduces cost, and has increased EV driving range per charge.

However, solid-state batteries are not widely commercialized. Thus, developing domestic capacity to manufacture solid-state batteries will be crucial to the net-zero GHG emissions clean energy economy. Many of the challenges to successful solid-state battery commercialization are still at the basic science and engineering R&D level. Research on solid-state battery manufacturing still faces several critical issues that must be addressed before large-scale production is possible (or ready). AMMTO seeks projects that focus on the following RD&D manufacturing areas:

- Translating fundamental solid-state electrolyte R&D into large format/high-volume manufacturing RD&D. There are significant barriers to overcome before commercial use. The technical gap between optimized cell chemistry and design in solid-state batteries results from the paucity of capability or facilities dedicated to translating fundamental solid-state electrolyte development R&D into large format/high-volume manufacturing techniques that might differ from those commonly used in LiB manufacturing;
- Enhancing precision processing and fabrication of solid-state batteries in large format cells. Without a widely available, high-quality material and the ability to dependably fabricate large batches of sufficiently sized cells, it is very difficult to ascertain the true state of readiness and performance of any proposed cell (solid-state electrolyte, interlayers, Li metal anode, and cathode). The lack of dedicated facilities for solid-state cell fabrication inhibits solid-state electrolyte development. Because of the variance in processing techniques and tools used in coin cell fabrication and testing in the lab, reliable comparison of solid-state electrolyte chemistries can be difficult. Some of the many fabrication and operational parameters that could be manipulated for specific battery chemistries and conditions in the lab are not practical, or even possible, in a real-world production line. More work pushing nascent methods from the laboratory scale to industrial readiness must be done to transition these batteries from the lab to the factory floor¹⁴; AND/OR
- Verification and validation (V&V) of solid-state battery scalability. Solid-state battery research still needs to: 1) assess the state of technology (i.e.,

¹³ P Albertus *et al*, Challenges for and Pathways toward Li-Metal-Based All-Solid-State Batteries, ACS Energy Lett., 2021, 6(4), pp. 1399-1404.

¹⁴ There are various issues that include, but are not limited to, large quantities of materials, densification at scale and maintaining high compression with the system, and integration of cell components into a system at an industry-relevant scale.

commercial readiness) accurately with standard methods for high-quality, larger fabricated cells; and 2) develop the capacity to rapidly verify the scalability of breakthroughs in solid-state battery cells.¹⁵

For Topic 1 of this Lab Call, applicants must clearly identify proposed targets for the project and justify how they were assigned. The proposed targets and the expected progress of the project towards meeting targets must be substantiated. The proposed targets need to include Technology Readiness Level (TRL) or Manufacturing Readiness Level (MRL), as well as technical performance metrics, manufacturing capability metrics, and manufacturing cost metrics (see Appendix C for definitions of TRLs and MRLs and Appendix D for metrics). Additionally, the applicants must clearly identify the project focal areas (see Appendix D). The TRL and MRL should be defined for the start of the project and a proposed target for the end of the project. The metrics should be specific to the proposed technology and must define the appropriate baseline (the start of the project), the final target (the end of the project), and the state-of-the-art with appropriate references. Not all component focus areas and metrics identified in Appendix D may be relevant, but at least 5 technical performance metrics, 5 manufacturing capability metrics, and any relevant manufacturing cost metrics must be quantified. Through Topic 1 of this battery manufacturing Lab Call, AMMTO will fund and establish pilot-scale facilities at national labs for solid-state batteries to create manufacturing RD&D capabilities that will help to advance solid-state battery manufacturing capabilities for commercialization. Performers will address these critical needs by bridging the gap between bench-scale research and practical large-format cells.

Topic 2: Developing Innovative Flow Battery Manufacturing Capabilities

- Estimated DOE Funding Available: \$2M-\$4M per project
- Estimated Number of Projects Expected: 2-4
- Estimated Project Duration: 24-36 months

Beyond the needs of the mobility sphere, LiBs are the dominant battery used for utility-scale grid storage and other on-site storage, despite the lower need for high specific energy. Flow batteries provide an alternative to LiBs for these stationary applications, considering their unique architecture that eliminates the need for critical materials (e.g., lithium) and offers more flexibility in the fundamental design and operation of the battery. Flow batteries, which consist of electrochemical cell stacks, storage tanks, and flow systems, have been widely recognized for their potential. The modular design and scalability of these batteries make it possible to decouple power and energy needs, to simultaneously charge and discharge, and to achieve excellent operational lifetimes.

¹⁵ For example, results for various chemistries are not reliable due to the dependency of assembly techniques and/or lack of accurate measurement techniques. In addition, insufficient cell size (edge effects, alignment, layer-to-layer adhesion, etc.) is one of the major challenges to demonstrate commercial readiness.

Flow batteries also have much lower safety risks than other battery technologies as they can be designed with aqueous or non-flammable solvents. All these traits are ideal for evolving grid and on-site needs with an increased reliance on intermittent renewable power sources as we aim to achieve carbon pollution-free electricity by 2035.

Technical and manufacturing challenges have kept flow batteries from being realized at scale for a wide range of applications. One of the most important gaps in the U.S. flow battery industry is the lack of first markets.¹⁶ While the LiB industry has benefited from consumer electronics and EV customers, there has been no opportunity for flow batteries to directly benefit these end users. Use cases do exist in commercial, industrial, and utility applications though, with each application having its own requirements to which flow batteries would need to be optimized.¹⁷

AMMTO aims to ameliorate the gap between potential flow battery use cases and the current state of manufacturing capabilities with this Lab Call. AMMTO seeks projects that focus on the following RD&D manufacturing areas:

- Manufacturing for new (or enhanced) cell/reactor architecture and configuration. A well-designed, flexible architecture and configuration for high power- and energy-dense flow batteries will accelerate adoption of the systems in varied use cases. Desired projects will be expected to consider architecture designs that are targeted for simplicity, adaptability, and/or scalability for specific use cases.¹⁸; AND/OR
- Developing manufacturing/process standards. To take full advantage of flow batteries' inherent modularity and scalability, the nascent flow battery industry would benefit from strengthened technical standards for component (e.g., cell, stack, electrode, bipolar plate, and/or membrane) manufacturing/process, testing, and validation. Developing such flow battery standards can accelerate the adoption of automated manufacturing to decrease the costs.

