

Richardson Electronics, Testing and Customized system integration development for flow batteries (VO7-1)

Richardson Electronics Testing and Customized system integration development for flow batteries (VO7-1)
<https://www.rell.com/>

Applicable Technology Area(s):

Flow Batteries
Lithium-ion Batteries
Batteries (Other)

Type of Technology: Next generation flow battery, such as organic and iron chromium complex based chemical energy storage solutions.

Capability Title: Testing and Customized system integration development for flow batteries

Capability Summary: Industrial level design, testing, and certification of customized flow battery solutions. Demo projects showcasing the modularized flow battery system solution at 0.1~ 1MWhr level. Certification of such systems for UL 9540 and 9540A. Early stage potential customer engagement and letters of interest.

Capability Core Competencies: Unlike the current generation of Long Duration Energy Storage solutions (e.g., the mature mixed acid vanadium technologies), the next generation of flow batteries are designed to be flexible, long-lasting, low-cost, and made from earth-abundant materials, as well as independent of foreign supply chain limitations. However, these advancements in chemistry need to be matched with a customized system integration design that is scalable and end-user friendly. Most startup companies developing flow battery chemistry lack the industrial capabilities and experience to bridge the gap between early-stage prototypes and industrial solutions.

Richardson Electronics, with 76 years of industrial experience and a wide network of clients and partners, can provide the hosting infrastructure for developing customized solutions, particularly the modularized system integration design of flow batteries. Additionally, we offer UL certification and testing services, which are crucial for engaging early-stage customers of next-generation flow battery technology developers.

Capability Qualifications and Credentials: Credentials: As a UL-DQS registered firm, our existing production process complies with ISO 9001 and ISO 13458 and OSHA certification requirements. Capability Qualifications: Richardson Electronics has long served as a supplier to prominent companies like NextEra, ENEL, and RWE, thanks to its innovative Ultra3000 supercapacitor battery module designed for driving wind turbine pitching event motors. The production line responsible for manufacturing these modules shares structural similarities with the capabilities for this voucher, including customized battery designs, battery supply chain management, assembly, and testing. Several members of the management team and engineers from the current production line can seamlessly transfer their expertise or provide training for new job positions. Richardson Electronics is well-positioned to serve as a direct off-taker of the product, leveraging its distribution team and existing customer base.

Capability Background: As a contracted manufacturer, Richardson Electronics has been entrusted with multiple projects aimed at boosting the domestic content of the final product. One notable example is the Progress Rail project (company currently under Caterpillar, project is business confidential), which involved relocating the supply chain from Brazil to Chicago. This move was made to facilitate the local manufacturing of the Lithium Iron Phosphate (LFP) battery-driven electric locomotive. Richardson Electronics plays a crucial role in assembling the battery cabinet, encompassing tasks from

Richardson Electronics, Testing and Customized system integration development for flow batteries (VO7-1)

Richardson Electronics, Testing and Customized system integration development for flow batteries (VO7-1)

sourcing the battery cells to integrating them into the locomotive with a focus on proper fire safety systems and quality assurance. Additionally, safety has been part of the DNA of Richardson Electronics for its entire manufacturing history.

Critical Inputs Required from Recipient: Flow battery technology description. Desired certification or certification description. Demonstration system size. Previous engagement with customers. Hazardous chemicals (diamond chart). Special tooling or special handling of electrolyte needed.

Geographic Constraints for Capability: The project site is limited to LaFox Illinois or nearby region.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Existing battery cycle testers (25KW). Mechanical design software, heat transfer simulation software and micro controller programmer (solidworks, Ansys, Matlab, Silicon Labs). Richardson Electronics also has in-house PCB assembly and Machine Shop Capability that can produce the ancillary components needed for a full system, and 250,000 sq ft of manufacturing floor space.

How many weeks capability will take: 4

Midpoint Milestone Description: System simulation, design, and customization: Richardson Electronics will provide the described system integration design during this period.

Final Milestone Description: UL certification and testing of demonstration project: Richardson Electronics will implement the demo project, test it and secure UL certification

Richardson Electronics, Testing and Customized system integration development for flow batteries (VO7-1)

Pacific Northwest National Laboratory, Energy storage research, development, validation, and analysis (VO7-2)

Pacific Northwest National Laboratory Energy storage research, development, validation, and analysis (VO7-2)
www.pnnl.gov

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: Various

Capability Title: Energy storage research, development, validation, and analysis

Capability Summary: PNNL's work on energy storage covers all facets of the technology. Our team includes the scientists conducting basic scientific research into energy storage materials, engineers developing and validating integrated systems, engineers and economists modeling the technical characteristics and benefits of energy storage systems, safety professionals developing codes and standards to ensure the safe interconnection and operation of energy storage systems, and analysts identifying the policy and regulatory changes needed to facilitate energy storage deployments. With these capabilities, our team has deep knowledge of energy storage system operations and the market environment for energy storage technologies in general. We are ready to assist voucher recipients in assessing the market opportunities for their technology, performing technical modeling and analysis of the economic potential for their technology and, where sufficiently funded by the voucher, in testing and validating that technology.

Capability Core Competencies: Technical and Economic Analysis: PNNL has developed the Energy Storage Evaluation Tool (ESET), a cutting-edge techno-economic assessment tool that has been used to study the benefits of dozens of projects around the country. ESET can be customized to model, optimize, and evaluate a variety of storage technologies, accounting for diverse deployment options and use cases. Testing and Validation: The Battery Reliability Testing Laboratory at PNNL has tested and validated dozens of diverse energy storage technologies under various grid duty cycles. Policy and Regulations: PNNL maintains a program that studies the policy and regulatory barriers to energy storage deployments and assists states in incorporating energy storage into their energy goals. Program staff in this area have knowledge of the market and policy landscape for storage technologies.

Capability Qualifications and Credentials: PNNL's qualifications and resources for this voucher program are primarily captured in its people – the scientists, engineers, economists, and analysts who carry out the lab's energy storage research. PNNL is also now the host of the Grid Storage Launchpad (GSL), which houses a suite of research and testing capabilities that may be leveraged for this voucher program. GSL is focused on using a scientifically derived knowledge base to develop protocols, improve understanding, and engineer new, safer, and more reliable systems. The overall goal is to develop evaluation protocols, materials, and system designs to ensure the safe and reliable operation of energy storage systems for the grid and help end-users better understand long term performance and reliability of emerging energy storage systems. GSL is equipped to test various technologies including, but not

Pacific Northwest National Laboratory, Energy storage research, development, validation, and analysis (VO7-2)

Pacific Northwest National Laboratory, Energy storage research, development, validation, and analysis (VO7-2)

limited to, Li-ion, Na-ion, Na metal halide, Pb-acid, Ni-based, Zn-based, and various flow battery chemistries.

Capability Background: Much of PNNL's work in this space has been funded by the Office of Energy's Energy Storage Program, which has supported PNNL for many years. The policy and regulatory team, which would perform market assessment tasks, has published extensively on matters of energy storage policies and market design has deep expertise in the opportunities for energy storage technologies. The economic analysis team has provided techno-economic analyses for utilities and technology developers from across the country on storage technologies including lithium-ion batteries, flow batteries, pumped storage hydropower, and gravity storage. The team's many publications and development of the Energy Storage Evaluation Tool (ESET) provide evidence of their capability in performing technical analysis for a wide range of energy storage technologies. The testing and validation team has tested and validated the performance of energy storage technologies ranging from individual cells in the battery reliability lab to utility-scale projects in the field.

Critical Inputs Required from Recipient: To begin work, we would require a clear statement of the voucher participant's objectives and an accurate description of their technology's current development status and technological characteristics, specifications, and data.

Geographic Constraints for Capability: We do not anticipate any geographic constraints. PNNL has worked with partners and completed projects around the country.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): We believe that our expertise in these topics, coupled with the extensive investments in equipment that the Department of Energy has made at PNNL, will allow us to flexibly adapt meet the needs of any voucher recipient who needs assistance in the areas identified in our application.

How many weeks capability will take: 40

Midpoint Milestone Description: Workplan 50 percent complete

Final Milestone Description: Workplan complete

Pacific Northwest National Laboratory, Energy storage research, development, validation, and analysis (VO7-2)

Boundless Impact Research & Analytics, VO-7– LCA Calculator Tool to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-3)

Boundless Impact Research & Analytics VO-7– LCA Calculator Tool to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-3)
<https://www.boundlessimpact.net/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Batteries (Other)
Other

Type of Technology: Gravitational Energy Storage

Capability Title: VO-7– LCA Calculator Tool to Support Long Duration Energy Storage (LDES) Technology Acceleration

Capability Summary: The Boundless LCA Calculator quantifies the potential environmental outcomes of different operational or product scenarios. It provides management with a decision-making tool and companies with comprehensive guidance to improve their climate and environmental impact. It offers immediate feedback for customizable scenarios as companies seek to better understand their environmental footprint and further develop and scale their technology. The calculator tool can either be industry specific or company specific and allows the user to evaluate how their environmental impact changes based on varied inputs and input quantities. The Boundless LCA Calculator tool includes an interactive, Excel-based LCA Calculator specified to the customer's technology of interest with a maximum of eight input categories and two to three subcategories per input. This product will allow companies to alter their material, energy, or other inputs to see the resultant change in their emissions associated with those decisions.

Capability Core Competencies: Boundless provides decision support and information tools for assessing the environmental impacts and technical efficiency of emerging technologies. These tools analyze multiple factors, including, but not limited to, costs, supply chain climate impacts, human and environmental toxicity, and greenhouse gas (GHG) impacts. The Boundless approach provides spider graphs to holistically assess data, bar charts to explain each Environmental Key Performance Indicator (EKPI) that we analyze, reports that provide important context, and other infographics and data that facilitate the rapid, rigorous, and consistent assessment of emerging clean technologies. Our industry analytics also provide direct comparison of specific technologies to industry peers, focusing on key environmental performance.

Capability Qualifications and Credentials: Boundless is an industry research and environmental impact analytics firm that provides objective and actionable information to move investment dollars more quickly toward clean technologies and companies driving positive environmental change. We employ a science-based, data-driven approach, grounded in the proven LCA methodology. The scores and metrics derived are trustworthy and reliable because they are unbiased and validated by external industry and/or scientific experts. Boundless' LCA incorporates conventional LCA databases, tools, and scientific literature reviews, and has a deep network of over 1,000 industry experts at leading

Boundless Impact Research & Analytics, VO-7– LCA Calculator Tool to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-3)

Boundless Impact Research & Analytics, VO-7– LCA Calculator Tool to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-3)

universities and consulting groups around the world who provide independent validation and peer reviews for our LCAs. We also have a Scientific Advisory Council made up of LCA and environmental impact measurement experts who guide, advise, and help refine our science-based methods, to ensure we are maintaining the highest standards in our work.

Capability Background: Boundless has completed assessments of hundreds of clean-tech products and projects in renewable energy, LDES, circular economy, food and ag technologies, bioenergy and bioproducts, and advanced materials. Our proprietary methodology and expert-validated dataset enable us to streamline and automate data collection and produce highly accurate and actionable industry and company analytics that are used to de-risk clean technologies, manage environmental impact reporting, and differentiate products. Boundless has assessed a variety of LDES technologies ranging from lithium-ion batteries, flow batteries, lead-acid batteries, zinc batteries, mechanical energy storage, and other storage methodologies. Some of these reports have been produced in partnership with the Energywerx platform and the information provided has been used to streamline storage pathways, minimizing environmental impact while maximizing storage potential.

Critical Inputs Required from Recipient: A brief Request for Information (RFI), produced in a timely manner, detailing material and resource inputs required for the production of the LDES solution. Cooperation and communication, including participation in one to two 30-minute virtual meetings as well as email communication throughout the process to ensure the reliability and accuracy of data.

Geographic Constraints for Capability: We are capable of working with teams across the country with the understanding that time zones will require flexibility regarding meeting times from both teams.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): For matching purposes, it may be relevant to match companies with higher TRLs to ISO-Compliant or Rapid LCAs and companies with lower TRLs to Boundless' Calculator or Rapid LCA capabilities. The Boundless Rapid LCA is most useful for companies at Technology Readiness Levels 4 and above.

How many weeks capability will take: 6

Midpoint Milestone Description: The midpoint milestone will be met when the first draft calculator has been completed and sent to the Voucher Recipient.

Final Milestone Description: The final milestone will be complete when the final calculator, with revisions incorporated, has been sent to the Voucher Recipient.

Boundless Impact Research & Analytics, VO-7– Rapid Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-4)

Boundless Impact Research & Analytics VO-7– Rapid Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-4)
<https://www.boundlessimpact.net/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Zinc Batteries
Lead-acid Batteries
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: N/A

Capability Title: VO-7– Rapid Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration

Capability Summary: The Boundless Rapid LCA follows the rigorous ISO guidelines but is performed at a fraction of the time and cost compared to a full ISO-Compliant LCA. Boundless proposes to conduct an Environmental Impact Assessment and write an Environmental Impact Report for the Voucher Recipient. Boundless will conduct an independent modeling assessment using its proprietary methodology supplemented by a literature review and independent expert analysis. Boundless will quantify the impact metrics relevant to LDES and customize a competitor analysis to the company of interest specifications and technology vertical. A Boundless report will highlight details about environmental performance, operations, and growth with institutional investors, impact investors, and strategic partners in mind. Boundless will work with each Voucher Recipient to tailor their assessment to the specific needs of their industry, expectations, and timeline. We will propose traditionally expected environmental metrics and work with your staff to find the metrics most applicable to your technology. Boundless will also customize the competitor analysis and traditional industry analysis to the company of interest specifications and technology vertical. Our objective is to provide you with valuable insights on the environmental impacts associated with the supply chain, production system, and operational life cycle of your LDES solution.

Capability Core Competencies: Boundless provides decision support and information tools for assessing the environmental impacts and technical efficiency of emerging technologies. These tools analyze multiple factors, including, but not limited to, costs, supply chain climate impacts, human and environmental toxicity, and greenhouse gas (GHG) impacts. The Boundless approach provides spider graphs to holistically assess data, bar charts to explain each Environmental Key Performance Indicator (EKPI) that we analyze, reports that provide important context, and other infographics and data that facilitate the rapid, rigorous, and consistent assessment of emerging clean technologies. Our industry analytics also provide direct comparison of specific technologies to industry peers, focusing on key environmental performance.

Capability Qualifications and Credentials: Boundless Impact Research & Analytics (Boundless) is an industry research and environmental impact analytics firm that provides objective and actionable information to move investment dollars more quickly toward clean technologies and companies driving positive environmental change. We employ a science-based, data-driven approach, grounded in the proven LCA methodology. The scores and metrics derived are trustworthy and reliable because they are

Boundless Impact Research & Analytics, VO-7– Rapid Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-4)

Boundless Impact Research & Analytics, VO-7– Rapid Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-4)

unbiased and validated by external industry and/or scientific experts. Boundless' LCA incorporates conventional LCA databases, tools, and scientific literature reviews, and has a deep network of over 1,000 industry experts at leading universities and consulting groups around the world who provide independent validation and peer reviews for our LCAs. We also have a Scientific Advisory Council made up of LCA and environmental impact measurement experts who guide, advise, and help refine our science-based methods, to ensure we are maintaining the highest standards in our work.

Capability Background: Boundless has completed assessments of hundreds of clean-tech products and projects in renewable energy, LDES, circular economy, food and ag technologies, bioenergy and bioproducts, and advanced materials. Our proprietary methodology and expert-validated dataset enable us to streamline and automate data collection and produce highly accurate and actionable industry and company analytics that are used to de-risk clean technologies, manage environmental impact reporting, and differentiate products. Boundless has assessed a variety of LDES technologies ranging from lithium-ion batteries, flow batteries, lead-acid batteries, zinc batteries, mechanical energy storage, and other storage methodologies. Some of these reports have been produced in partnership with the Energywerx program and the information provided has been used to streamline storage pathways, minimizing environmental impact while maximizing storage potential.

Critical Inputs Required from Recipient: Our projects are comprehensive and require customer cooperation to maximize effectiveness. As such the following is required from our customers: An extensive and completed Request for Information (RFI), produced in a timely manner, detailing material and resource use per unit of product/technology, including all phases of production from raw materials to grave. Cooperation and communication, including participation in two to four 30-minute virtual meetings as well as email communication throughout the process to ensure the reliability and accuracy of data.

Geographic Constraints for Capability: We are capable of working with teams across the country with the understanding that time zones will require flexibility regarding meeting times from both teams.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): For matching purposes, it may be relevant to match companies with higher TRLs to ISO-Compliant or Rapid LCAs companies with lower TRLs to Boundless' Calculator or Rapid LCA capabilities. The Boundless Rapid LCA is most useful for companies at Technology Readiness Levels 4 and above.

How many weeks capability will take: 8

Midpoint Milestone Description: The midpoint milestone will be met when the preliminary results report has been completed and sent to the Voucher Recipient.

Final Milestone Description: Boundless will provide DOE a copy of the email confirmation sent to Voucher Recipient with the preliminary results report attached.

1728 Solutions, LLC, Model-Based Decision-Making (MBDM) and Organizational Friction-Reduction (OFR) for Technology Acceleration (VO7-5)

1728 Solutions, LLC Model-Based Decision-Making (MBDM) and Organizational Friction-Reduction (OFR) for Technology Acceleration (VO7-5)

<https://1728.solutions>

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Pumped Storage Hydropower (PSH)

Mechanical (Other)

Compressed-Air Energy Storage (CAES)

Thermal Energy Storage

Other

Type of Technology: Any chargeable and/or dispatchable storage technology

Capability Title: Model-Based Decision-Making (MBDM) and Organizational Friction-Reduction (OFR) for Technology Acceleration

Capability Summary: To synchronously and asynchronously facilitate connections among people, models, and data necessary for project planning, organization coordination, and team success, the key deliverables and deployments from the Voucher Project include and are not limited to: codebase CI/CD, model coordination documentation (architecture documents, user guides, roadmaps to future modeling capabilities and activities), verification and validation plans and reports, digital twinning technology readiness assessments, new product introduction design decision logs and stage gate reports, communication plans for interfacing with the public and permitting agencies about technology siting and encroachment, trust-building documentation and relationships with the public and permitting agencies, strategic plans, quarterly strategic hygiene plans, growth assessments, growth assessment update plans, post mortem analyses, bespoke (team specific) conflict resolution and feedback plans, and decision discovery and justification tools. The Voucher Provider and the Voucher Recipient will discover together and agree upon the set of deliverables and deployments that will strategically support the Recipient's decision-making and friction-reduction to (set and/or) meet their intentions.

Capability Core Competencies: The Voucher Provider brings 28,000 hours of renewable energy startup experience. Comprising 23,000 hours of Simulation Engineering are the development, maintenance, and operation of proprietary and validated heliostat field, plant system, and techno-economic models at eSolar & Heliogen. Comprising 5,000 hours of Management are the growth of a team from 1 to 12, the identification and professional development of line management within the team, exporting a successful onboarding process company-wide, and providing company-wide conflict resolution, mentorship, and strategic planning services. 1728 Solutions has seen first-hand what works and what doesn't for technology and people to interoperate. Deploying a collection of human-centered technologies & processes can help a Voucher Recipient meet and exceed the professional and personal challenges that face Technology Acceleration with joy and enthusiasm.

Capability Qualifications and Credentials: David Gross, Founder & President of 1728 Solutions, holds a B.S. in Mathematics from Harvey Mudd College, conferred in 2008, with 3 Major Concentrations (in Pure Math, Applied Math, and Scientific Computing), and a Humanities Concentration in Literature. At eSolar, Gross completed corporate training in Project Management and ISO 9000 compliance,

1728 Solutions, LLC, Model-Based Decision-Making (MBDM) and Organizational Friction-Reduction (OFR) for Technology Acceleration (VO7-5)

1728 Solutions, LLC, Model-Based Decision-Making (MBDM) and Organizational Friction-Reduction (OFR) for Technology Acceleration (VO7-5)

published in Energy Procedia, and patented in the US. At Heliogen, Gross received personal executive coaching in management (specifically feedback, delegation, and concise messaging) and completed Engineering Manager training, both from The Executive Advisory. He also presented at SolarPACES in Daegu and online, and published each in AIP Conference Proceedings. In 2023, Gross incorporated 1728 Solutions, LLC (1728) and since has provided hundreds of hours of decision-making, business development, and professional development to energy startups and established small businesses. At 1728, Gross received a Positive Intelligence Grant for Coaches (Cohort 17).

Capability Background: Gross's publications "Statistical Analysis and Verification of Performance for CSP Subsystems" (<https://doi.org/10.1016/j.egypro.2015.03.092>), "Solar field modeling and verification" (<https://doi.org/10.1063/5.0030111>), and "Simulation, control, and verification of novel closed-chain kinematics" (<https://doi.org/10.1063/5.0087180>) represent successful verifications & validations enabling critical data-based business decisions. Deployments of those systems--23,712 eSolar SCS5 Heliostats and ~500 Heliogen heliostats of multiple generations--have, as of June 2024, accrued over 700 million operational heliostat-hours. Proprietary and unpublished works by Gross on assembly-line reflector surfaces, population quality targets, and plant maintenance scheduling all directly added value at eSolar & Heliogen. Right-sizing a New Product Introduction is a core Product Development Lifecycle activity to which Gross brings over 15,000 hours of experience as a developer, product/project/program manager, and people manager. Gross's competencies as a science communicator earned him the trusted Heliogen Engineering role to support Business Development in Glint/Glare & Encroachment discussions with the Audubon Society, the DOD, the DOE, and other permitting agencies."

Critical Inputs Required from Recipient: Discovery at 1728 takes the form of 3Ds (what Decision needs to be made with what Data and Due when) and 5Whys as a root-cause justification for all of us to be working on that decision with that data in the given timeframe. This process is implemented at large and small scales in order for us to collectively agree on a New Product Introduction process of the right size for the right product.

Geographic Constraints for Capability: While 1728's services are primarily delivered online, 1728 is situated near a Small Hub airport in CA and can participate in quarterly or other special offline summits as required by or designed into the project plan.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): 1728's model-based decision-making and organizational friction-reduction services are broadly agnostic to equipment specification or organizational structure.

How many weeks capability will take: 48

Midpoint Milestone Description: Discovered metrics of decision-making and friction-reduction are reevaluated for suitability in the second half of the project.

Final Milestone Description: Evolved metrics of decision-making and friction-reduction are evaluated for success and further recommendations at the end of the project.

1728 Solutions, LLC, Model-Based Decision-Making (MBDM) and Organizational Friction-Reduction (OFR) for Technology Acceleration (VO7-5)

ICL-IP America Inc, Durability testing services and facility access for long-duration batteries and battery materials. (VO7-6)

ICL-IP America Inc Durability testing services and facility access for long-duration batteries and battery materials. (VO7-6)
www.icl-group.com

Applicable Technology Area(s):

Zinc Batteries
Lithium-ion Batteries
Flow Batteries
Batteries (Other)

Type of Technology: ○ ICL Tarrytown is an R&D center with technology capabilities in the fields of lithium-ion batteries (LFP, LMFP chemistries), zinc bromide flow batteries, sodium-ion battery material testing, material characterization, as well as corrosion and safety testing.

Capability Title: Durability testing services and facility access for long-duration batteries and battery materials.

Capability Summary: ○ ICL is able to provide a full suite of durability testing services for long-duration energy storage technology developers for lithium-ion, sodium-ion, and zinc-bromide chemistries at the system, cell, and material levels. ○ Durability testing includes electrochemical testing for cycle-life of cells and electrodes, at a wide range of operating parameters including high-rate cycling and temperature control in thermal environmental control chambers. ○ Component-level testing also includes anti-corrosion durability, such as bromine resistance in zinc-bromine battery systems. ○ In addition, post-mortem analysis services can be provided, with battery teardown facilities and glove boxes available, as well as chemical analysis techniques such as ICP-OES (Inductively Coupled Plasma Optical Emission Spectroscopy). ○ Finally, ICL Tarrytown has expertise in flame retardant chemistry and testing that can be suitable for evaluating the safety of long-duration energy storage technologies.

Capability Core Competencies: ICL is a global leader in chemicals, as the world's largest producer of bromine, as well as a major supplier of phosphate products which are both critical components in key long-duration battery technologies. ICL Tarrytown is an R&D center with technology capabilities in the fields of lithium-ion batteries (LFP, LMFP chemistries), zinc bromide flow batteries, sodium-ion battery material testing, material characterization, as well as corrosion and safety testing.

Capability Qualifications and Credentials: ICL Tarrytown serves as an R&D center for energy storage with the following resources: 2000 square feet of lab space

24 channels for low current battery testing

8 channels of 5V, 60A high amperage cyclers

4 channels of 60V, 60A pack system cycling testers

8 channels of 5V, 6A cyclers with electrochemical impedance spectroscopy

MBraun Labstar Pro SP argon glovebox for air-free handling of cells and components

Tenney thermal control chamber (-68°C to 180°C)

Full suite of electrode and test cell fabrication equipment: Thinky AR-100, automatic film coater, calendaring machine, vacuum ovens

TA AR-2000 rheometer with parallel Peltier plate geometry, Brookfield Viscometer for slurry analysis

Spectro ARCOS III ICP-OES for chemical analysis

Agilent GC-MS quadrupole with FID for identification and detection of unknown species

ICL-IP America Inc, Durability testing services and facility access for long-duration batteries and battery materials. (VO7-6)

ICL-IP America Inc, Durability testing services and facility access for long-duration batteries and battery materials. (VO7-6)

Capability Background: ICL Group is a global leader in chemicals, as the world's largest producer of bromine, as well as a major supplier of phosphate products which are both critical components in key long-duration battery technologies. ICL is leading a project in LiFePO₄ lithium-ion battery cathode active material manufacturing, currently commissioning a \$400M 30 kTPA LFP manufacturing site in St. Louis. ICL is also leading the construction of a customer innovation and qualification center (CIQC) which is expected to accelerate the development of Infrastructure Reduction Act compliant material and cell-level battery technologies.

Critical Inputs Required from Recipient: ICL Group is a global leader in chemicals, as the world's largest producer of bromine, as well as a major supplier of phosphate products which are both critical components in key long-duration battery technologies. ICL is leading a project in LiFePO₄ lithium-ion battery cathode active material manufacturing, currently commissioning a \$400M 30 kTPA LFP manufacturing site in St. Louis. ICL is also leading the construction of a customer innovation and qualification center (CIQC) which is expected to accelerate the development of Infrastructure Reduction Act compliant material and cell-level battery technologies.

Geographic Constraints for Capability: All services are provided on-site at ICL Tarrytown

Provide any other critical details that may help with matching (including equipment specifications where appropriate): ICL Tarrytown serves as an R&D center for energy storage with the following resources: 2000 sq. ft. lab space 24 channels for low current battery testing 8 channels of 5V, 60A high amperage cyclers 4 channels of 60V, 60A pack system cycling testers 8 channels of 5V, 6A cyclers with electrochemical impedance spectroscopy MBraun Labstar Pro SP argon glovebox Tenney thermal control chamber (-68°C to 180°C) Electrode and cell fabrication equipment: Thinky AR-100, automatic film coater, calendaring machine, vacuum ovens TA AR-2000 rheometer, Brookfield Viscometer Spectro ARCOS III ICP-OES Agilent GC-MS quadrupole with FID

How many weeks capability will take: 52

Midpoint Milestone Description: 26 weeks of cycling data and/or state of health estimation. Chemical analysis of battery electrolytes for various corroded/degraded cell components

Final Milestone Description: 52 weeks of cycling data, post-mortem analysis for smaller form factor batteries. Chemical analysis of electrolytes for corroded/degraded cell components

ICL-IP America Inc, Durability testing services and facility access for long-duration batteries and battery materials. (VO7-6)

Strategic Analysis, Inc. Commercialization Strategy Support (VO7-7)

<https://sainc.com>

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Other

Type of Technology: SA has broad experience in electrochemical devices and specific experience providing services described for battery technologies.

Capability Title: Commercialization Strategy Support

Capability Summary: Strategic Analysis (SA) provides development and analysis of comprehensive, market-driven business cases for product commercialization. SA leverages its extensive experience assisting commercial clients and venture capitalists to understand common pain points and identify features required by potential customers. SA is able to support business case development for manufacturing technologies and specific products. SA has successfully supported start-ups looking to enter the market, in addition to large companies looking to adapt existing technologies and products for new markets. Depending on the needs and interest of the client, SA offers the following services to support commercialization strategy development: 1) technology roadmap development with key performance indicators tied to growth and R&D, 2) market/product entry roadmap with market forecasting of technical needs and volumes, 3) product sales forecast based on technology development and market outlooks, and 4) scenario-based financial projections by year based on modeling of costs and prices. The final work product will be spreadsheet-based models accompanied with a written report suitable for technical and financial stakeholders.

Capability Core Competencies: SA specializes in techno-economic and manufacturing analysis, market studies, and technology due diligence. SA studies various materials, components, and systems for hydrogen production and storage, fuel cells, batteries, gas purification, chemical synthesis (monomers/polymers, catalysts, MOFs, electrochemical), and energy transmission. SA has extensive experience in capital cost and life-cycle cost estimation. SA is a prime System Engineering and Technical Analysis (SETA) provider to all 6 offices of the Defense Advanced Research and Projects Agency (DARPA) . SA provides a combination of technical, programmatic, contractual, and financial services to premier R&D agencies in the Department of Defense. Additionally, SA has extensive experience with transition and commercialization in support of DARPA funded SBIR/STTR projects, as well as those of other organizations, such as NSWC Crane. SA supports the full tech transition cycle, including understanding technology gaps; identifying transition opportunities; coordinating networking events; reviewing program policies and translating policies into guidance for small businesses.

Capability Qualifications and Credentials: SA employs over 30 PhD staff in various technical areas engineering and science, and maintains a network of highly specialized technical consultants. The Energy Services division pioneered the Design for Manufacture and Assembly methodology for hydrogen storage, hydrogen production, and fuel cell capital cost projections. SA has held DOE contracts continuously for over 20 years in the areas of cost and performance analysis of PEM fuel cells for transportation, H₂ production, and H₂ storage. SA regularly works with commercial clients to provide product benchmarking, market analysis, value-chain assessment, and pre-investment due diligence. SA has had commercial contracts with a major auto OEM to conduct an electrolyzer market assessment, a

Strategic Analysis, Inc., Commercialization Strategy Support (VO7-7)

Fortune 500 auto Tier1 supplier to conduct a value-walk analysis and market assessment in support of new product development, emerging energy startups to develop go-to-market strategies, and global venture capital and family fund managers to provide technical due diligence.