For Topic 2 of this Lab Call, applicants must clearly identify proposed targets for the project and justify how they were assigned. The proposed targets and the expected progress of the project towards meeting targets must be substantiated. The proposed

¹⁶ A. Goldstein, [Federal Policy to Accelerate Innovation in Long-Duration Energy Storage: The Case for Flow Batteries](#) April, 2021.

¹⁷ Examples include, but are not limited to, backup power of sites, peak shaving, renewable integration, server racks in data centers, electric utility vehicles, and so on.

¹⁸ The new architecture/configuration may entail the parallel improvement in manufacturing processes for individual components. Given the proposed use cases, examples include, but are not limited to, membranes with increased operational lifetime and decreased crossover, electrode manufacturing, redox targeting, continuous electrolyte production, electrolyte flow engineering/management, and cost-effective operation/maintenance technologies.

targets need to include TRL or MRL, as well as technical performance metrics, manufacturing capability metrics, and manufacturing cost metrics (see Appendix C for definitions of TRLs and MRLs and Appendix D for metrics). Additionally, the applicants must clearly identify the project and component focal areas of the project (see Appendix D). The TRL and MRL should be defined for the start of the project and a proposed target for the end of the project. The metrics should be specific to the proposed technology and must define the appropriate baseline (the start of the project), the final target (the end of the project), and the state-of-the-art with appropriate references. Not all component focus areas and metrics identified in Appendix D may be relevant, but at least 5 technical performance metrics, 5 manufacturing capability metrics, and any relevant manufacturing cost metrics must be quantified.

Through this battery manufacturing Lab Call, AMMTO will fund and establish pilot-scale facilities at national labs for flow batteries to create manufacturing RD&D capabilities for commercialization. Performers will focus on platform manufacturing technologies that are adaptable to multiple chemistries and processing steps for various industry applications/use cases. Specifically, this topic will advance the manufacturability, scalability, and adaptability of flow battery systems to strengthen both the domestic supply chain for flow battery technologies and the domestic capacity for overall energy storage solutions with more use-cases and alternatives to existing technologies.

II. Application Submission and Review Information

A. Application and Submission Details

i. Application Process

To apply to this Lab Call, applicants must register with their lab email address and submit application materials through EERE eXCHANGE at <https://eere-eXCHANGE.energy.gov>, EERE's online application portal. Applicants will be required to have a Login.gov account to access EERE eXCHANGE. As part of the eXCHANGE registration process, users will be directed to create an account in <https://login.gov/>. Please note that the email address associated with Login.gov must match the email address associated with the eXCHANGE account. For more information, refer to the Exchange Multi-Factor Authentication (MFA) Quick Guide in the [Manuals section](#) of eXCHANGE.

All submissions must conform to the guidelines for format and length, and be submitted at, or prior to, the deadline listed in [section I.A.ii](#).

Applicants are required to submit a LOI to demonstrate interest in this Lab Call. AMMTO will not provide any response or feedback on the LOI, but will use the LOI to identify reviewers and engage industry interest. **To submit the LOI, applicants must register with their lab email address and submit application materials through EERE**

Exchange's Pre-Application Section on <https://eere-Exchange.energy.gov>, EERE's online application portal.

The application process consists of two phases.

- In the first phase,
 - Applicants who are interested in this opportunity must identify what existing areas, facilities, and capabilities at the lab(s) will be leveraged, as well as any other equipment or expertise that will be required.
 - AMMTO plans to designate lab points of contact and publicize the results or findings of a lab or group of labs to industry stakeholders in order to raise awareness of the lab's capabilities and this Lab Call.
- In the second phase, applicants will meet the following expectations:
 - A lab or group of labs will develop full proposals with a domestic industry partner(s).
 - Domestic industry partners are encouraged to CRADA options with their lab partners. A CRADA between each lab and its partners will be required to govern the work responsibilities for the project, intellectual property, cost share and other applicable requirements for the project and the lab M&O contact. Failure to execute a CRADA within 6 months of project selection may result in cancellation of the project.

Applicants will be required to include project information and details in eXCHANGE that will be used to develop and accelerate negotiations of FY 2023 AOPs if selected.

[Appendix A](#) provides a worksheet to guide applicants through this process in eXCHANGE. Any information the applicant considers to be of significance for the review process must be included in the proposal, as reviewers will not have access to the AOP development information entered in eXCHANGE.

ii. General Proposal Requirements

Proposals should be formatted for 8.5 x 11 paper, single spaced, and have 1-inch margins on each side. Typeface size should be 12-point font, except tables and figures, which may be in 10-point font.

iii. Proposal Content

Proposal content aligns with content required in the EERE AOP project forms, with additional information to assist reviewers in evaluating technical details. The narrative should build on the information provided as part of the EERE eXCHANGE template.

Applicants must include all content they wish to have reviewed in the proposal (proposal reviewers will not review any information provided in eXCHANGE for AOP development).

Letters of Intent (LOIs)

All LOIs will be no longer than 1-page and must conform to the following content requirements:

- Lead laboratory and point of contact;
- Names of participating lab or labs if it is a collaboration;
- The specific topic area the applicant is responding to;
- Major relevant research foci;
- Specific facilities and capabilities including hardware; and
- Potential partners for the project

Full Applications

- An eligible LOI must have been submitted prior to the Full Application.
- EERE will not review or consider ineligible Full Applications.
- Each Full Application shall be limited to a single concept or technology. Unrelated concepts and technologies shall not be consolidated in a single Full Application.