Capability Background: Strategic Analysis, Inc. (SA) is a ~200-person R&D and science consulting firm founded in 1986 to provide support to the Federal government and private industry clients. Energy Analysis Services division at SA is a team of engineers and scientist with diverse technology backgrounds in alternative energy systems, oil and gas, and materials. The team area specialists in techno-economic analysis (TEA) and process modeling of emerging technologies, particularly electrochemical systems. In addition to work performed for industry clients, the team has had prime and subcontracts with US DOE for over 20 years, ARPA-e, DOT, and DOD on a variety of topics including hydrogen storage, hydrogen production, fuel cell cost analysis, and other electrochemical devices including various battery chemistries.

Critical Inputs Required from Recipient: None

Geographic Constraints for Capability: Our team is distributed throughout the United States and typically supports projects virtually.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): None

How many weeks capability will take: 16

Midpoint Milestone Description: Technology and Market Roadmap

Final Milestone Description: Financial Projections and Final Report

Boundless Impact Research & Analytics , VO-7– Full ISO-Compliant Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-8)

Boundless Impact Research & Analytics VO-7– Full ISO-Compliant Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-8)

<https://www.boundlessimpact.net/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: N/A

Capability Title: VO-7– Full ISO-Compliant Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration

Capability Summary: Boundless' Life Cycle Assessment (LCA) follows rigorous ISO guidelines (ISO 14040 & 14044) and incorporates conventional LCA databases, tools, and scientific literature reviews. In line with such guidelines, our LCA involves recruiting and deeply engaging three LCA experts for peer review, thorough sensitivity analysis ensuring data quality, complete documentation of sources, and extensive internal review to ensure all values align with Boundless' data integrity promise. The Boundless methodology results in a report that extensively details the customer's environmental performance throughout the entire life cycle of a product or service and can include GHG emission reduction and removal enhancement initiatives and targets (ISO 14064-1). This can include the upstream and downstream processes associated with the production, use phase, and disposal. The final product will be a full ISO-Compliant report, reviewed by a panel of three experts. These reports generally range from 60 to 100 pages in length.

Capability Core Competencies: Boundless provides decision support and information tools for assessing the environmental impacts and technical efficiency of emerging technologies. These tools analyze multiple factors, including, but not limited to, costs, supply chain climate impacts, human and environmental toxicity, and greenhouse gas (GHG) impacts. The Boundless approach provides spider graphs to holistically assess data, bar charts to explain each Environmental Key Performance Indicator (EKPI) that we analyze, reports that provide important context, and other infographics and data that facilitate the rapid, rigorous, and consistent assessment of emerging clean technologies. Our industry analytics also provide direct comparison of specific technologies to industry peers, focusing on key environmental performance.

Capability Qualifications and Credentials: Boundless is an industry research and environmental impact analytics firm that provides objective and actionable information to move investment dollars more quickly toward clean technologies and companies driving positive environmental change. We employ a science-based, data-driven approach, grounded in the proven Life Cycle Assessment (LCA) methodology. The scores and metrics derived are trustworthy and reliable because they are unbiased and validated by external industry and/or scientific experts. Boundless' LCA incorporates conventional LCA databases, tools, and scientific literature reviews, and has a deep network of over 1,000 industry experts at leading universities and consulting groups around the world who provide independent

Boundless Impact Research & Analytics , VO-7– Full ISO-Compliant Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-8)

Boundless Impact Research & Analytics , VO-7– Full ISO-Compliant Life Cycle Assessment to Support Long Duration Energy Storage (LDES) Technology Acceleration (VO7-8)

validation and peer reviews for our LCAs. We also have a Scientific Advisory Council made up of LCA and environmental impact measurement experts who guide, advise, and help refine our science-based methods, to ensure we are maintaining the highest standards in our work.

Capability Background: Boundless has completed assessments of hundreds of clean-tech products and projects in renewable energy, LDES, circular economy, food and ag technologies, bioenergy and bioproducts, and advanced materials. Our proprietary methodology and expert-validated dataset enable us to streamline and automate data collection and produce highly accurate and actionable industry and company analytics that are used to de-risk clean technologies, manage environmental impact reporting, and differentiate products. Boundless has assessed a variety of LDES technologies ranging from lithium-ion batteries, flow batteries, lead-acid batteries, zinc batteries, mechanical energy storage, and other storage methodologies. Some of these reports have been produced in partnership with the Energywerx program and the information provided has been used to streamline storage pathways, minimizing environmental impact while maximizing storage potential.

Critical Inputs Required from Recipient: Our projects are comprehensive and require customer cooperation to maximize effectiveness. As such the following is required from our customers: An extensive and completed Request for Information (RFI), produced in a timely manner, detailing material and resource use per unit of product/technology, including all phases of production from raw materials to grave. Cooperation and communication, including participation in two to four 30-minute virtual meetings as well as email communication throughout the process to ensure the reliability and accuracy of data.

Geographic Constraints for Capability: We are capable of working with teams across the country with the understanding that time zones will require flexibility regarding meeting times from both teams.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): For matching purposes, it may be relevant to match companies with higher TRLs to ISO-Compliant or Rapid LCAs and companies with lower TRLs to Boundless' Calculator or Rapid LCA capabilities. The Boundless Rapid LCA is most useful for companies at Technology Readiness Levels 4 and above.

How many weeks capability will take: 16

Midpoint Milestone Description: Milestone will be met when the LCA Model is completed and internally reviewed to be sent to the expert panel.

Final Milestone Description: Milestone will be complete when the report has been reviewed by experts and sent to the Voucher Recipient.

Riverview Climate Ventures LLC Fundraise and Commercialization Strategy (VO7-9)

Applicable Technology Area(s):

Thermal Energy Storage
Lithium-ion Batteries
Flow Batteries

Type of Technology:

Capability Title: Fundraise and Commercialization Strategy

Capability Summary: Riverview Climate Ventures supports climate tech companies on fundraising, commercialization, and other special projects related to strategy and finance. The proposed project involves 3 steps: 1. First, data collection and understanding of the highest-value work we can do. In some cases this is purely equity fundraise support, in some cases it is a market study on a future growth area, in some cases it is clarifying and defining executive-level KPIs and OKRs. 2. Second, collateral development. In the example of fundraising, this includes refining the pitch deck, financial model, and supporting materials for prospective investors 3. Third, prepare for execution. In the fundraise example, this includes pipeline development, process documentation, and initial investor outreach.

Capability Core Competencies: Project track record - Riverview Climate Ventures has successfully completed or is in process of completing 6 value-add projects for climate tech startups since Q4 2023. These projects range from \$3m customer offtake deal for a Seed-stage company to a \$40m Series B fundraise. VC investing - Riverview is led by Daniel Ketyer, formerly a climate-focused venture capital investor at Piva Capital (investors in 2 energy storage companies). He brings the VC lens and network to support company fundraise efforts Long-duration storage experience - For select projects, we bring on 1-2 sub-contractors in our network with specific expertise that can make a project more successful. In one project, a market study for a solar energy firm, we brought on an ex-strategy consultant with energy sector experience to support for 20 hours per week. For long duration storage, we will tap our network of ex-VCs and industry operators

Capability Qualifications and Credentials: - Led by Daniel Ketyer, former VC at Piva Capital, consultant at Deloitte, and current fundraising & commercialization advisor to climate tech startups at Riverview Climate Ventures. Education at University of Michigan and Duke University. Supported VC diligence on a molten salt long-duration storage investment.

- Based in San Francisco, the hub of the climate VC ecosystem

Capability Background: - \$40m Series B fundraise: development of data room (incl. pitch deck, financial model), investor relations, overall fundraise process

- \$30m Series B fundraise: pitch deck, financial model, investor pipeline development

- \$3.5m pre-Series A bridge: development of data room, investor outreach

- Prior to launching Riverview, diligenced 120+ Seed through Series C companies - including several long duration energy storage companies

Critical Inputs Required from Recipient: Company capitalization history, months of runway remaining, number of employees

Geographic Constraints for Capability: N/a

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/a

How many weeks capability will take: 12

Midpoint Milestone Description: Pitch deck complete and ready to present externally

Final Milestone Description: Investor pipeline complete and process documented

Strategic Analysis, Inc., Competitive Landscape and Market Analysis (VO7-10)

Strategic Analysis, Inc. Competitive Landscape and Market Analysis (VO7-10)

<https://sainc.com>

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Other

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Type of Technology: SA has broad experience in electrochemical devices and specific experience providing services described for battery technologies.

Capability Title: Competitive Landscape and Market Analysis

Capability Summary: Strategic Analysis (SA) provides comprehensive competitive landscape and market analysis to recommend data-driven pathways for market entry and expansion that account for the clients' unique value proposition. SA leverages its prior experience in the lithium battery and emerging energy value chains to understand common pain points and identify features required for market acceptance. SA has previously completed projects assessing the manufacturing cost of lithium-ion and nickel metal hydride batteries through a detailed Design for Manufacturing and Assembly analysis, performed technoeconomic analyses (TEA) of sodium and lithium-based electrode materials, and developed a go-to-market strategy for domestic lithium conversion technology. Depending on the needs and interest of the client, SA offers the following services to assess the competitive landscape and market: 1) Identifying and defining key attributes of competitors, 2) Surveying customers to define market demand and timing, 3) Interviews with subject matter experts and customers to validate market acceptance criteria, 4) Financial assessment of economic value to customer with client's new product or process, and 5) Market share outlook in perspective of client value proposition. The final work product will be data tables, market models, and a written report suitable for technical and financial stakeholders.

Capability Core Competencies: SA specializes in techno-economic and manufacturing analysis, market studies, and technology due diligence. SA studies various materials, components, and systems for hydrogen production and storage, fuel cells, batteries, gas purification, chemical synthesis (monomers/polymers, catalysts, MOFs, electrochemical), and energy transmission. SA has extensive experience in capital cost and life-cycle cost estimation. SA is a prime System Engineering and Technical Analysis (SETA) provider to all 6 offices of the Defense Advanced Research and Projects Agency (DARPA). SA provides a combination of technical, programmatic, contractual, and financial services to premier R&D agencies in the Department of Defense. Additionally, SA has extensive experience with transition and commercialization in support of DARPA funded SBIR/STTR projects, as well as those of other organizations, such as NSWC Crane. SA supports the full tech transition cycle, including understanding technology gaps; identifying transition opportunities; coordinating networking events; reviewing program policies and translating policies into guidance for small businesses.

Capability Qualifications and Credentials: SA employs over 30 PhD staff in various technical areas engineering and science, and maintains a network of highly specialized technical consultants. The Energy Services division pioneered the Design for Manufacture and Assembly methodology for hydrogen storage, hydrogen production, and fuel cell capital cost projections. SA has held DOE contracts continuously for over 20 years in the areas of cost and performance analysis of PEM fuel cells for transportation, H₂ production, and H₂ storage. SA regularly works with commercial clients to provide

Strategic Analysis, Inc., Competitive Landscape and Market Analysis (VO7-10)

Strategic Analysis, Inc., Competitive Landscape and Market Analysis (VO7-10)

product benchmarking, market analysis, value-chain assessment, and pre-investment due diligence. SA has had commercial contracts with a major auto OEM to conduct an electrolyzer market assessment, a Fortune 500 auto Tier1 supplier to conduct a value-walk analysis and market assessment in support of new product development, emerging energy startups to develop go-to-market strategies, and global venture capital and family fund managers to provide technical due diligence.

Capability Background: Strategic Analysis, Inc. (SA) is a ~200-person R&D and science consulting firm founded in 1986 to provide support to the Federal government and private industry clients. Energy Analysis Services division at SA is a team of engineers and scientist with diverse technology backgrounds in alternative energy systems, oil and gas, and materials. The team area specialists in techno-economic analysis (TEA) and process modeling of emerging technologies, particularly electrochemical systems. In addition to work performed for industry clients, the team has had prime and subcontracts with US DOE for over 20 years, ARPA-e, DOT, and DOD on a variety of topics including hydrogen storage, hydrogen production, fuel cell cost analysis, and other electrochemical devices including various battery chemistries.

Critical Inputs Required from Recipient: To facilitate the pace of work, we request clients to provide as much detail upfront as possible and have a minimum of one point of contact (POC) to work with on a regular cadence.

Geographic Constraints for Capability: Our team is distributed throughout the United States and typically supports projects virtually.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): None

How many weeks capability will take: 12

Midpoint Milestone Description: Market survey

Final Milestone Description: Competitive value assessment and market outlook

ICatalysts LLC, Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

ICatalysts LLC Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

www.icatalysts.net

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Pumped Storage Hydropower (PSH)

Compressed-Air Energy Storage (CAES)

Mechanical (Other)

Thermal Energy Storage

Other

Type of Technology: Fly wheels and others

Capability Title: Commercialization strategy support: To achieve key milestones consistent with business plan and strategy.

Capability Summary: Assisting the company with strategy, deliverables, and connections to funding and resources/partners to de risk the business plan and to achieve critical near-term milestones. These services compliment business plan formulation services (see separate submittal). For ICatalysts providing these services is a creative and interactive process where company executives are first interviewed to understand their business, barriers/blockers, and near and mid-term goals: securing pilot customers, R&D grants, corporate development agreements, and equity financing. Key to support will be a scope of work and a strong communications plan. Provide the most value to the company if we are integrated into the team and workflow during this engagement. Based on the company needs/scope, activities/deliverables may include: a go to market strategy based on a market assessment, cost/technoeconomic analysis to inform pricing, equity and non-equity fund raising targets, and a partners/competitors landscape analysis to identify external relationships needed to reach short-term milestones.

Capability Core Competencies: ICatalysts has more than 25 years of commercialization strategy experience and over 11 years of experience in energy storage company development including business planning and commercialization support, evaluating companies and technologies for funders and investors, and energy storage RD&D project delivery. Overall, we have coached and provided business plan training to 1000+ startups who have raised over \$3.5B. This includes over 300 energy companies. For this voucher program, we have 10 storage experts and 12 commercial strategy specialists located across the U.S. Core capabilities:

Market Assessment

Business Planning

Fundraising

Intellectual Property/patents

Techno-economic analysis

Life Cycle analysis

Supply chain analysis

Community benefits analysis and planning Market readiness analysis Business model development (e.g., lean launchpad, etc).

ICatalysts LLC, Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

ICatalysts LLC, Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

Competitive research and analysis
Technology and commercial benchmarking (TRL, CRL)
Financial modeling and projections
Business and investor communications
Grant development and writing Investor analysis and development
Team and staff planning and recruiting
Partnership development

Capability Qualifications and Credentials: 10 experts with storage experience across all listed technology areas. 12 experts with energy business plan formation experience. Dr. Rakesh Radhakrishnan: Engineer/MBA with 25 years of experience. Recent Sr. Tech to Market Advisor, ARPA-E. Tom Jensen: 11 years energy storage company business planning and commercialization experience. Managed DOE 2022/2023 Energy Storage Innovation Prize Power Connector Prize Project. Dr. Zachary Holman: Experience advising over 10 storage companies; expert in solar and storage integration topics. Founded 3 funded solar startups. Steve Messner: Engineer who has advised over 10 storage startups on business plans and pitch decks. Cameron Barnes: 10 years of experience in operationalizing DEI strategy including \$125M in community benefit planning and training for the DOE. Nathan Fink: 15 years of experience in energy company due diligence, financing, and M&A for Shell Ventures and other investors. Brian Van Osdol: Engineer/Patent agent with 15 years of experience primary in energy technology companies.

Capability Background: Led several deliverables for a ground-breaking \$25M microgrid/storage program led by SDG&E funded by the DOE and the State of California. Recently, Tom, Dr. Zachary Holman, and Steve Messner served as experts to train and provide 1:1 support to 22 teams competing for the DOE's 2022/2023 Office of Electricity's Energy Storage Innovations Prize. Other experience providing commercialization strategy support to 40+ other storage startups. Since 2016, for the California Energy Commission, we have evaluated over 30 energy storage startups competing for R&D and demonstration grant applications. ICatalysts platforms/software: Empower Innovation: Fundraising, business development and partnering platform with 4,400+ members (www.empowerinnovation.net). Salesforce CRM: 30,000 contacts; 90% in energy and investment industry. Network Analyzer Software: Pitchbook, Crunchbase, and other data to identify competitors, investors, and commercial pathways. Our team has written community benefit plans for \$125+ million DOE proposals, and lead several CB trainings funded by DOE

Critical Inputs Required from Recipient: Provide existing materials including prior business, marketing, operational plans, market, and competitive research, etc. Provide details on technology, intellectual property, team, current financials, etc.

Geographic Constraints for Capability: None; can service companies in any state

Provide any other critical details that may help with matching (including equipment specifications where appropriate): We have a strong client service mindset and collaborative approach

How many weeks capability will take: 8

Midpoint Milestone Description: Complete draft deliverables in commercialization strategy scope of work set with company.

ICatalysts LLC, Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

ICatalysts LLC, Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

Final Milestone Description: Complete final deliverables in commercialization strategy scope of work set with company.

ICatalysts LLC, Commercialization strategy support: To achieve key milestones consistent with business plan and strategy. (VO7-11)

Electric Power Research Institute, Inc. Voice of the Customer, Technoeconomic Analysis, Lifecycle Assessment (VO7-12)
epri.com

Applicable Technology Area(s):

Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: Mechanical - gravitational; Other - thermochemical energy storage

Capability Title: Voice of the Customer, Technoeconomic Analysis, Lifecycle Assessment

Capability Summary: EPRI has broad expertise in the evaluation of long-duration energy storage (LDES) technologies. EPRI's role as a provider will be as follows: Develop an industry adoption plan and provide the voice of the customer feedback to the project team. Coordinate industry steering committee meetings to provide feedback on research and the path to commercial projects. Perform technoeconomic analysis on the potential cost, benefits, and utilization of the paired LDES system. The project team will develop an 8760-hour annual dispatch model with energy storage showing intermittent charging with zero-carbon energy and discharging on demand. Capital and operating costs for the full commercial scale system will be estimated. The benefits will be quantified, including arbitrage revenue and ancillary services, reduced fuel costs, carbon emissions reduction credits, and other value streams as applicable. The costs and benefits will be used to estimate the value proposition for the energy storage system when deployed at commercial scale. Perform life cycle assessment (LCA) on the LDES system. LCA work will quantify the embodied carbon or other criteria in the energy storage system and estimate the payback time required to achieve net emissions savings. Areas of investigation include system inputs/components, energy inputs, and end of life considerations.

Capability Core Competencies: EPRI is a public-benefit research organization founded in 1972 that conducts research on the production, transmission, and distribution of electric power and its environmental impacts. EPRI's mission is to advance safe, reliable, affordable, and environmentally responsible energy. Furthermore, EPRI's access to numerous energy companies will allow the project to receive important feedback on what will be accepted and useful. EPRI has historically focused on the electricity sector but has increasingly expanded into other areas related to energy. EPRI's involvement ensures participation from the energy industry and effective and unbiased technology transfer. EPRI also has extensive experience coordinating multiple teaming partners, funding entities, and technology vendors, and has demonstrated the ability to successfully conduct R&D activities, meeting objectives on schedule and within budget. This wealth of experience and reputation within the energy industry for being a leader in conducting unbiased research is a key aspect of EPRI's value for this project.

Capability Qualifications and Credentials: Within EPRI is the bulk energy storage team, which contains employees with decades of experience working with the machinery that forms the foundation of many LDES technologies. This team will be performing the work related to this voucher, particularly the tasks related to the costs and performance of LDES systems. EPRI also has staff with expertise in LCA that will be performing that section of the voucher work.

Capability Background: EPRI has produced costs and performance studies for a number of LDES technologies, including pumped heat energy storage, concrete and molten salt thermal energy storage, liquid air energy storage, and compressed air energy storage. These paper studies detail plant costs and

Electric Power Research Institute, Inc., Voice of the Customer, Technoeconomic Analysis, Lifecycle Assessment (VO7-12)

benefits based on the utilization of the energy storage facility. As such, we have developed the methodology for bringing these projects to completion with high quality results.

Critical Inputs Required from Recipient: Components, material makeup (concrete, steel, etc.), system diagrams and conditions, intended use case, proposed location and conditions (ambient temperature, pressure, other pertinent variables)

Geographic Constraints for Capability: No geographical constraints.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): We have spoken to RCAM Technologies, who plan to submit a Voucher Recipient application this fall. If both EPRI and RCAM are selected, we would like to be matched. We are open to working with a broad range of technologies. In general, our team is best suited to perform analysis on thermal, mechanical, and chemical LDES technologies.

How many weeks capability will take: 25

Midpoint Milestone Description: Completion of voice of the customer webcast, delivery of information to EPRI and initial developer webcast to confirm project specifics.

Final Milestone Description: EPRI will develop a report that will include voice of the customer summary, cost and benefits, utilization analysis, and LCA.

Johnston Engineering PLLC, Test Fixture Design and/or Build: 3D CAD Modeling, Analysis, Fabrication, and Assembly of Test Fixture (VO7-13)

Johnston Engineering PLLC Test Fixture Design and/or Build: 3D CAD Modeling, Analysis, Fabrication, and Assembly of Test Fixture (VO7-13)

<https://www.johnstonpe.com/>

Applicable Technology Area(s):

Other

Thermal Energy Storage

Mechanical (Other)

Compressed-Air Energy Storage (CAES)

Pumped Storage Hydropower (PSH)

Batteries (Other)

Zinc Batteries

Lead-acid Batteries

Flow Batteries

Lithium-ion Batteries

Type of Technology: Long Duration Energy Storage

Capability Title: Test Fixture Design and/or Build: 3D CAD Modeling, Analysis, Fabrication, and Assembly of Test Fixture

Capability Summary: Johnston Engineering offers custom test fixture design and build services to conduct LDES performance testing. Test fixtures enable performance testing, device characterization, device verification, process validation, process recipe development, and correlation creation. Our work involves the engineering design and analysis of custom, low-uncertainty experiments used to gather accurate and reliable LDES test results. We design and build complete test systems including piping and instrumentation, sensors, custom hardware, and off-the-shelf components. We offer structural & thermal FEA and fluid flow CFD services to design test fixture components and systems. Deliverables may include 3D CAD models, engineering drawings, uncertainty analysis, results of structural, thermal or fluid flow analysis needed to design test fixtures and custom test fixtures. Our test fixtures are custom-designed for the type of LDES testing being conducted.

Capability Core Competencies: Expertise: Johnston Engineering is an expert in designing test fixtures. Andy Johnston has over 20 years of experience in designing and conducting low-uncertainty R&D, process & device characterization, device verification and lifecycle testing. Experience: Design of mechanical, thermal and fluid flow test systems. We have designed custom test fixtures for LDES technologies, ensuring accurate performance validation. The majority of our work is in prototype and test fixture design. Capabilities: 3D CAD modeling, system-level design, and test fixture fabrication. Approach: We use an analysis-driven design approach to develop and improve custom test fixtures, leveraging a network of fabrication shops for component fabrication to incorporate with off-the-shelf components and then build test fixtures internally.

Capability Qualifications and Credentials: Johnston Engineering is a Professional Engineering firm in Washington state with over 150 years of combined experience. We have been in operation for 8 years and have 15 full-time employees and 14 contractors working to develop new machines, equipment, and devices. Johnston Engineering Owner, Andy Johnston, is a licensed P.E in WA State with over 20 years of experience in advanced analysis from a military and aerospace electronics cooling and packaging background. To date, we have completed over 150 projects. We have experience with 5 previous LDES projects as well as 15+ clean energy projects. We are headquartered in Spokane, Washington. We own two buildings; one is offices and a clean shop that we use for final assembly. The other is a fabrication

Johnston Engineering PLLC, Test Fixture Design and/or Build: 3D CAD Modeling, Analysis, Fabrication, and Assembly of Test Fixture (VO7-13)

Johnston Engineering PLLC, Test Fixture Design and/or Build: 3D CAD Modeling, Analysis, Fabrication, and Assembly of Test Fixture (VO7-13)

shop. We have a network of trusted, local, and domestic fabrication shops for metal, plastic, and composite material fabrication.

Capability Background: We have designed multiple LDES tests including device verification, device characterization, process recipe development, thermal and HALT testing. These test fixture designs included generation P&ID, thermodynamics simulation, and analysis of overall system efficiency, custom hardware design and analysis, instrumentation, and hardware build. Test systems included fans, pumps, piping, data acquisition and control systems, liquid-cooled cold plates, immersion cooling, custom heat exchangers, and custom vapor compression systems. We can operate systems in thermal chambers, altitude chambers, and harsh environments. We have experience with LDES battery system manufacturers, finalizing packaging for UL certification or MIL-STD-810, and have collaborated with Pacific Northwest National Laboratory to build and test a proof-of-concept LDES system. We have experience leading R&D projects, including a three-year study on evaporating flows in microchannels, involving multi-configuration part design, instrumentation, and data analysis.

Critical Inputs Required from Recipient: Our engineering services require the following inputs: System information, including system size, P&ID, BOM, and 3D CAD models if available. And a minimum of one engineering POC to provide system and application details. If necessary, we can generate these items as part of the voucher funding.

Geographic Constraints for Capability: We are capable of supporting projects anywhere in the US and Canada with a strong in-person presence in Washington and the Pacific Northwest region.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Johnston Engineering is offering to design and build the test fixture. We can also conduct the testing, but conducting testing is not in this scope of this work. Our core competency is in engineering design and analysis, build and test. We own two physical buildings in Spokane, Washington where we can receive and assemble the custom parts that we design up to 40 feet long. We have internal machining, sheet metal and welding capabilities, but we typically order custom machined and sheet metal parts from a network of fabrication shops then assemble hardware internally.

How many weeks capability will take: 24

Midpoint Milestone Description: Delivery of preliminary test fixture design and plan

Final Milestone Description: Assembled test fixture hardware, test fixture design documentation which may include 3D CAD models, drawings and/or analysis

Johnston Engineering PLLC, Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)

Johnston Engineering PLLC Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)
<https://www.johnstonpe.com/>

Applicable Technology Area(s):

Other

Thermal Energy Storage

Mechanical (Other)

Compressed-Air Energy Storage (CAES)

Pumped Storage Hydropower (PSH)

Batteries (Other)

Zinc Batteries

Lead-acid Batteries

Flow Batteries

Lithium-ion Batteries

Type of Technology: Long Duration Energy Storage

Capability Title: Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly

Capability Summary: Johnston Engineering offers mechanical component and system design, analysis, fabrication, and assembly services to advance, improve, demonstrate, and commercialize energy technologies. Our engineering design and analysis services for LDES technologies involve using SolidWorks 3D CAD and ANSYS analysis software for advanced system and component modeling. We perform thermal, structural, and fluid-flow analysis using Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD) software tools. Our fabrication services are supported by our network of fabrication shops, and we assemble hardware internally. Deliverables include 3D CAD models, mechanical engineering drawings, performance analysis studies, and/or fabricated hardware. Our work involves mechanical design, analysis, and fabrication and assembly of custom hardware. System-level design may include custom and OTS hardware, overall system layout, packaging, and thermal management to improve energy density and cooling efficiency. Our services cover design for scalability and manufacturability, modular design, structural design of custom components and systems, fluid system design, cost reduction, piping and instrumentation, and process modeling. We use skilled fabricators to produce custom hardware and then assemble complete systems in-house to ensure our clients can scale, test, and commercialize their technologies effectively.

Capability Core Competencies: Expertise: Johnston Engineering is a subject matter expert in thermal management and electronics packaging and cooling with strong proficiency in integrating mechanical design with thermal, structural and fluid-flow analysis. We specialize in first-of-a-kind products, devices, and machines, offering services from concept development through commercialization.

Experience: We collaborate with businesses, research institutions, and cross-disciplinary engineering firms to develop new products, devices, equipment, and machines across multiple industries. Our focus is on green energy projects, including carbon capture, nuclear, hydrogen, and energy storage technologies. We have designed custom components, battery packaging, and thermal management systems for LDES technologies, including boiling and condensing systems such as custom cold plates, heat exchangers, and vapor compression systems. Capabilities: 3D CAD modeling, thermal, structural, and fluid-flow analysis, and system-level design and fabrication. Approach: We follow an analysis-

Johnston Engineering PLLC, Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)

Johnston Engineering PLLC, Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)

driven design approach, then rely on a network of fabrication shops for custom components before we assemble the system.

Capability Qualifications and Credentials: Johnston Engineering is a Professional Engineering firm in Washington state with over 150 years of combined experience. We have been in operation for 8 years and have 15 full-time employees and 14 contractors working to develop new machines, equipment, and devices. Johnston Engineering Owner, Andy Johnston, is a licensed P.E in WA State with over 20 years of experience in advanced analysis from a military and aerospace electronics cooling and packaging background. To date, we have completed over 150 projects. We have experience with 5 previous LDES projects as well as 15+ clean energy projects. We are headquartered in Spokane, Washington. We own two buildings; one is offices and a clean shop that we use for final assembly. The other is a fabrication shop. We have a network of trusted, local, and domestic fabrication shops for metal, plastic, and composite material fabrication.

Capability Background: We have designed and built multiple battery packaging and thermal management systems for LDES systems, including liquid-cooled cold plates, immersion cooling, custom heat exchangers, and custom vapor compression systems. This work included a system design optimization study to identify components, generate P&ID, perform thermodynamics & fluid flow simulation, and analyze overall system efficiency. We have modeled internal battery isotropic transient conduction and heat dissipation during charge/discharge cycles and matched battery array performance to custom cooling solutions. We have experience with LDES battery system manufacturers, finalizing electronics packaging for UL certification, and are currently collaborating with Pacific Northwest National Laboratory to build and test a proof-of-concept LDES system. Additionally, we have designed high-performance boiling and condensing thermal management systems for LDES technologies. We have provided system modeling for CAES including system design, P&ID, component selection, and system efficiency modeling. We have also provided water turbine turbo machine CFD analysis.

Critical Inputs Required from Recipient: Our engineering services require the following inputs: System information, including system size, P&ID, BOM, and 3D CAD models if available. And a minimum of one engineering POC to provide system and application details. If necessary, we can generate these items as part of the voucher funding.

Geographic Constraints for Capability: We are capable of supporting projects anywhere in the US and Canada with a strong in-person presence in Washington and the Pacific Northwest region.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Our typical scope of work is in engineering design and analysis, build and test. We own two physical buildings in Spokane, Washington where we can receive and assemble the custom parts that we design (up to 40 feet long). We have internal machining, sheet metal and welding capabilities, but we typically order custom machined and sheet metal parts from a network of fabrication shops then assemble hardware internally.

How many weeks capability will take: 24

Midpoint Milestone Description: Delivery of preliminary analysis report(s), initial design models, and/or manufacturing drawings

Johnston Engineering PLLC, Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)

Johnston Engineering PLLC, Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)

Final Milestone Description: Completion and delivery of detailed analysis report(s), final design models, manufacturing drawings, and/or delivery of fabricated and assembled hardware.