Full Applications must conform to the following requirements:

SECTION	FILE FORMAT	PAGE LIMIT	FILE NAME
Technical Volume	PDF	15	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	PDF	1	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	PDF	1	ControlNumber_LeadOrganization_LOCs
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint	1	ControlNumber_LeadOrganization_Slide
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF	N/A	ControlNumber_LeadOrganization_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF	N/A	ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF	N/A	ControlNumber_LeadOrganization_SF-LLL

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Waiver Requests: Foreign Entities and Foreign Work (if applicable)	PDF	N/A	ControlNumber_LeadOrganization_Waiver
Data Management Plan	MS Word	1	ControlNumber_LeadOrganization_DMP
Diversity, Equity, Inclusion, and Accessibility (DEIA) Implementation Plan	PDF	2	ControlNumber_LeadOrganization_DEIAIP

Technical Volume

The Technical Volume must be submitted in PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages. Save the Technical Volume in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_TechnicalVolume”.

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. However, EERE and reviewers are under no obligation to review cited sources.

The Technical Volume to the Full Application may not be more than 15 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The applicant should consider the weighting of each of the evaluation criteria when preparing the Technical Volume.

The Technical Volume must conform to the following content requirements:

SECTION / PAGE LIMIT	DESCRIPTION
Title/Cover Page (1 page)	This should include the proposal title, topic(s) being applied for, requested funding and proposed cost-share, PI(s) and business POCs, names of all team member organizations, any statements regarding confidentiality, a nonproprietary project summary, and a 200-or-less-word summary of the project suitable for public release if the project is funded. <ul style="list-style-type: none"> • Include name, address, phone number, and email address of the lead applicant (organization) for contract issues and project issues.
Project Overview (Approximately 10% of the Technical Volume)	The Project Overview component of the technical volume should contain the following information, succinctly described:

*Questions about this Lab Call? Email BatManLabCall@ee.doe.gov.
 Problems with EERE eXCHANGE? Email EERE-eXCHANGESupport@hq.doe.gov.
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SECTION / PAGE LIMIT	DESCRIPTION
	<ul style="list-style-type: none"> • Background: The applicant should briefly discuss the background of their organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application. • Project Goal: The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal. • DOE Impact: The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding — relative to prior, current, or anticipated funding from other public and private sources — is necessary to achieve the project objectives.
<p>Technical Description, Innovation, and Impact (Approximately 30% of the Technical Volume)</p>	<p>The Technical Description should contain the following information:</p> <ul style="list-style-type: none"> • Relevance and Outcomes: The applicant should provide a detailed description of the technology, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the Lab Call, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. • Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology and capability of achieving the anticipated performance targets, including a description of previous work done and prior results. • Innovation and Impacts: The applicant should describe the current state-of-the-art in the applicable field, the specific innovation of the proposed technology, the advantages of proposed technology over current and emerging technologies, and the overall impact on advancing the state-of-the-art/technical baseline if the project is successful.
<p>Workplan and Market Transformation Plan (Approximately 40% of the Technical Volume)</p>	<p>The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go Decision Points, and Project Schedule. A detailed SOPO is separately requested. The Workplan should contain the following information:</p> <ul style="list-style-type: none"> • Project Objectives: The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes. • Technical Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period.

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SECTION / PAGE LIMIT	DESCRIPTION
	<ul style="list-style-type: none"> • WBS and Task Description Summary: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard WBS for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as “we will then complete a proprietary process” is unacceptable). It is the applicant’s responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this Lab Call. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a SMART technical milestone. SMART milestones should be Specific, Measurable, Achievable, Relevant, and Timely, and must demonstrate a technical achievement rather than simply completing a task. Unless otherwise specified in the Lab Call, the minimum requirement is that each project must have at least one milestone per quarter for the duration of the project with at least one SMART technical milestone per year (depending on the project, more milestones may be necessary to comprehensively demonstrate progress). The applicant should also provide the means by which the milestone will be verified. The summary provided should be consistent with the Milestone Summary Table in the SOPO. • Go/No-Go Decision Points: The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. A Go/No-Go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. At a minimum, each project must have at least one project-wide Go/No-Go decision point for each budget period (12 to 18-month period) of the project. The applicant should also provide the specific technical criteria to be used to evaluate the project at the Go/No-Go decision point. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered “SMART” and can fulfill the requirement for an annual SMART milestone.

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SECTION / PAGE LIMIT	DESCRIPTION
	<ul style="list-style-type: none"> • End of Project Goal: The applicant should provide a summary of the end of project goal(s). At a minimum, each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO. • Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and Go/No-Go decision points. • Project Management: The applicant should discuss the team’s proposed management plan, including the following: <ul style="list-style-type: none"> ○ The overall approach to and organization for managing the work ○ The roles of each project team member ○ Any critical handoffs/interdependencies among project team members ○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices ○ The approach to project risk management ○ A description of how project changes will be handled ○ If applicable, the approach to Quality Assurance/Control ○ How communications will be maintained among project team members • Market Transformation Plan: The applicant should provide a market transformation plan, including the following: <ul style="list-style-type: none"> ○ Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including a mitigation plan ○ Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, and product distribution.
<p>Technical Qualifications and Resources (Approximately 20% of the Technical Volume)</p>	<p>The Technical Qualifications and Resources should contain the following information:</p> <ul style="list-style-type: none"> • Describe the project team’s unique qualifications and expertise, including those of key subrecipients. • Describe the project team’s existing equipment and facilities that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project. • This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives. • Describe the time commitment of the key team members to support the project. • Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable.

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SECTION / PAGE LIMIT	DESCRIPTION
	<ul style="list-style-type: none"> • For multi-organizational or multi-investigator projects, describe succinctly: <ul style="list-style-type: none"> ○ The roles and the work to be performed by each PI and Key Participant; ○ Business agreements between the applicant and each PI and Key Participant; ○ How the various efforts will be integrated and managed; ○ Process for making decisions on scientific/technical direction; ○ Publication arrangements; ○ Intellectual Property issues; and ○ Communication plans

Resumes

Applicants are required to submit one-page resumes for key participating team members. Multi-page resumes are not allowed. Save the resumes in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_Resumes”.

Letters of Commitment

Submit letters of commitment from at least one domestic industry partner and any other partner or third-party cost share provider. The letter must indicate the willingness of the domestic industry partner to provide the required cost share (one-page maximum per letter). Save the letters of commitment in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_LOCs”.

Summary/Abstract for Public Release

Applicants are required to submit a single page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (e.g., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as DOE may make it available to the public after selections are made. The project summary must not exceed a single page when printed using standard 8.5 x 11 paper with 1” margins (top, bottom, left, and right) with font not smaller than 12 point. Save the Summary for Public Release in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_Summary”.

Summary Slide

Applicants are required to provide a single MS Powerpoint slide summarizing the proposed project. This slide is used during the evaluation process.

The Summary Slide template requires the following information:

- A technology summary;
- A description of the technology's impact;
- Proposed project goals;
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Project title, prime recipient, Principal Investigator, and Key Participant information; and
- Requested EERE funds and proposed applicant cost share.

Save the Summary Slide in a single page MS Powerpoint file using the following convention for the title "ControlNumber_LeadOrganization_Slide".

Budget for DOE/NNSA FFRDC (if applicable)

If a DOE/NNSA FFRDC contractor is to perform a portion of the work, the applicant must provide a DOE WP in accordance with the requirements in DOE Order 412.1A, Work Authorization System, Attachment 3, available at <https://www.directives.doe.gov/directives-documents/400-series/0412.1-BOrder-a-chg1-AdmChg> Save the WP in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_WP".

SF-LLL: Disclosure of Lobbying Activities

Prime recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Prime recipients and subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (<https://www.grants.gov/web/grants/forms/sf-424-individual-family.html>) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

- An officer or employee of any federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

Save the SF-LLL in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_SF-LLL"

Waiver Requests: Foreign Entities and Foreign Work (if applicable)

1. Foreign Entity Participation:

All non-lab partners for this Lab Call must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. To request a waiver of this requirement for a lab partner, the applicant must submit an explicit waiver request in the Full Application. Appendix B lists the necessary information that must be included in a request to waive this requirement.

2. Performance of Work in the United States (Foreign Work Waiver)

All work funded by EERE must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. Appendix B lists the necessary information that must be included in a foreign work waiver request.

Save the Waivers in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_Waiver”.

Data Management Plan

Each proposal under this Lab Call must have a data management plan (DMP). A DMP explains how, when appropriate, data generated in the course of the proposed work will be shared and preserved in order to validate the results of the work or how the results could be validated if the data is not shared or preserved. The DMP must provide a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publications.

A lab may have a previously DOE approved DMP, such as a lab-wide DMP, and to the extent that the DMP applies to the proposal submitted under this Lab Call, the lab may rely on that DMP to satisfy the DMP requirement of this Lab Call. If there is no existing DMP that can apply and the applicant fails to submit a DMP as part of the proposal, then the default DMP for the proposal is the following:

For any publication that includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the applicant must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Save the DMP in a single Microsoft Word file using the following convention for the title “ControlNumber_LeadOrganization_DMP”.

Project Diversity, Equity, Inclusion, and Accessibility (DEIA) Plan

The Project Diversity, Equity, Inclusion, and Accessibility Implementation Plan should be integrated into the technical volume. As part of the application, applicants are required to describe how DEIA objectives will be incorporated in the project. Specifically, applicants are required to submit a description of how the project will support or implement the lab wide DEIA plan and describe the actions the applicant will take to foster a welcoming and inclusive environment, support people from groups underrepresented in STEM, advance equity, and encourage the inclusion of individuals from these groups in the project, as well as the extent to which the project activities will be located in or benefit underserved communities. The plan should include at least one SMART milestone per budget period supported by metrics to measure the success of the proposed actions, which will be incorporated into the award if selected. The DEIA section should contain the following information:

- Equity Impacts: the impacts of the proposed project on underserved communities, including social and environmental impacts;
- Benefits: The anticipated overall benefits of the proposed project, if funded, to underserved communities;
- How DEIA objectives will be incorporated in the project.

The following is a non-exhaustive list of actions that can serve as examples of ways the proposed project could incorporate DEIA elements:

- Include faculty or students from Minority Serving Institutions as PI/co-PI, senior personnel, and/or student researchers, as applicable;
- Enhance or collaborate with existing diversity programs at your home organization and/or nearby organizations;
- Collaborate with students, researchers, and staff in Minority Serving Institutions;
- Disseminate results of research and development in Minority Serving Institutions or other appropriate institutions serving underserved communities;
- Implement evidence-based, diversity-focused education programs (such as implicit bias training for staff) in your organization;
- Identify Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, and Veteran Owned Businesses to solicit as vendors and subcontractors for bids on supplies, services, and equipment;
- Include faculty or students from Minority Serving Institutions as PI/co-PI, senior personnel, and/or student researchers;

- Enhance or collaborate with existing diversity programs at your home organization and/or nearby organizations;
- Collaborate with students, researchers, and staff in Minority Serving Institutions.

Explicit diversity in research impact

- Illustrated outcome impact in underserved communities;
- Disseminate results of research and development in Minority Serving Institutions or other appropriate institutions serving underserved communities;
- Explicit diversity in research design;
- Inclusion of a broad community, academic, policymaking staff in research design and execution phase.

Save the Diversity, Equity, Inclusion, and Accessibility (DEIA) Implementation Plan in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_DEIAIP”.

Treatment of Application Information

Proprietary Information

In general, DOE will use data and other information contained in proposals only for evaluation purposes, unless such information is generally available to the public or is already the property of the government.

Proposals should not include trade secrets or commercial or financial information that is privileged or confidential unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in the Lab Call.