Johnston Engineering PLLC, Mechanical System Design, Analysis, and/or Build: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, Fabrication, and Assembly (VO7-14)

Johnston Engineering PLLC, Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis (VO7-15)

Johnston Engineering PLLC Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis (VO7-15)
<https://www.johnstonpe.com/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Pumped Storage Hydropower (PSH)
Batteries (Other)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: Long Duration Energy Storage

Capability Title: Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis

Capability Summary: Johnston Engineering offers mechanical engineering design and analysis services to advance, improve, demonstrate, and commercialize energy technologies. Our services for LDES technologies involve using SolidWorks 3D CAD software and ANSYS analysis software for advanced system and component modeling. Deliverables include design improvements, 3D CAD drawings, and/or thermal, fluid-flow, and structural performance analysis studies. Our work involves mechanical concept development, iteration, performance optimization and improvement, and generating 3D CAD models for custom hardware or simulations. We perform thermal, structural, and fluid-flow analysis using Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD) simulations. System-level design and analysis may include custom mechanical hardware and component design, system layout and packaging, and electronics packaging and cooling to improve energy density and cooling efficiency. Additionally, our services cover thermal management, scalability, modular design, piping and instrumentation, structural design of battery packs and large-scale systems, fluid system design and modeling, cost reduction modeling, pressure drop analysis, uncertainty analysis, transient and steady-state analysis, single and two-phase flow analysis, and process modeling.

Capability Core Competencies: Expertise: Johnston Engineering is a subject matter expert in thermal management and electronics packaging and cooling with strong proficiency in integrating mechanical design with thermal, structural, and fluid-flow analysis. We specialize in first-of-a-kind products, devices, and machines, offering services from concept development through commercialization. Experience: We collaborate with businesses, research institutions, and cross-disciplinary engineering firms to develop new products, devices, equipment, and machines across multiple industries. Our focus is on green energy projects, including carbon capture, nuclear, hydrogen, and energy storage technologies. We have designed custom battery packaging and thermal management systems for LDES technologies, including high-performance boiling and condensing systems such as custom cold plates, heat exchangers, and vapor compression systems. Capabilities: 3D CAD modeling, thermal, structural and fluid-flow analysis, and system-level design. Approach: We follow an analysis-driven design approach to reduce risk and ensure our clients' technical success while magnifying their team capabilities.

Johnston Engineering PLLC, Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis (VO7-15)

Johnston Engineering PLLC, Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis (VO7-15)

Capability Qualifications and Credentials: Johnston Engineering is an Engineering firm in Spokane, Washington with over 150 years of combined experience. We have been in operation for 8 years and have 15 full-time employees and 14 contractors working to develop new machines, equipment, and devices. Johnston Engineering Owner, Andy Johnston, is a licensed P.E in WA State with over 20 years of experience in design and advanced analysis and comes from a military and aerospace electronics cooling and packaging background. To date, our work includes over 150 projects. We have experience with 5 previous LDES projects as well as 15+ clean energy projects.

Capability Background: We have designed multiple battery packaging and thermal management systems for LDES systems, including liquid-cooled cold plates, immersion cooling, custom heat exchangers, and custom vapor compression systems. This work included a system design optimization study to identify components, generate P&ID, perform thermodynamics & fluid flow simulation, and analyze overall system efficiency. We have modeled internal battery isotropic transient conduction and heat dissipation during charge/discharge cycles and matched battery array performance to custom cooling solutions. We have experience with LDES battery system manufacturers, finalizing electronics packaging for UL certification, and are currently collaborating with Pacific Northwest National Laboratory to build and test a proof-of-concept LDES system. Additionally, we have designed high-performance boiling and condensing thermal management systems for LDES technologies. We have provided system modeling for CAES including system design, P&ID, component selection, and system efficiency modeling. We have also provided water turbine turbo machine CFD analysis.

Critical Inputs Required from Recipient: Our engineering services require the following inputs. System information, including system size, P&ID, BOM, and 3D CAD models if available. And a minimum of one engineering POC to provide system and application details. If necessary, we can generate these items as part of the voucher funding.

Geographic Constraints for Capability: We are capable of supporting projects anywhere in the US and Canada with a strong in-person presence in Washington and the Pacific Northwest region.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): The title, Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis, reflects our flexibility in providing design, analysis, or both services. This scope allows us to adapt to the recipient's project needs, whether it requires more design or analysis. Our services include design and/or analysis where the "and/or" language is intended to ensure we can meet diverse project needs effectively in the timeline and budget constraints.

How many weeks capability will take: 16

Midpoint Milestone Description: Delivery of preliminary analysis report and/or initial design models.

Final Milestone Description: Completion and delivery of detailed analysis report, final design models, and/or performance validation results.

Johnston Engineering PLLC, Mechanical System Design and/or Analysis: 3D CAD Modeling, Thermal, Structural, and/or Fluid-Flow Analysis (VO7-15)

ICatalysts LLC, Business plan formulation: Written business plan, financial model and statements (P&L, Income) and full stack investor/customer slide deck (VO7-16)

ICatalysts LLC Business plan formulation: Written business plan, financial model and statements (P&L, Income) and full stack investor/customer slide deck (VO7-16)
www.icatalysts.net

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other
Zinc Batteries

Type of Technology: Long duration energy storage

Capability Title: Business plan formulation: Written business plan, financial model and statements (P&L, Income) and full stack investor/customer slide deck

Capability Summary: The business plan will be a roadmap for advancing the technology toward a commercially viable and market-ready product. A creative process with ICatalysts where company executives are first interviewed to understand their goals and uses for a business plan. Business Plan Components: Lead in/attention getter/hook, brief business/product description, technology, IP, unmet need business will meet (including value proposition), market opportunity (addressable market), business model (including price point and manufacturing/scaling), competitive analysis, market development strategy (including “go to” target market, partners, and risk mitigation), team, economics/cost model, budget, financials and assumptions, etc. Full stack PPT slide deck components (to support 10–15-minute presentation): Full stack deck components: Who are we? What do we do? What customer problem(s) do we solve? What is our beachhead market and target customer segment? What is our specific business value proposition including customer business, cost, and energy benefits? Are we addressing a problem/opportunity that a large group of target customers would pay you to solve? How big is your market opportunity? How are we different/better than other solutions? What is commercial traction to date? What is our next key commercial milestone for your venture? What are our fundraising goals and use of funds?

Capability Core Competencies: ICatalysts has more than 25 years of business planning experience and over 11 years of experience in energy storage company development including business planning and commercialization support, evaluating companies and technologies for funders and investors, and energy storage RD&D project delivery. Overall, we have coached and provided business plan training to 1000+ startups who have raised over \$3.5B. This includes over 300 energy companies. For this voucher program, we have 10 storage experts and 12 business planning specialists located across the U.S. Core capabilities:

Business and executive coaching
Market research and landscaping
Business model development (e.g., lean launchpad, etc).
Patent research and patentability assessment
Competitive research and analysis
Technology and commercial benchmarking (TRL, CRL)

ICatalysts LLC, Business plan formulation: Written business plan, financial model and statements (P&L, Income) and full stack investor/customer slide deck (VO7-16)

ICatalysts LLC, Business plan formulation: Written business plan, financial model and statements (P&L, Income) and full stack investor/customer slide deck (VO7-16)

Technoeconomic analysis

Financial modeling and projections

Business and investor communications

Grant development and writing Investor analysis and development

Team and staff planning and recruiting

Partnership development

Project management

Capability Qualifications and Credentials: 10 experts with storage experience across all listed technology areas. 12 experts with energy business plan formation experience. Dr. Rakesh Radhakrishnan: Engineer/MBA with 25 years of experience. Recent Sr. Tech to Market Advisor, ARPA-E. Tom Jensen: 11 years of experience in energy storage company business planning and commercialization. Managed DOE 2022/2023 Energy Storage Innovation Prize Power Connector Prize Work Order Dr. Zachary Holman: Experience advising over 10 storage companies; expert in solar and storage integration topics. Founded 3 funded solar startups. Steve Messner: Engineer who has advised over 10 storage startups on business plans. Cameron Barnes: 10 years of experience in operationalizing DEI strategy including \$125M in community benefit planning and training for the DOE. Nathan Fink: 15 years of experience in energy company due diligence, financing, and M&A for Shell Ventures and other investors. Brian Van Osdol: Engineer/Patent agent with 15 years of experience primary in energy technology companies.

Capability Background: Our storage experience began 11 years ago with developing the Borrego Springs Microgrid project, a ground-breaking \$25M program led by San Diego Gas and Electric, funded by the DOE and the State of California. Tom Jensen, our managing director, lead several project deliverables for both agencies. Recently, Tom, Dr. Zachary Holman, and Steve Messner served as experts to train and provide 1:1 support to 22 teams competing for the DOE's 2022/2023 Office of Electricity's Energy Storage Innovations Prize. Many of these teams we coached sought feedback on their technologies, market development and business commercialization. Other experience is providing business plan training and support to over 40 other storage startups, many who came out of top research institutions. Since 2016, for the California Energy Commission, we have evaluated over 30 energy storage startups competing for R&D and demonstration grant applications. Our team has written community benefit plans for \$125+ million DOE proposals.

Critical Inputs Required from Recipient: Provide existing materials including prior business, marketing, operational plans, market, and competitive research, etc. Provide details on technology, intellectual property, team, current financials, etc.

Geographic Constraints for Capability: Service anywhere in the U.S.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Strong company service mindset and experience.

How many weeks capability will take: 8

Midpoint Milestone Description: Draft business plan (with appendices) and draft full stack business plan slide deck

Final Milestone Description: Final business plan (with appendices) and draft full stack business plan slide deck

ICatalysts LLC, Business plan formulation: Written business plan, financial model and statements (P&L, Income) and full stack investor/customer slide deck (VO7-16)

Electric Power Research Institute, Inc. Techno-Economic Modeling (VO7-17)

epri.com

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Type of Technology: Other battery technologies may include, but are not limited to, metal air, sodium-based, alkaline, liquid metal, or metal hydrogen batteries

Capability Title: Techno-Economic Modeling

Capability Summary: This effort aims to support technology suppliers in understanding the potential economics of their technology participating in various electricity markets or other use cases under different conditions. Using EPRI's DER-VET software, a number of scenarios and sensitivities will be evaluated to understand their impact on project valuation. The results will help determine where the technology may make sense to deploy. The study will consider up to four scenarios, which could represent participation in four different wholesale electricity markets or four sets of data relevant to other use cases. These are subject to change upon agreement between EPRI and the recipient. EPRI will also conduct sensitivity analyses, shifting certain performance, cost, or other parameters between low, medium, and high values to characterize their impact on the result. EPRI will work with the recipient to determine the final list of parameters and the ranges for up to five independent sensitivity cases. Sensitivity parameter options include: degradation rate, cycles per day/year, roundtrip efficiency, capital costs, fixed O&M, variable O&M, self-discharge rate, auxiliary load, system life, energy and ancillary service prices, discount rate, or incentive rates. The output will be financial results, presented as NPV / IRR.

Capability Core Competencies: For more than five decades, EPRI's team of scientists and engineers have worked with energy companies, government agencies, and technology developers to accelerate the adoption of new energy storage technologies. Founded in 1972, EPRI is an independent non-profit energy research, development, and deployment organization. The institute collaborates with hundreds of organizations representing the energy sector, academia, and governments, in 45 countries around the world. EPRI staff has expertise in technology development and evaluation, cost and performance assessments, benefit analyses, lab testing, field deployment, and commercial operation, including firsthand experience with hundreds of proposed energy storage technologies and products. EPRI established the Energy Storage Integration Council in 2013, a collaborative effort with more than 2,200 participants to address technical and operational issues associated with energy storage systems and advance the deployment, safety, and integration of these systems.

Capability Qualifications and Credentials: EPRI has developed DER-VET or Distributed Energy Resources Value Estimation Tool, a free, publicly accessible, open-source platform for calculating, understanding, and optimizing the value of distributed energy resources (DER) based on their technical merits and constraints. The tool provides a consistent platform for communication of site-specific DER and storage value between stakeholders of utilities, regulators, and vendors. It also provides a method to fairly, transparently, and consistently estimate the project economics and operations.

Capability Background: EPRI has worked with project developers, utilities, and energy storage technology developers across the industry to apply this tool to inform project-level decisions based on

Electric Power Research Institute, Inc., Techno-Economic Modeling (VO7-17)

sound technical understanding and cost-performance data. EPRI also hosts a task force to get industry input on DER-VET capability development.

Critical Inputs Required from Recipient: To conduct this service, recipients are expected to provide technology performance and cost parameter inputs.

Geographic Constraints for Capability: No geographical constraints

Provide any other critical details that may help with matching (including equipment specifications where appropriate): See request for inputs required from voucher recipients.

How many weeks capability will take: 12

Midpoint Milestone Description: Interim results with preliminary findings

Final Milestone Description: Final report with techno-economic analysis and results for the various scenarios

ELECTRIC POWER RESEARCH INSTITUTE, INC, Hazard Mitigation Analysis and Emergency Response Plan (VO7-18)

ELECTRIC POWER RESEARCH INSTITUTE, INC Hazard Mitigation Analysis and Emergency Response Plan (VO7-18)
epri.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)

Type of Technology: Other battery technologies may include, but are not limited to, metal air, sodium-based, alkaline, liquid metal, or metal hydrogen batteries.

Capability Title: Hazard Mitigation Analysis and Emergency Response Plan

Capability Summary: Understanding emerging technology safety is important to the utilities or developers who will procure and own storage, as well as to communities where they will be located. This project aims to help provide practical resources for technology solution providers to help facilitate deployment discussions with their various stakeholders. Specific tasks include performing a hazard mitigation analysis (HMA) and developing an emergency response plan (ERP) for either a planned demonstration or for a pre-defined reference case. The hazard mitigation analysis will leverage the ESIC Safety Task Force Reference HMA. EPRI will perform a design review, review potential hazard pre-conditions, review pertinent literature, conduct a workshop with the recipient and relevant parties (e.g., integrators, site hosts, design firms), and develop targeted guidance to support safety audits. A report will document findings and recommendations. EPRI will also incorporate generalized learnings into the ESIC reference guide to support facilitation of transparent hazard discussion for future projects. Using the information from the hazard analysis, an emergency response plan will be developed. This includes additional coordination with first responders or other local authorities. The output will be a site-specific or reference case study emergency response plan plus a training workshop.

Capability Core Competencies: For more than five decades, EPRI's team of scientists and engineers have worked with energy companies, government agencies, and technology developers to accelerate the adoption of new energy storage technologies. Founded in 1972, EPRI is an independent non-profit energy research, development, and deployment organization. The institute collaborates with hundreds of organizations representing the energy sector, academia, and governments, in 45 countries around the world. EPRI staff has expertise in technology development and evaluation, cost and performance assessments, benefit analyses, lab testing, field deployment, and commercial operation, including firsthand experience with hundreds of proposed energy storage technologies and products. EPRI established the Energy Storage Integration Council in 2013, a collaborative effort with more than 2,200 participants to address technical and operational issues associated with energy storage systems and advance the deployment, safety, and integration of these systems.

Capability Qualifications and Credentials: EPRI has performed HMAs for over 10 utility-scale BESS and developed extensive tools and guidance documents to support safe deployment. EPRI has conducted safety reviews of several technologies including lithium ion, flow batteries of varying chemistries, and iron-air batteries.

Capability Background: EPRI is conducting a phased research program titled BESS Fire Prevention and Mitigation. This program is focused on characterizing the risks of energy storage, developing best

ELECTRIC POWER RESEARCH INSTITUTE, INC, Hazard Mitigation Analysis and Emergency Response Plan (VO7-18)

ELECTRIC POWER RESEARCH INSTITUTE, INC, Hazard Mitigation Analysis and Emergency Response Plan (VO7-18)

practices for deployment and operation, and conducting site-specific hazard mitigation analysis and emergency response plans. This research program also considers codes, standards and regulations related to storage safety, and provides training for various stakeholders that may interact with storage systems. Through these projects, 10 public-facing generalized resources, templates, and guides were developed to support the industry as a whole.