Proposals containing confidential, proprietary, or privileged information must be conspicuously marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Federal Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

If a proposal contains confidential, proprietary, or privileged information, it must include a cover sheet marked as follows identifying the specific pages containing confidential, proprietary, or privileged information:

1. Notice of Restriction on Disclosure and Use of Data:

*Questions about this Lab Call? Email BatManLabCall@ee.doe.gov.
Problems with EERE eXCHANGE? Email EERE-eXCHANGESupport@hq.doe.gov.
Include Lab Call name and number in subject line.*

Pages [List Applicable Pages] of this proposal may contain confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for the purposes described in this Lab Call. The government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. In addition, (1) the header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure” and (2) every line and paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

B. Application Review Details

i. Merit Review and Selection Process

Upon receipt and review for initial compliance with requirements, all proposals received in eXCHANGE by the deadline will undergo a thorough technical review. AMMTO will use expert reviewers familiar with the AMMTO portfolio, goals, and objectives. AMMTO will collect and collate review scores and comments for use in making final project selections. The AMMTO Selection Official will consider the merit review results to make the final project selections. For transparency, AMMTO will provide summaries of the review results to assist labs in understanding how their submission reviewed and aid in improving future work.

ii. Technical Review Criteria

Letters of Intent (LOIs)

AMMTO has not established separate criteria to evaluate LOIs. LOIs are reviewed to check to ensure that they are responsive. AMMTO will not provide any response or feedback on the LOI, but will use the LOI to identify reviewers and engage industry interest.

Full Applications

Applications will be evaluated against the merit review criteria shown below:

Criterion 1: Technical Merit, Innovation, and Impact (50%)

This criterion involves consideration of the following factors:

Technical Merit and Innovation

- Extent to which the proposed technology or process is innovative, with topic-specific emphases for;
 - Topic 1: Developing Innovative Solid-State Battery Manufacturing Capabilities
 - The extent to which the proposed innovations will lead to solid-state battery cells of sufficient-size and capabilities

- for identified target applications in Market Transformation Plan;
 - The translatability of solid-state batteries into large format/high volume manufacturing commensurate with Market Transformation Plan; and
 - The degree to which innovations enable V&V to critically evaluate performance from component to system level and adequately simulate system operation in relevant environments.
 - Topic 2: Developing Innovative Flow Battery Manufacturing Capabilities
 - The strength of the proposed innovations towards the design of architectures and configurations for high power and energy-dense flow batteries for identified target applications in Market Transformation Plan; and
 - The ability of the innovations to enhance commonality and versatility in flow batteries via design and/or manufacturing and process standards.
- Degree to which the current state of the technology and the proposed advancement are clearly described;
- Extent to which the application specifically and convincingly demonstrates how the applicant will move the state-of-the-art to the proposed advancement; and
- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious and revolutionary, including relevant data, calculations, and discussion of prior work in the literature with analyses that support the viability of the proposed work.

Impact of Technology Advancement

- How the project supports the topic area objectives and target specifications and metrics; and
- The potential impact of the project on advancing the state-of-the-art.

Criterion 2: Project Research and Market Transformation Plan (25%)

This criterion involves consideration of the following factors:

Research Approach, Workplan and SOPO

- Degree to which the approach and critical path have been clearly described and thoughtfully considered; and
- Degree to which the task descriptions are clear, detailed, timely, and reasonable, resulting in a high likelihood that the proposed Workplan and SOPO will succeed in meeting the project goals.

Identification of Technical Risks

- Discussion and demonstrated understanding of the key technical risk areas involved in the proposed work and the quality of the mitigation strategies to address them.

Baseline, Metrics, and Deliverables

- The level of clarity in the definition of the baseline, metrics, and milestones; and
- Relative to a clearly defined experimental baseline, the strength of the quantifiable metrics, milestones, and a mid-point deliverables defined in the application, such that meaningful interim progress will be made.

Market Transformation Plan

- Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including mitigation plan; and
- Comprehensiveness of market transformation plan including but not limited to product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, and product distribution.

Criterion 3: Team and Resources (15%)

This criterion involves consideration of the following factors:

- The capability of the principal investigator(s) and the proposed team to address all aspects of the proposed work with a high probability of success. The qualifications, relevant expertise, and time commitment of the individuals on the team;
- The sufficiency of the facilities to support the work;
- The degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed technologies;
- The level of cohesion between the principal investigator(s) and team members, as demonstrated by the Workplan’s proposed schedule and structure that ensure effective communication and active participation from all members;
- The level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan; and
- The reasonableness of the budget and spend plan for the proposed project and objectives.

Criterion 4: Diversity, Equity, Inclusion, and Accessibility (10%)

This criterion involves consideration of the following factors:

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- The quality and manner in which the measures incorporate diversity, equity, inclusion, and accessibility goals in the project; and
- Extent to which the project benefits underserved communities.

iii. Selection for Award Negotiation

AMMTO carefully considers all of the information obtained through the proposal process and makes an independent assessment of each compliant and responsive proposal based on the criteria set forth in this Lab Call. AMMTO may select or not select a proposal for negotiations. AMMTO may also postpone a final selection determination on one or more proposals until a later date, subject to availability of funds and other factors. AMMTO will notify applicants if they are, or are not, selected for award negotiation.

iv. Selection Notification

AMMTO anticipates completing the project selection process and notifying labs of selections during the month of July 2023 (**subject to change**).

AMMTO will notify lab leads of selection results from BatManLabCall@ee.doe.gov and will provide lab leads with summaries of anonymized review comments for each proposal submitted.

v. Questions and Agency Contacts

Specific questions about this Lab Call should be submitted via e-mail to BatManLabCall@ee.doe.gov. To ensure fairness across all labs, individual AMMTO staff cannot answer questions while the Lab Call remains open. To keep all labs informed, AMMTO will post all questions and answers on EERE eXCHANGE.

Appendix A: Lab Call Full Application Worksheet for eXCHANGE

Lab Call Full Application Worksheet

IMPORTANT: This document is provided as a courtesy to allow Lab Call applicants to collaborate offline to develop Full Applications for Lab Calls. All information must be entered into the eXCHANGE system and cannot be submitted with this document.

Please contact ITSIHelp@ee.doe.gov with any questions.

Project General Information

Control Number:

Applicant (Name and Email):

Organization Name:

Project Title:

Topic:

Project Start Date:

Project End Date:

Partner Laboratories:

Partner Laboratory	Email	First Name	Last Name
—	—	—	—

Is this a continuation of an existing project?

WBS Number:

Fiscal Year Existing Project:

Project Overview (Multi-year):

Project Objectives (Multi-year):

Contact Information

Lab Lead Point of Contact and Business Contact Information

Name:

Email:

Title:

Address:

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Include Lab Call name and number in subject line.

Phone:

Fax:

Financials

Please add a separate table for each partner laboratory.

Lead Laboratory Name:

Year	Planned Project Costs
2023	–
2024	–
2025	–
Subtotal	–

Partner Laboratory (If Applicable) Name:

Year	Planned Project Costs
2023	–
2024	–
2025	–
Subtotal	–

Total Planned Project Costs:

Performers

Please add a separate table for each partner laboratory.

Lead Laboratory Name:

Subcontractor Name	Sub Type	Start Date	End Date	2023 Planned Costs	2024 Planned Costs	2025 Planned Costs	Total Funding
Subcontractor Subtotal							

Partner Laboratory (If Applicable) Name:

Subcontractor Name	Sub Type	Start Date	End Date	2023 Planned Costs	2024 Planned Costs	2025 Planned Costs	Total Funding
Subcontractor Subtotal							

Total Planned Project Costs:

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Project Plan

Project Tasks:

Task Number	Title	Description	Team Members	Planned Costs	Start Date	End Date

Project Milestones:

Item Number	Type	Title	Description	End Date	Team Members	Criteria

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Risks

Project Tasks:

Risk Name	Description	Response Plan	Severity	Probability	Response	Source	Classification	Team Members	Target Completion Date

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Modalities/Technology Readiness Level (TRL)

Modalities:

Modality Number	Modality	FY23 Weight (%)	FY23 Planned Costs (\$)
Total:			

Current TRL of the proposed technology (1-9):

Estimated TRL the technology will reach at project end (2-9):

Project Impacts

Deliverable/Product or "Output" Description:

Audience/Customer:

Audience/Customer Use:

Communications/Outreach Strategy:

Does this project involve significant industry engagement?

Description of Engagement:

Associated CRADAs?

CRADA Text

Appendix B: Waiver Requests and Approval Processes:

1. Foreign Entity Participation as Lab Partners; and

2. Performance of Work in the United States (Foreign Work Waiver)

1. Waiver for Foreign Entity Participation as Lab Partners

Many of the technology areas DOE funds fall in the category of critical and emerging technologies (CETs). CETs are a subset of advanced technologies that are potentially significant to United States national and economic security.³¹ Lab partners (industry and/or organization partners that are **not** DOE/National Nuclear Security Agency (NNSA), Federally Funded Research and Development Centers (FFRDCs) and all National Laboratories) providing cost share as part of a Lab-led team must be organized and chartered or incorporated (or otherwise formed) under the laws of a state or territory of the United States; have majority domestic ownership and control; and have a physical location for business operations in the United States. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Waiver Criteria

Foreign entities seeking to participate in a project funded under this Lab Call must demonstrate to the satisfaction of DOE that:

- a. Its participation is in the best interest of U.S. industry and U.S. economic development;
- b. The project team has appropriate measures in place to control sensitive information and protect against unauthorized transfer of scientific and technical information;
- c. Adequate protocols exist between the U.S. subsidiary and its foreign parent organization to comply with export control laws and any obligations to protect proprietary information from the foreign parent organization;
- d. The work is conducted within the U.S. and the entity acknowledges and demonstrates that it has the intent and ability to comply with the U.S. competitiveness provision (see Section VI.B.xxi.); and
- e. The foreign entity will satisfy other conditions that DOE may necessary to protect U.S. government interests.

Content for Waiver Request

A foreign entity waiver request must include the following:

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- a. Information about the entity: name, point of contact, and proposed type of involvement in the project;
- b. Country of incorporation, the extent of the ownership/level control by foreign entities, whether the entity is state owned or controlled, a summary of the ownership breakdown of the foreign entity, and the percentage of ownership/control by foreign entities, foreign shareholders, foreign state, or foreign individuals;
- c. The rationale for proposing a foreign entity participate (must address criteria above);
- d. A description of the project's anticipated contributions to the U.S. economy;
 - How the project will benefit the U.S., including manufacturing, contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
 - How the project will promote manufacturing of products and/or services in the U.S.;
- e. A description of how the foreign entity's participation is essential to the project;
- f. A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP; and
- g. Countries where the work will be performed. (Note: If any work is proposed to be conducted outside the U.S., the applicant must also complete a separate request foreign work waiver.)

DOE may also require:

- A risk assessment with respect to IP and data protection protocols that includes the export control risk based on the data protection protocols, the technology being developed, and the foreign entity and country. These submissions could be prepared by the project lead (if not the prime recipient), but the prime recipient must make a representation to DOE as to whether it believes the data protection protocols are adequate and make a representation of the risk assessment – high, medium, or low risk of data leakage to a foreign entity.
- Additional language be added to any agreement or subagreement to protect IP, mitigate risk, or other related purposes.

DOE may require additional information before considering the waiver request.

DOE's decision concerning a waiver request is not appealable.

2. Waiver for Performance of Work in the United States (Foreign Work Waiver)

All work funded under this Lab Call must be performed in the United States. To seek a waiver of the Performance of Work in the United States requirement, the lab partner must submit an explicit waiver request in the Full Application. A separate waiver request must be submitted for each entity proposing performance of work outside of the United States.