Critical Inputs Required from Recipient: To conduct this service, access to equipment specifications, installation and operation manuals, design drawings, certification testing data (e.g., UL 1973 and 9540A test results) are required. Relevant recipient organization environmental, health and safety policies and procedures are also needed. Recipients are expected to participate in workshops.

Geographic Constraints for Capability: No geographical constraints

Provide any other critical details that may help with matching (including equipment specifications where appropriate): See inputs required from voucher recipients.

How many weeks capability will take: 12

Midpoint Milestone Description: Hazard Mitigation Analysis Workshop

Final Milestone Description: Final Documentation Delivery and Emergency Response Plan Training

CleanTech Strategies LLC, “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies” (VO7-19)

CleanTech Strategies LLC “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies” (VO7-19)

<https://www.linkedin.com/company/cleantech-strategies-llc/about/?viewAsMember=true>

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Pumped Storage Hydropower (PSH)

Compressed-Air Energy Storage (CAES)

Mechanical (Other)

Thermal Energy Storage

Other

Type of Technology: Each of the above are types of stationary energy storage systems (ESS), including electro-chemical, mechanical, and thermal.

Capability Title: “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies”

Capability Summary: Established in 2018, CleanTech Strategies (CTS) is a team of subject matter experts drawing on many decades of industry experience, and J.D., P.E., and E.E. professional training. We’re experts in energy storage including long duration energy storage (LDES), power electronics, microgrids, renewables, and advanced materials. CTS’ customers include energy storage system and subsystem developers, U.S. national laboratories, private equity firms, non-governmental organizations, conference companies, and generalist consulting firms. Drawing on that expertise and experience, CTS brings a strong capability to accelerate the growth of energy storage companies, from start-ups to mid-market firms to conglomerates. This includes companies developing and going to market with flow batteries (metal-based and organic, carbon-based) and other electrochemical batteries, mechanical and thermal systems, and subsystems for lithium-ion batteries. The work to be delivered by CTS includes Technical Modeling Analysis and Performance Evaluation, which are key areas of support needed by energy storage companies to accelerate the development and maturation of their products and businesses as a whole. For each VO7 Recipient that CTS assists, CTS would analyze the work done thus far in the particular area, advise on the work to be accomplished, agree on milestones, and deliver and discuss written work products.

Capability Core Competencies: CTS has core competencies in both energy storage technical matters – including LDES technical modeling analysis and performance evaluation; and business matters – including LDES market assessment, business planning, and commercialization strategy. These CTS core competencies derive from the expertise, experience, and capabilities of the CTS team, which includes two business experts and two technical experts. (Qualifications and credentials below.) CTS’ energy storage industry expertise on LDES is broad, including operating companies, the electric power industry, commercial activities, research and development, product development, system deployment, field assessment, strategic advising, and legal management. Between the CTS team, there is over a century of combined experience (enumerated below) at energy storage companies, utilities, electronics and software companies, governmental bodies, law firms, and consulting firms. Each member of the CTS team has demonstrated their capabilities during their careers to date, with recognition by their peers including in the energy storage industry. (References available.)

CleanTech Strategies LLC, “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies” (VO7-19)

CleanTech Strategies LLC, “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies” (VO7-19)

Capability Qualifications and Credentials: CTS president Russ Weed, J.D., is an energy storage industry veteran, including business, product, and project development; strategic planning; government relations; and legal management. He has 23 years of experience in business and legal positions with private and public companies including GE, mid-market, and start-ups; and 10 years as an attorney. Fellow engineer Curt Kirkeby, P.E., has over 40 years of utility experience, serving as technology strategist at investor-owned Avista and holds patents on multiple grid technologies. Consulting expert Chris Murray, J.D., has 20 years of “Beltway” experience, serving Congress and the Executive branch, supporting the Navy, and working for a utility. Consulting engineer Dave Ridley, E.E., has 15 years of experience in energy storage product development, including zinc, vanadium, lithium, CO₂, and sodium, particularly power electronics and controls. In addition to the expertise, experience, and capabilities of its people, CTS has developed an industry reputation for getting things done.

Capability Background: CTS commenced its work for energy storage system and subsystem developers in 2018. The developers including LDES companies are as follows: • Hotstart (liquid thermal management for lithium-ion)

- Advanced Rail Energy Storage (gravity mechanical)
 - Invinity (vanadium flow)
 - BioZen (organic flow)
 - CMBlu (organic solid flow)
 - Stryten (vanadium flow)
 - EarthEn (CO₂ mechanical and thermal)
 - Inlyte (sodium metal)
- Current efforts by CTS include negotiations with NETL on a FOA 3020 award to CTS for “Pre-Competitive Research & Development to Accelerate the Maturation of Flow Battery Technologies into Cost-Effective Long Duration Energy Storage” for \$5M, with \$1.25M cost-share from the seven members of the Flow Battery Industry group (FBIG). Preceding the FOA, CTS proposed the creation of FBIG to a U.S. national laboratory, and collaborated with flow battery developers and other stakeholders to establish FBIG as a part of the long-standing Battery Council International (BCI) trade association.

Critical Inputs Required from Recipient: CTS inputs required from each Recipient: (1) company information (formation date and jurisdiction, business location(s), staffing number and backgrounds); (2) LDES product information (technical specifications, technology readiness level (TRL), manufacturing readiness level (MRL), competitive comparisons); (3) descriptions of deployed LDES pilot or demonstration projects; (4) LDES productization roadmap (to date and future); (5) go-to-market timeline (to date and future); (6) current business plan; and (7) proposed scope of work by CTS on Technical Modeling Analysis and Performance Evaluation tasks to accelerate the development and maturation of the Recipient’s LDES.

Geographic Constraints for Capability: CTS can provide its services on energy storage technical matters – including LDES technical modeling analysis and performance evaluation - and business matters – including LDES market assessment, business planning, and commercialization strategy anywhere in the United States. The CTS team is located in the State of Washington and the Washington, D.C. area. CTS also has an extensive network of further energy storage experts, including on LDES, around the U.S. that it can partner with as needed for tasks for VO7 Recipients. In addition, CTS works closely with U.S. national laboratories located throughout the country, on energy storage including LDES.

CleanTech Strategies LLC, “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies” (VO7-19)

Provide any other critical details that may help with matching (including equipment specifications where appropriate): CTS is committed to identify and accomplish collaboratively the strategic objectives of each energy storage company it serves, including U.S. for-profit companies which are currently developing and/or manufacturing LDES technology.

How many weeks capability will take: 16

Midpoint Milestone Description: Completion of analysis of work done to date, advice on work to be accomplished, and agreement on milestones.

Final Milestone Description: Completion of delivery of CTS’ written work products to VO7 Recipient, and discussion of them by VO7 Recipient and CTS.

CleanTech Strategies LLC, “LDES Technical Modeling Analysis and Performance Evaluation from Subject Matter Experts CleanTech Strategies” (VO7-19)

Electric Power Research Institute, Inc., LDES Testing Facility and Performance Validation
(VO7-20)

Electric Power Research Institute, Inc. LDES Testing Facility and Performance Validation
(VO7-20)

epri.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)

Type of Technology: Other battery technologies may include, but are not limited to, metal air, sodium-based, alkaline, liquid metal, or metal hydrogen batteries

Capability Title: LDES Testing Facility and Performance Validation

Capability Summary: EPRI maintains space at the Solar TAC and Grid NXT microgrid facility in Denver, Colorado which can be used to test and characterize the performance of integrated LDES systems. EPRI would receive the system, install and integrate into the facility, commission, conduct a series of performance tests, analyze the results, provide lessons learned, and prepare the system for removal at the end of the test period. For the testing, EPRI will leverage the ESIC Energy Storage Test Manual which provides protocols for consistent characterization of energy storage. Baseline characterization includes available energy capacity, roundtrip efficiency, self-discharge rate, rated continuous active power, charge duration, response time, startup and shutdown time. EPRI will work with the recipient to determine application duty cycle testing. After initial baseline testing, monthly reference performance testing along with use case testing would be performed. Testing can take place over a full calendar year to capture real-world seasonal conditions that may impact performance. EPRI would work with the recipient to identify where any technology-specific adaptations to the protocols are required and develop any new protocols that are feasible within the constraints of the project. The output of the project is monthly and a final test report summary.

Capability Core Competencies: For more than five decades, EPRI's team of scientists and engineers have worked with energy companies, government agencies, and technology developers to accelerate the adoption of new energy storage technologies. Founded in 1972, EPRI is an independent non-profit energy research, development, and deployment organization. The institute collaborates with hundreds of organizations representing the energy sector, academia, and governments, in 45 countries around the world. EPRI staff has expertise in technology development and evaluation, cost and performance assessments, benefit analyses, lab testing, field deployment, and commercial operation, including firsthand experience with hundreds of proposed energy storage technologies and products. EPRI established the Energy Storage Integration Council in 2013, a collaborative effort with more than 2,200 participants to address technical and operational issues associated with energy storage systems and advance the deployment, safety, and integration of these systems.

Capability Qualifications and Credentials: Solar TAC offers 100+ acres of outdoor testing space that can easily accommodate emerging technologies as there is no permitting, interconnection, or certification/listing required to test equipment at this facility. Existing site infrastructure that can be leveraged includes a 1.2 MW microgrid, MV interconnection, solar PV, PV and wind simulators, diesel generation, underground cable trays and pre-wired equipment pads, microgrid controllers, and metering and protection hardware. There are onsite electricians and maintenance personnel

Electric Power Research Institute, Inc., LDES Testing Facility and Performance Validation
(VO7-20)

Electric Power Research Institute, Inc., LDES Testing Facility and Performance Validation
(VO7-20)

Capability Background: EPRI has been engaged in testing and analyzing experimental and fielded system performance for more than 50 years. Recent testing at Solar TAC includes nickel-hydrogen, zinc manganese dioxide, flow, numerous lithium ion products as well as adjacent technologies. EPRI has also led test plan development and data analysis for system hosted at utilities, including organic flow, vanadium redox flow, advanced lead acid, and numerous lithium ion systems.

Critical Inputs Required from Recipient: To conduct this service, recipients are expected to deliver a system to Solar TAC and should include an integrated storage system with enclosure, BMS, and inverter. Site integration could potentially be supported if products are not available as complete systems, though this would require a scoping discussion to understand any specific needs.

Geographic Constraints for Capability: Testing is at Solar TAC in Denver, Colorado and product needs to be delivered there. The site is about 10 minutes from Denver International Airport and is close to many freight terminals.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Equipment must be provided with specifications, safety data sheets, and instructions as appropriate.

How many weeks capability will take: 60

Midpoint Milestone Description: Baseline reference performance testing and interim report

Final Milestone Description: Final report with baseline and reference testing analysis results and lessons learned.

350Solutions, Inc, Independent Performance Validation via ISO 14034 Verification of Long Duration Energy Storage Technologies (VO7-21)

350Solutions, Inc Independent Performance Validation via ISO 14034 Verification of Long Duration Energy Storage Technologies (VO7-21)
www.350solutions.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: 350Solutions can provide independent performance assessments for a range of technologies, and has completed evaluations in the past that consider a variety of battery types, including all listed, and staff have developed thermochemical energy storage technology

Capability Title: Independent Performance Validation via ISO 14034 Verification of Long Duration Energy Storage Technologies

Capability Summary: 350Solutions, Inc. provides independent third-party evaluation of innovative clean technologies compliant with the ISO 14034 Environmental Technology Verification standard. The ISO 14034 ETV approach ensures a rigorous evaluation of performance data – typically in real-world field demonstration conditions – to ensure high-quality data, proper analysis procedures, relevant testing standards, and representative conditions are utilized to determine technology performance and impacts and that ultimate claims are valid. For LDES technologies, 350 proposes completing ISO 14034 performance verifications of technologies at large pilot or demonstration scales, preferably in field operating conditions. 350 will review all submitted information and validate the performance of the LDES technology based on the provided data, including evaluation of data streams, calculations from raw data to calculated final results, engineering factors, data validity, and data quality, all as required by the ISO 14034 standard. 350 will also identify gaps, issues, and improvements in data collection, testing, and evaluation, and may request additional testing if ISO 14034 requirements are not met. 350 provides a full report on each verification documenting all activities, verified values, and validation of approaches, as well as recommendations for improvements.

Capability Core Competencies: 350Solutions, Inc. (350) is a private consulting company located in Raleigh, NC providing independent 3rd-party verification of clean technology and low carbon innovations. Our team has independently evaluated, field tested, or verified over 100 novel innovations in the environmental and climate tech sector. At 350Solutions and previous entities, our team has provided energy storage technology evaluation and field demonstration support, thermal energy storage technology development, and energy storage technology state of the art review and initial downselect for government and industrial clients. We've also developed a wide range of technology verification and testing protocols and supported the development of an international standard – ISO 14034 for environmental technology verification (ETV). Our staff have also managed multi-million-dollar field demonstration programs of novel cleantech and low carbon innovations and worked to develop technologies from proof of concept to large demonstrations.

Capability Qualifications and Credentials: 350Solutions provides independent technology verifications for a variety of technologies for a range of client requirements, protocols, and standards.

350Solutions, Inc, Independent Performance Validation via ISO 14034 Verification of Long Duration Energy Storage Technologies (VO7-21)

350Solutions, Inc, Independent Performance Validation via ISO 14034 Verification of Long Duration Energy Storage Technologies (VO7-21)

350Solutions is an ANAB-accredited ISO/IEC 17020:2012 independent inspection body for ISO 14034:2016 Environmental Technology Verification. The 350Solutions Quality Management Plan and Quality Systems Procedures are generally apply to activities associated with independent verifications completed by 350Solutions. 350Solutions staff include a registered Professional Engineer (Chemical Engineering), Chemical, Mechanical, and Civil Engineers, and an Environmental Scientist, who is a Certified Measurement & Verification Professional (CMVP).

Capability Background: Specifically, within the energy storage space, 350Solutions and its staff have:

- Managed the evaluation of energy storage technologies for microgrid installations, including assessment of technology options, with design and control optimization for selected technologies completed by partner organizations
- Evaluated energy storage technology options and current state of the art for application in the chemical industry to support electrification and decarbonization
- Managed the field demonstration of novel low cost power metering systems for high resolution load data to enable improved microgrid design and control optimization
- Led the development of a high temperature thermochemical energy storage system for application to high temperature processes, including concentrating solar power
- Managed the field demonstration and independent verification of numerous distributed energy generation technologies for the US EPA, Depart of Defense, NYSERDA, and others

Critical Inputs Required from Recipient: 350 requires the following, at a minimum, from potential voucher recipients: Documentation on technology performance testing to date (controlled lab, field, or other); Technology summary and principles documentation; Current state of the art test methods, standards, or certifications; Engineering drawings and documentation of technology and test installation, including lists of equipment and instrumentation; Specific site and operating conditions; Full existing data set on technology performance or Test Plan for obtaining performance data; Accessibility to demonstration / test facility and team support for up to three days (typical) site visit and data review meeting

Geographic Constraints for Capability: 350Solutions supports projects nationally, and internationally, if required. The majority of our existing projects are located throughout the US, Canada, and the EU.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Task 1: ISO 14034 Verification Application: 350 reviews company application for ISO 14034 Verification for completeness. Task 2: Information request: 350 will provide a written information request for additional information. Task 2: Site visit: 350 staff visit test site to observe LDES system operation, verify inputs/outputs, instrumentation, measurements, data collection, and processing. Task 3: Performance Validation – 350 will review submitted information and validate performance of the LDES technology (data streams, calculations, data validity and quality). 350 will identify gaps and issues and may request additional testing. Task 4: Reporting – 350 provides a full verification report documenting verified performance.