Overall, a waiver request must demonstrate to the satisfaction of DOE that it would further the purposes of this Lab Call and is otherwise in the economic interests of the United States to perform work outside of the United States. A request for a foreign work waiver must include the following:

1. The rationale for performing the work outside the U.S. (“foreign work”);
2. A description of the work proposed to be performed outside the U.S.;
3. An explanation as to how the foreign work is essential to the project;
4. A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the U.S. economy;
5. The associated benefits to be realized and the contribution to the project from the foreign work;
6. How the foreign work will benefit the U.S., including manufacturing, contributions to employment in the U.S., and growth in new markets and jobs in the U.S.;
7. How the foreign work will promote manufacturing of products and/or services in the U.S.;
8. A description of the likelihood of IP being created from the foreign work and the treatment of any such IP;
9. The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
10. The countries in which the foreign work is proposed to be performed; and
11. The name of the entity that would perform the foreign work.
Information about the entity(ies) involved in the work proposed to be conducted outside the U.S. (i.e., the entity seeking a waiver and the entity(ies) that will conduct the work).

DOE may require additional information before considering the waiver request.

DOE’s decision concerning a waiver request is not appealable.

Appendix C: Definition of Technology and Manufacturing Readiness Levels

Level	Technology Readiness Level (TRL)	Manufacturing Readiness Level (MRL) ¹⁹
1	Basic principles observed and reported	Basic manufacturing implications identified
2	Technology concept and/or application formulated	Manufacturing concepts identified
3	Analytical and experimental critical function and/or characteristic proof of concept	Manufacturing proof-of-concept developed
4	Component and/or breadboard validation in a laboratory environment	Capability to produce the technology in a laboratory environment
5	Component and/or breadboard validation in a relevant environment	Capability to produce prototype components in a production relevant environment
6	System/subsystem model or prototype demonstration in a relevant environment	Capability to produce a prototype system or subsystem in a production relevant environment
7	System prototype demonstration in an operational environment	Capability to produce systems, subsystems, or components in a production representative environment
8	Actual system completed and qualified through test and demonstrated	Pilot line capability demonstrated; ready to begin low-rate, initial production
9	Actual system proven through successful mission operations	Low-rate production demonstrated; capability in place to begin full-rate production
10	—	Full-rate production demonstrated and lean production practices in place

¹⁹ [Manufacturing Readiness Level \(MRL\) Deskbook](#), Version 2.0, the OSD Manufacturing Technology Program May 2011.

Appendix D: Lab Call Performance Metrics Worksheet

1. Topic 1: Developing Innovative Solid-State Battery Manufacturing Capabilities

<i>Solid-State Battery Project Focus</i>
<p>What type of solid-state battery will this project focus on? [e.g., oxide-based, sulfide-based, or polymer-based (or hybrid)]</p> <p>Proposed electrolyte, cathode (including additives/processing, e.g., slurry-coated), and anode (e.g., Li metal):</p>
<p>What type of manufacturing methods will this project focus on?</p>
<p>What manufacturing capabilities will this project focus on?</p>

<i>Technical Performance Metrics</i>					
<p>From the list provided, please select the key performance metrics that this project will focus on. Select as many as apply. Applicants may also specify their own, project-specific metrics. At least 5 technical performance metrics, 5 manufacturing capability metrics, and any relevant manufacturing cost metrics must be quantified.</p> <p>For each selected metric, provide quantitative values for baseline and final target. Indicate all units. The baseline value should reflect the status of the proposed technology at the time of proposal, and should be quantified for all metrics. The final target (the value targeted at project end) should be quantified for all metrics. Identify all references and assumptions below, including literature sources (if any).</p>					
Focus Area	Metric	Key metric for this project?	Baseline & Project Targets (for each selected metric)		State of the Art / Benchmark (for each selected metric) based on literature values
			Baseline (Project Start)	Final Target (Project End)	Reference & Notes
Electrolyte/cell performance	Solid electrolyte Li-ion conductivity (S/cm) at room temperature				
	Total interfacial impedance (Ω/cm^2)				
	Solid electrolyte critical current density (mA/cm^2) at room temperature				

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	Solid electrolyte thickness (μm)				
	Mechanical properties of the solid electrolyte ²⁰				
	Voltage and chemical stability at the electrodes (vs Li/Li ⁺)				
	Applied intracellular pressure (MPa)				
	Other / Applicant defined electrolyte metrics ²¹				
	Other / Applicant defined cell performance ²²				

Manufacturing Capability Metrics					
Focus Area	Metric	Key metric for this project?	Baseline & Project Targets (for each selected metric)		State of the Art / Benchmark (for each selected metric) based on literature values
			Baseline (Project Start)	Final Target (Project End)	Reference & Notes
Process	Applicant defined metrics ²³				
Other / Applicant defined metrics					

²⁰ The mechanical property is to maintain contact at electrodes and block Li dendrite growth (sufficient to cycle at current density $> 1 \text{ mA/cm}^2$ for 300 cycles).

²¹ Examples of additional electrolyte performance metrics include, but are not limited to, solid electrolyte density (g/cm^3), Coulombic efficiency averaged over 300 cycles, maximum discharge/charge rates, cathode material used and loading (g/cm^2), anode material loading and density (g/cm^2 and g/cm^3), cathode specific capacity (mAh/g), total cathode matrix specific capacity (mAh/g), maximum current density (mA/cm^2), applied intracellular pressure (MPa), etc.

²² Performance/quality of any proposed cell component (i.e., solid-state electrolytes, interlayers, Li metal anode, and cathode).

²³ Examples of process metrics include, but are not limited to, capability of precision fabrication for large batches of sufficiently sized cells (e.g., multilayer pouch cells, 2Ah or greater), readiness of testing protocols/standards for V&V, measurement accuracy, handling and processing of thin Li metal layers (foils of $20 \mu\text{m}$ or less or Li evaporative deposition), environmentally controlled setting for high-volume manufacturing processes, and other process metrics for large-scale, high-volume manufacturing processes such as speed (i.e., yield or throughput), control, stability, flexibility, and efficiency in terms of time, cost, and/or energy.

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Manufacturing Cost Metrics					
Focus Area	Metric	Key metric for this project?	Baseline & Project Targets (for each selected metric)		State of the Art / Benchmark (for each selected metric) based on literature values
			Baseline (Project Start)	Final Target (Project End)	Reference & Notes
Manufacturing cost for solid-state battery components					
Other / Applicant defined metrics					
Manufacturing cost for solid-state battery systems					
Other / Applicant defined metrics					

2. Topic 2: Developing Innovative Flow Battery Manufacturing Capabilities

Flow Battery Project Focus
Proposed use case:
What type of flow battery will this project focus on? (e.g., Aqueous, hybrid, or non-aqueous)
What flow battery chemistry will this project focus on (e.g., all Vanadium, all Iron, Zinc-Bromine, Quinone-Bromine, etc.)?

Component Focus - Which components of the flow battery will be focal areas of this project? Select all that apply		
Component		Key focus of this project (Select all that apply by putting 'Yes')
Cell Stack	Bipolar plate	
	Electrode	
	Membrane	
	Cell frame	
Electrolyte Storage	Catholyte	
	Anolyte	
	Tank	
Auxiliary Parts ("Balance-of-Plant")	Recirculation loops (pump, pipes)	
	Battery management system (BMS) for operational control (e.g., process control, thermal management, and so on)	
	Power conditioning system (PCS) for current conversion (inverter)	

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	Other structural supporting accessories	
Other / Applicant defined metrics		

Technical Performance Metrics

From the list provided, please select the key performance metrics that this project will focus on. Select as many as apply. Applicants may also specify their own, project-specific metrics. **At least 5 technical performance metrics, 5 manufacturing capability metrics, and any relevant manufacturing cost metrics must be quantified.**

For each selected metric, provide quantitative values for baseline and final target. Indicate all units. The baseline value should reflect the status of the proposed technology at the time of proposal, and should be quantified for all selected metrics. The final target (the value targeted at project end) should be quantified for all selected metrics. Identify all references and assumptions below, including literature sources (if any).

Focus Area	Metric	Key metric for this project?	Baseline & Project Targets (for each selected metric)		State of the Art / Benchmark (for each selected metric) based on literature values
			Baseline (Project Start)	Final Target (Project End)	Reference & Notes
Flow Battery Performance	Round-trip efficiency (RTE) (%)				
	Annual RTE degradation factor (%)				
	Response time limited by power conversion system (PCS)				
	Cycles at SOC range >80%				
	Charge/discharge rates				
	Energy efficiency (%) ²⁴				
	Current density (mA/cm ²)				
	Volumetric energy density (Wh/L)				
	Areal power density (mW/cm ²)				
	Rated power of system				
	Duration that system can deliver rated power				
Long-term stability ²⁵					

²⁴ Due to the auxiliary power (e.g., pump), energy efficiency in practical flow batteries could widely vary depending on the applications. Specify the pump power consumption, if necessary.

²⁵ Some flow battery systems could include capacity rebalance capabilities. Specify recover frequency, expected town time, etc., if necessary.

	Cycle life (number of cycles)				
	Cycle life (duration)				
	Calendar life				
	Component lifetime (e.g., days before electrolyte replacement)				
Catholyte and electrolyte	Redox potential (V)				
	Solubility (M or mol/L)				
	Viscosity (Pa s)				
	Ion transport kinetics (applicant defined)				
	Precipitation temperature (°C)				
pH					
Electrode	Chemical stability (applicant defined)				
	Voltage efficiency (%)				
	Conductivity (S/cm)				
	Electron-transfer kinetics (applicant defined)				
Membrane	Thickness (um)				
	Ion exchange capacity (mmol/g)				
	Water uptake (%)				
	Swelling ratio (%)				
	Area resistance ($\Omega \text{ cm}^2$)				
	Proton conductivity (mS/cm)				
	Permeability (cm^2 or m^2/min)				
	Porosity (%)				
	Ion selectivity ($\text{S min}/\text{cm}^3$)				
	Coulombic efficiency (%) for crossover				
Other / Applicant defined metrics					

Manufacturing Capability Metrics				
Focus Area	Metric	Key metric for this project?	Baseline & Project Targets (for each selected metric)	State of the Art / Benchmark (for each selected metric)

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						based on literature values
				Baseline (Project Start)	Final Target (Project End)	Reference & Notes
Manufacturing cost for flow battery components						
Process	Applicant defined metrics ²⁶					
Other / Applicant defined metrics						

Manufacturing Cost Metrics						
Focus Area	Metric	Key metric for this project?	Baseline & Project Targets (for each selected metric)		State of the Art / Benchmark (for each selected metric) based on literature values	
			Baseline (Project Start)	Final Target (Project End)	Reference & Notes	
Manufacturing cost for flow battery components						
	Membrane (\$/m ²)					
	Bipolar plate (\$/m ²)					
	Graphite felt (\$/m ²)					
	PVC frame (\$/m ²)					
	Cost of active species (\$/kg)					
	Electrolyte cost per unit mass (\$/kg)					
	Gaskets, bolts, end plates, (\$/m ²)					
	Stack manufactory					
	Heat exchanger (\$/kW)					
	PCS (\$/kW)					
	Thermal insulation material (\$/m ²)					
	Tank (\$/gallon)					
	Pump (\$/GPM)					
	Rebalance cell (\$/kW)					
	Other / Applicant Defined Metrics					
Manufacturing cost for flow battery systems						
	Capital Cost (\$/kWh)					

²⁶ Examples of metrics for flow battery manufacturing processes include, but are not limited to, speed (i.e., yield or throughput), control, stability, flexibility, readiness of testing protocols/standards for V&V, measurement accuracy, and efficiency in terms of time, cost, and/or energy.

Annualized Capital Cost (\$/kW or \$/kWh)				
Power Conversion System (PCS) Cost (\$/kW)				
Annualized PCS Cost (\$/kW or \$/kWh)				
Balance of Plant (BOP) Cost (\$/kW)				
Annualized BOP Cost (\$/kW or \$/kWh)				
Construction and Commissioning (C&C) Cost (\$/kWh)				
Annualized C&C Cost (\$/kW or \$/kWh)				
Total Project Cost (\$/kW or \$/kWh)				
Fixed operations and maintenance Cost (O&M) (\$/kW-yr)				
Annualized O&M Cost (\$/kW or \$/kWh)				
Other / Applicant defined metrics				

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