How many weeks capability will take: 52

Midpoint Milestone Description: Completion of LDES Performance Verification Site Visit

Final Milestone Description: Submission of Final LDES Technology Performance Verification Report

350Solutions, Inc, Independent Performance Validation via ISO 14034 Verification of Long Duration Energy Storage Technologies (VO7-21)

RTI International Life Cycle Assessment (VO7-22)

rti.org

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Thermal Energy Storage
Other

Type of Technology: RTI supports commercialization work across batteries, power electronics, thermal energy, pumped storage hydropower and chemical storage (e.g., hydrogen, ammonia).

Capability Title: Life Cycle Assessment

Capability Summary: New and emerging energy storage technologies can potentially offer energy security, economic and environmental benefits, the net reductions in environmental impact. Net life cycle energy storage gains associated with some technologies may be less than anticipated when the full up- and down-stream sources of energy consumption are considered. For this service, RTI will provide technical support Voucher partners in the application of DOE's life cycle assessment (LCA) procedures to analyze the environmental performance of long-duration energy storage (LDES) technologies. RTI has decades of experience in applying DOE's LCA procedures across different classes of technology (e.g., bioenergy production, carbon capture) and applying standard LCA datasets and models (e.g., OpenLCA). While many energy storage technologies use common materials (e.g., concrete, steel, sand, salts), one potential challenge of conducting LCAs for emerging energy storage technologies can be the lack of data for novel materials. Often this challenge is overcome using proxy data within conventional LCA datasets. RTI has also constructed new life cycle data for materials and processes by conducting detailed process discussions with technology providers and using economic and engineering tools such as ASPEN+ to develop data.

Capability Core Competencies: RTI International helps corporations, foundations, and federal agencies solve their most complex innovation challenges by providing market insights and innovation commercialization services. We leverage our staff of nearly 6,000 experts with degrees in more than 250 scientific, technical, and professional disciplines to bring uniquely broad and deep expertise in technology development and commercialization to provide clients with customized, actionable results. We collaborate to support work across batteries, power electronics, thermal energy, pumped storage hydropower and chemical storage (e.g., hydrogen). For example, RTI has advised clients on emergent battery technologies and emergent thermophotovoltaic technologies; develops and scales novel technologies for energy production and storage from TRL 3-7; and has evaluated opportunities for pumped storage hydropower and integrated river system modeling with production cost modeling.

Capability Qualifications and Credentials: RTI has demonstrated expertise in conducting detailed LCAs for several applications ranging from low-carbon concrete, direct air capture (DAC) technologies to sustainable maritime fuels and waste-to-energy technologies, using both conventional and novel technologies. RTI leverages standard LCA datasets and models (e.g. OpenLCA) as well as construct new life cycle data for materials and processes by conducting detailed process discussions with technology providers and using economic and engineering tools such as ASPEN+ to develop data. We are experts in end of life management and have evaluated circular approaches and the current state of recycling for electronics, batteries and solar panels.

Capability Background: RTI has compared incumbent maritime fuels to emergent chemical fuels (including methanol and ammonia) for an organization's sustainability and low-carbon shipping outlook report. We have experience conducting LCAs on emergent energy technologies, including low-carbon concrete and direct air capture technologies as well as a wider variety of products including faucets and medical devices. Additionally, RTI has ample expertise in end of life management, including leading the development of the municipal solid waste (MSW) decision support tool (DST) in cooperation with the US EPA and DOE. The MSW DST which was designed to help quantify the environmental impacts of current and potential end-of-life materials management options to help evaluate alternatives for meeting sustainability targets such as carbon emissions reductions. Last, RTI brings experience with battery technologies, pumped storage hydropower and thermophotovoltaic technologies (TPV) through our work with Fortune 500 companies, utilities and government organizations.

Critical Inputs Required from Recipient: For this effort, RTI will require that our clients: (1) provide background data and information to enable the LCA and (2) commit time for senior technical personnel to contribute technical information in the project kickoff meeting, during regular updates on an ad-hoc basis to answer technical questions and participate in the LCA throughout the project period of performance.

Geographic Constraints for Capability: We are capable of supporting projects across the US as we regularly work remotely with clients.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 24

Midpoint Milestone Description: The mid-point milestone will be the preliminary LCA, including details about key data and any assumptions being used.

Final Milestone Description: A written document summarizing the results of the LCA.

RTI International AACE Class 5 Techno-Economic Analysis (VO7-23)

rti.org

Applicable Technology Area(s):

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Thermal Energy Storage

Pumped Storage Hydropower (PSH)

Other

Type of Technology: RTI supports commercialization work across batteries, power electronics, thermal energy, pumped storage hydropower and chemical storage (e.g., hydrogen, ammonia)).

Capability Title: AACE Class 5 Techno-Economic Analysis

Capability Summary: For this service, RTI will perform a Concept Screening-level (Association for the Advancement of Cost Engineering Level 5) techno-economic analysis for DOE-funded startups. We will first conduct a kick-off meeting with the startup to discuss their technology and associated design basis and desired case comparisons for conventional and emergent technologies. RTI will then develop a technology analysis plan and work with the startup to ensure all the details are correct. This information will be documented in a written word document and shared with the startup. Once all details are agreed upon, the performance model will be developed and RTI will run the model to get cost estimates for all case comparisons agreed upon. Additionally, RTI will compare cost results against publicly available information for similar technologies to that of the startup. RTI will deliver our findings, including all cost breakdown details, in a written document and through a virtual meeting. The written document in electronic form will be sent to the startup as a final deliverable.

Capability Core Competencies: RTI International helps corporations, foundations, and federal agencies solve their most complex innovation challenges by providing market insights and innovation commercialization services. We leverage our staff of nearly 6,000 experts with degrees in more than 250 scientific, technical, and professional disciplines to bring uniquely broad and deep expertise in technology development and commercialization to provide clients with customized, actionable results. We support work across batteries, power electronics, thermal energy, pumped storage hydropower and chemical storage (e.g., hydrogen). For example, RTI has advised clients on emergent battery technologies and emergent thermophotovoltaic technologies; develops and scales novel technologies for energy production and storage from TRL 3-7; and has evaluated opportunities for pumped storage hydropower and integrated river system modeling with production cost modeling.

Capability Qualifications and Credentials: RTI has demonstrated expertise in conducting detailed TEA for several applications including power generation (coal- and natural gas-based plants, renewables), energy storage, syngas clean-up, carbon capture and sequestration, chemicals production for e.g., methanol, sustainable aviation fuel, ammonia (grey, blue, and green), and hydrogen, using both conventional and novel technologies. RTI uses fundamental process modeling tools such as Aspen Plus Suite (Aspen Plus, Aspen Adsorption, etc.), Hysys, Chemkin, and Promax to generate detailed process flow diagrams, heat and mass balances, equipment lists, and sizing. In addition to using software-based costing tools such as Aspen Process Economics Analyzer, RTI also maintains a database of equipment costs from its process build-and-operate projects. These data are used to generate detailed TEA models and sensitivity analyses.

Capability Background: RTI developed a detailed evaluation of grid-scale storage technologies, comparing chemical storage (hydrogen and ammonia) as energy storage medium to battery storage to understand tradeoffs in cost over different time periods and sizes. Additionally, RTI has provided TEA to two startups as part of the Voucher (V01) program and regularly conducts TEA for novel technologies for energy production and storage. Further, we bring experience in battery technologies, pumped storage hydropower and thermophotovoltaic technologies (TPV) through our work with Fortune 500 companies, utilities and government organizations.

Critical Inputs Required from Recipient: For this effort, RTI will require that our clients: (1) provide background data and information to enable the TEA and (2) commit time for senior technical personnel to contribute technical information in the project kickoff meeting, during regular updates on an ad-hoc basis to answer technical questions and participate in the TEA throughout the project period of performance.

Geographic Constraints for Capability: We are capable of supporting projects across the US as we regularly work remotely with clients.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 16

Midpoint Milestone Description: The mid-point milestone will be the Technology Analysis Plan, including details about the desired case comparisons.

Final Milestone Description: A written document summarizing cost comparisons, including assumptions, cost breakdowns, and comparisons to relevant publicly available costs.

RTI International Market Opportunities Landscape and Competitive Analysis (VO7-24)

rti.org

Applicable Technology Area(s):

Thermal Energy Storage

Mechanical (Other)

Lithium-ion Batteries

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Pumped Storage Hydropower (PSH)

Other

Type of Technology: RTI supports commercialization work across batteries, power electronics, thermal energy, pumped storage hydropower and chemical storage (e.g., hydrogen, ammonia)).

Capability Title: Market Opportunities Landscape and Competitive Analysis

Capability Summary: RTI will leverage our technology-driven market intelligence process, initially developed for NASA and NIST MEP, to evaluate markets of interest and deliver actionable next steps for entry for each start-up. We will begin our work by aligning with the start up through a kick-off meeting to discuss in depth, the needs, opportunities, hypothetical value propositions, and current understanding of the startup's market and competitors. Following this kickoff meeting, our team will employ divergent research strategies to identify potential applications and markets. RTI will present these findings at an interim meeting and use this information to work with the start-up to down select to 3 markets for deep dives. We'll further investigate factors that influence market opportunities including drivers for adoption, competitive technologies, predicted market size, and key players leading new technology adoption, which will inform our determination of the best entry and expansion markets. After refining these insights with 2-3 expert interviews per market, RTI will deliver our findings, including interview summaries, via a PowerPoint presentation in a virtual meeting and provide the presentation in electronic form as a final deliverable.

Capability Core Competencies: RTI International helps corporations, foundations, and federal agencies solve their most complex innovation challenges by providing market insights and innovation commercialization services. We leverage our staff of nearly 6,000 experts with degrees in more than 250 scientific, technical, and professional disciplines to bring uniquely broad and deep expertise in technology development and commercialization to provide clients with customized, actionable results. We collaborate to support work across batteries, power electronics, thermal energy, pumped storage hydropower and chemical storage (e.g., hydrogen). For example, RTI has advised clients on emergent battery technologies and emergent thermophotovoltaic technologies; develops and scales novel technologies for energy production and storage from TRL 3-7; and has evaluated opportunities for pumped storage hydropower and integrated river system modeling with production cost modeling.

Capability Qualifications and Credentials: We have extensive experience supporting entrepreneurs, emerging technologies, startups, and small businesses through our work for DOE, NASA, NIH, USAID, National Academy of Sciences, NIST MEP and DOD. Of note, RTI IA has recently been selected to be a Power Connector for DOE's American-Made Challenges Program, supports 5 startups through DOE's Voucher (V01) Program, supporting Black & Veatch's IgniteX accelerator program through the Pre-Commercial DAC EPIC Prize, in addition to working directly with climate tech startups. We developed our technology-driven market intelligence methodology for NASA and NIST MEP and have used it to help

RTI International, Market Opportunities Landscape and Competitive Analysis (VO7-24)

hundreds of startups and small businesses better understand market opportunities and product-market fit. Coupled with competitive and SWOT analyses, we help startups understand how to best position themselves and develop their go-to-market strategy. We've used this methodology for startups, NASA, NIST MEP clients, NIH SBIR/STTR recipients, and DOE Voucher (V01) Program recipients.

Capability Background: Recent work:

- **State of Battery Technologies, Trends and Opportunities:** We developed a "state-of-the-technology" analysis for battery technologies comparing lithium-ion, sodium, solid-state, flow batteries, and silicon, as well as relevant regulations and incentives to help inform a Fortune 500 company's electrification strategy .
- **Opportunities for Ammonia as Chemical Energy Storage:** RTI developed a detailed evaluation of the energy storage market opportunities for small/medium-duration applications including backup power for data centers, as well as long-duration for grid power back up using hydrogen and ammonia as energy storage medium. • **Assessment of Pumped Storage Hydropower:** We evaluated energy arbitrage benefits and potential impacts of new pumped storage hydropower for a vertically-integrated utility and determined the potential impacts of the facility on the associated river system. • **Thermophotovoltaic (TPV) Technologies:** We assessed dual-use markets for TPV generators and large-scale markets for TPV cells to drive adoption and build volume to reduce cost.

Critical Inputs Required from Recipient: For this effort, RTI will require the following from our clients: (1) to participate in a kickoff meeting with relevant staff and (2) participate in regular collaborative, conversational video conference touchpoints throughout the project to update the company on research findings.

Geographic Constraints for Capability: We are capable of supporting projects across the US as we regularly work remotely with clients.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 14

Midpoint Milestone Description: The mid-point milestone will be a list of potential market opportunities and potential value proposition.

Final Milestone Description: A PowerPoint summarizing key findings and recommendations, including the evaluation of 3 top markets, interview summaries and contact information.

CleanTech Strategies LLC, “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)

CleanTech Strategies LLC “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)
<https://www.linkedin.com/company/cleantech-strategies-llc/about/?viewAsMember=true>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Pumped Storage Hydropower (PSH)
Mechanical (Other)
Batteries (Other)
Compressed-Air Energy Storage (CAES)
Thermal Energy Storage
Other

Type of Technology: Each of the above are types of stationary energy storage systems (ESS), including electro-chemical, mechanical, and thermal.

Capability Title: “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies”

Capability Summary: Established in 2018, CleanTech Strategies (CTS) is a team of subject matter experts drawing on many decades of industry experience, and J.D., P.E., and E.E. professional training. We’re experts in energy storage including long duration energy storage (LDES), power electronics, microgrids, renewables, and advanced materials. CTS’ customers include energy storage system and subsystem developers, U.S. national laboratories, private equity firms, non-governmental organizations, conference companies, and generalist consulting firms. Drawing on that expertise and experience, CTS brings a strong capability to accelerate the growth of energy storage companies, from start-ups to mid-market firms to conglomerates. This includes companies developing and going to market with flow batteries (metal-based and organic) and other electrochemical batteries, mechanical and thermal systems, and subsystems for lithium-ion batteries. The work to be delivered by CTS includes Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support, which are key areas of support needed by energy storage companies to accelerate the development and maturation of their products and businesses as a whole. For each VO7 Recipient that CTS assists, CTS would analyze the work done thus far in the particular area, advise on the work to be accomplished, agree on milestones, and deliver and discuss written work products.

Capability Core Competencies: CTS has core competencies in both energy storage business matters – including LDES market assessment, business planning, and commercialization strategy; and technical matters – including LDES technical modeling analysis and performance evaluation. These CTS core competencies derive from the expertise, experience, and capabilities of the CTS team, which includes two business experts and two technical experts. (Qualifications and credentials below.) CTS’ energy storage industry expertise on LDES is broad, including operating companies, the electric power industry, commercial activities, research and development, product development, system deployment, field assessment, strategic advising, and legal management. Between the CTS team, there is over a century of combined experience (enumerated below) at energy storage companies, utilities, electronics and software companies, governmental bodies, law firms, and consulting firms. Each member of the CTS

CleanTech Strategies LLC, “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)

CleanTech Strategies LLC, “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)

team has demonstrated their capabilities during their careers to date, with recognition by their peers including in the energy storage industry. (References available.)

Capability Qualifications and Credentials: CTS president Russ Weed, J.D., is an energy storage industry veteran, including business, product, and project development; strategic planning; government relations; and legal management. He has 23 years of experience in business and legal positions with private and public companies including GE, mid-market, and start-ups; and 10 years as an attorney. Fellow engineer Curt Kirkeby, P.E., has over 40 years of utility experience, serving as technology strategist at investor-owned Avista and holds patents on multiple grid technologies. Consulting expert Chris Murray, J.D., has 20 years of “Beltway” experience, serving Congress and the Executive branch, supporting the Navy, and working for a utility. Consulting engineer Dave Ridley, E.E., has 15 years of experience in energy storage product development, including zinc, vanadium, lithium, CO₂, and sodium, particularly power electronics and controls. In addition to the expertise, experience, and capabilities of its people, CTS has developed an industry reputation for getting things done.

Capability Background: CTS commenced its work for energy storage system and subsystem developers in 2018. The developers including LDES companies are as follows: • Hotstart (liquid thermal management for lithium-ion)

- Advanced Rail Energy Storage (gravity mechanical)
 - Invinity (vanadium flow)
 - BioZen (organic flow)
 - CMBlu (organic solid flow)
 - Stryten (vanadium flow)
 - EarthEn (CO₂ mechanical and thermal)
 - Inlyte (sodium metal)
- Current efforts by CTS include negotiations with NTEL on an FOA 3020 award to CTS for “Pre-Competitive Research & Development to Accelerate the Maturation of Flow Battery Technologies into Cost-Effective Long Duration Energy Storage” for \$5M, with \$1.25M cost-share from the seven members of the Flow Battery Industry group (FBIG). Preceding the FOA, CTS proposed the creation of FBIG to a U.S. national laboratory, and collaborated with flow battery developers and other stakeholders to establish FBIG as a part of the long-standing Battery Council International (BCI) trade association.

Critical Inputs Required from Recipient: CTS inputs required from each Recipient: (1) company information (formation date and jurisdiction, business location(s), staffing number and backgrounds); (2) LDES product information (technical specifications, technology readiness level (TRL), manufacturing readiness level (MRL), competitive comparisons); (3) descriptions of deployed LDES pilot or demonstration projects; (4) LDES productization roadmap (to date and future); (5) go-to-market timeline (to date and future); (6) current business plan; and (7) proposed scope of work by CTS on Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support tasks to accelerate the development and maturation of the Recipient’s LDES.

Geographic Constraints for Capability: CTS can provide its services on energy storage business matters – including LDES market assessment, business planning, and commercialization strategy; and technical matters – including LDES technical modeling analysis and performance evaluation - anywhere in the United States. The CTS team is located in the State of Washington and the Washington, D.C. area. CTS also has an extensive network of further energy storage experts, including on LDES, around the U.S. that it can partner with as needed for tasks for VO7 Recipients. In addition, CTS works closely with U.S. national laboratories located throughout the country, on energy storage including LDES.

CleanTech Strategies LLC, “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)

CleanTech Strategies LLC, “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)

Provide any other critical details that may help with matching (including equipment specifications where appropriate): CTS is committed to identify and accomplish collaboratively the strategic objectives of each energy storage company it serves, including U.S. for-profit companies which are currently developing and/or manufacturing LDES technology.

How many weeks capability will take: 16

Midpoint Milestone Description: Completion of analysis of work done to date, advice on work to be accomplished, and agreement on milestones.

Final Milestone Description: Completion of delivery of CTS’ written work products to VO7 Recipient, and discussion of them by VO7 Recipient and CTS.

CleanTech Strategies LLC, “LDES Market Assessment Support, Business Plan Formulation, and Commercialization Strategy Support from Subject Matter Experts CleanTech Strategies” (VO7-25)

Feldhake Consulting LLC Manufacturing Analysis (VO7-26)

<https://fconsult.llc/>

Applicable Technology Area(s):

Compressed-Air Energy Storage (CAES)

Mechanical (Other)

Other

Batteries (Other)

Type of Technology: Developing several energy storage, conservation and capture solutions that could enhance new LDES solutions. Current solutions range from TRL 3 to 7 and involve CAES, Flywheel Energy (FES) and Supercapacitor battery systems.

Capability Title: Manufacturing Analysis

Capability Summary: As an engineering professional for over 30+ years, Mr. Feldhake has specialized in manufacturing, engineering, and software development and was a Voucher Provider for round 1 of the VO1 program. He has worked with Fortune 500 companies such as MillerCoors, Anheuser Busch, Peabody, Owens Corning, Chrysler, and Boeing. Specializing in power, process optimization, advanced instrumentation integration, Process and Machine Safety, and project development, Michael has many years of experience developing solutions involving new technologies, power electronics, communications, and AI/ML components. Feldhake Consulting LLC's expert level of manufacturing and process development can provide your team with an excellent road map for moving a product or solution concept to market. Our analysis can look at the supply chain availability matrix, technology spectrum, current state-of-the-art manufacturing processes, plant models, and other factors to provide a comprehensive report on available approaches to go to market.

Capability Core Competencies: CORE COMPETENCIES: Project Development with a focus on Return on Investment (ROI) solutions. Specializes in Case Studies and manufacturing analysis for new ideas that include models, schedules, costs, and detailed scopes of work. Expert level in other areas that include Instrument integration, process, mechanical and electrical engineering, Process Safety Analysis (PSA), machine safety, and process optimization. Software development experience includes; plant floor, communications, AI/ML, cloud, desktop applications, database development, and modeling. Industry experience with and Patent Holder of mature AI/ML technology. DIFFERENTIATORS: Expertise in understanding the concerns of stakeholders, Solid track record of successful projects in multiple industries, Expert level in Power Distribution, Instrumentation, Software, AI/ML Tools.

Capability Qualifications and Credentials: Feldhake Consulting LLC is made up of a 30-plus-year veteran with a vast network of engineering, legal, supply chain, software, manufacturing, and testing companies. As needs arise, Mr. Feldhake can leverage this network to ensure that the right resources are providing exceptional work products. Feldhake Consulting LLC is also certified VOSB.

Capability Background: Just completed work as part of Voucher Provider (VO1) for a Hydrogen Startup. Completed many case studies ranging from \$100K - \$40M involving many different industries, manufacturing, and processes coordinating multi-disciplined teams. Completed several laboratory projects, including upgrading a large wind tunnel complex's control scheme and environmental test chamber. Completed initial conceptual design of large brewery permanent power diesel-to-electric generator sets, including fuel and power distribution system. Completed assessment of a wastewater facility and conducted testing and analysis to determine the next steps to improve operations. Completed manufacturing solution for a new high-speed line that reduced waste and increased operational pace for a medical device.

Critical Inputs Required from Recipient: Diagrams, part specifications, and descriptions of the product. Access to current supplier information. Current and future development plans, Information on production timeline, and annual demand forecast. Stakeholder participation during initial kickoff and planned review meetings and a minimum of 1 POC to work with on a regular cadence.

Geographic Constraints for Capability: No constraints within CONUS. Alaska and outside CONUS, including territories of the US, may involve additional costs for travel if required.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Please see our website at these locations: 1) <https://fconsult.llc/publications> 2) <https://fconsult.llc/hybrid-energy-systems>. Also in the above section labelled 'Applicable Technology Area(s):' it only lists the area appropriate for our concepts. We are experienced in all of those areas and more.

How many weeks capability will take: 10

Midpoint Milestone Description: Initial Manufacturing Analysis

Final Milestone Description: Final Project Report and recommended next steps

Ridgeline Strategy LDES go-to-market, dispatch, and remuneration strategy (VO7-27)

www.ridgelinestrategy.com

Applicable Technology Area(s):

Flow Batteries

Compressed-Air Energy Storage (CAES)

Mechanical (Other)

Thermal Energy Storage

Other

Type of Technology: Ridgeline Strategy specializes in non-battery long-duration energy storage.

Capability Title: LDES go-to-market, dispatch, and remuneration strategy

Capability Summary: Market remuneration structures for LDES technologies are not yet mature. As a result, technology developers have been “skating towards where the puck is going” for the past 20 years. Assumptions around project remuneration, risk structures, and market evolution have been necessary, but have resulted in optimization around long-term metrics at the expense of near-term deployability. Triangulation between fractured market requirements and needed capabilities has led to more broadly applicable productized solutions that cannot overcome first-of-a-kind project cost requirements. This project will assess the Voucher Recipient’s technology capabilities against beachhead market opportunities and identify specific product-customer-project structures to overcome first-of-a-kind barriers. In phase 1, Ridgeline Strategy will (1) assess the Voucher Recipient’s technology capabilities and cost vs. performance vs. risk tradeoffs and (2) enumerate possible applicable beachhead markets and the required assessments to validate those market entry points. In phase 2, Ridgeline Strategy will (1) perform the beachhead market assessments identified in phase 1, (2) engage beachhead market customers/offtakers to validate market entry point assumptions, and (3) recommend a specific product-customer-project structure with the highest apparent likelihood of successful FOAK project.

Capability Core Competencies: Ridgeline Strategy (a trade name of BRBOLLINGER LLC) was formed in May 2023 to provide strategic consulting to venture-backed startups in the tough-tech and clean-tech sectors. Ridgeline Strategy’s expertise is seamlessly integrating and unifying strategic planning across corporate, fundraising, staffing, and technology scaling/ demonstration goals and supporting this with underlying technical expertise. Ridgeline Strategy’s technical expertise—spanning, among other things, systems engineering, product development processes, technical design reviews, hazard analyses, use-case-driven requirements definition, modeling and simulation, technoeconomic assessments, and technical feasibility assessments—enables us to home in on the underlying technical risks and execution paths that impact successful technology scaling and demonstration. Ridgeline Strategy’s founder, Ben Bollinger, has worked on LDES project structure, risk profiles, and compensation schemes in both deregulated and regulated markets in the US and overseas.

Capability Qualifications and Credentials: Ridgeline Strategy’s founder and principal, Ben Bollinger, holds a Ph.D. in Engineering Sciences from Dartmouth College and has spent the past 16 years leading engineering at three separate venture-funded startup companies, including one as co-founder and employee #1. Two of the three were LDES companies: SustainX (isothermal compressed air) and Malta (heat pump thermal energy storage). He has pitched investors, won government grants, scaled multiple technologies from bench-top to engineering-scale to commercial scale, and built teams with a mentality of we’re all in this together. He has been integrally involved in nine venture-capital fundraising processes on the technology company side of the table and two on the VC side of the table. At Ridgeline Strategy, Ben leverages those experiences to help companies avoid potential pitfalls and lay out

Ridgeline Strategy, LDES go-to-market, dispatch, and remuneration strategy (VO7-27)

successful paths to commercialization. Ben has worked in the LDES industry since 2007 and is familiar with multiple worldwide electricity market structures.

Capability Background: At prior roles, Ridgeline Strategy's founder and principal, Ben Bollinger, has performed or led the following relevant activities: • DOE-funded efforts to assess the repowering of fossil plants as LDES plants

- Project application engineering for hybrid LDES and industrial heat project evaluations
- Customer/offtaker use case assessments and translation to LDES system requirements
- LDES and industrial heat competitive landscape assessments
- System operation and dispatch assessments and controls design and propagation to system performance and cost requirements

Critical Inputs Required from Recipient: Voucher recipients will need to provide Ridgeline Strategy with the following information in whatever extent that it exists: • Concept of operations documents • Design cost and performance trades studies • Performance metrics • Target long-term and short-term market applications and stakeholder requirements • Derived system requirements and system cost • Technology and scale-up risk assessments

Geographic Constraints for Capability: Ridgeline Strategy will perform this voucher service at its office site in the Greater Boston Area and interface with the Voucher Recipient remotely. For Voucher Recipients in the Greater Boston Area, Ridgeline Strategy will meet with recipients at their site for portions of the project.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): This capability is best suited to LDES technology companies who have not yet progressed beyond simple one-full-charge-discharge-cycle-per-day assumptions.

How many weeks capability will take: 16

Midpoint Milestone Description: Interim report delivery: assessment of Voucher Recipient's technology and options and enumeration of possible beachhead markets and their required validation.

Final Milestone Description: Final report delivery, including recommend product-project-customer structure for FOAK deployment.

Ridgeline Strategy Operability Design and Design for Commissioning and Testing (VO7-28)
ridgelinestrategy.com

Applicable Technology Area(s):

Compressed-Air Energy Storage (CAES)

Mechanical (Other)

Thermal Energy Storage

Other

Flow Batteries

Type of Technology: Ridgeline Strategy specializes in non-battery long-duration energy storage.

Capability Title: Operability Design and Design for Commissioning and Testing

Capability Summary: Many LDES startups focus on first demonstrating their core innovation at steady-state. As designs scale for real-world deployment, however, additional operational use-cases become critical drivers of engineering design and can substantially drive system requirements. These use-cases include startup, shutdown, ramping, power loss, trip offline, subsystem commissioning, and others. Failure to account for these use-cases can result in equipment failure during commissioning or operation, resulting in substantially (and sometimes fatally) extended timelines. This project will assess the Voucher Recipient's technology scaling efforts and advance its design for operability, commissioning, and testing to ensure technology scaling deployment success. In phase 1, Ridgeline Strategy will (1) assess the Voucher Recipient's next generation system design status with a focus on concept of operations (CONOPS) and satisfaction of the design against stakeholder requirements, and (2) Advance the state of the CONOPS development to the next design level, including propagation to system, subsystem, and equipment requirements. In phase 2, Ridgeline Strategy will (1) assess the Voucher Recipient's current commissioning and test plans, and (2) advance the state of the commissioning and test plans to the next level, including propagation to both equipment requirements and automated control and fault response to enable low-risk commissioning.

Capability Core Competencies: Ridgeline Strategy (a trade name of BRBOLLINGER LLC) was formed in May 2023 to provide strategic consulting to venture-backed startups in the tough-tech and clean-tech sectors. Ridgeline Strategy's expertise is seamlessly integrating and unifying strategic planning across corporate, fundraising, staffing, and technology scaling/ demonstration goals and supporting this with underlying technical expertise. Ridgeline Strategy's technical expertise—spanning, among other things, systems engineering, product development processes, technical design reviews, hazard analyses, use-case-driven requirements definition, modeling and simulation, technoeconomic assessments, and technical feasibility assessments—enables us to home in on the underlying technical risks and execution paths that impact successful technology scaling and demonstration. Of particular importance for startup companies working on technology scaling demonstrations is smooth and mishap-free commissioning, testing, and operation, since the downside risk of mishaps and failures is so much larger for startups than for large companies.

Capability Qualifications and Credentials: Ridgeline Strategy's founder and principal, Ben Bollinger, holds a Ph.D. in Engineering Sciences from Dartmouth College and has spent the past 16 years leading engineering at three separate venture-funded startup companies, including one as co-founder and employee #1. Two of the three were LDES companies: SustainX (isothermal compressed air) and Malta (heat pump thermal energy storage). He has pitched investors, won government grants, scaled multiple technologies from bench-top to engineering-scale to commercial scale, and built teams with a mentality of we're all in this together. He has been integrally involved in nine venture-capital fundraising processes on the technology company side of the table and two on the VC side of the table. At Ridgeline

Ridgeline Strategy, Operability Design and Design for Commissioning and Testing (VO7-28)

Strategy, Ben leverages those experiences to help companies avoid potential pitfalls and lay out successful paths to commercialization.

Capability Background: At prior roles, Ridgeline Strategy's founder and principal, Ben Bollinger, has led all company systems engineering processes. These include:

- Concept of operations
- Requirements generation and justification
- Hazard and safety analyses (e.g. PHAs, FMEAs, ETAs)
- Mapping of hazard mitigation steps to design requirements, digital twin model requirements, startup checklists, subsystem test requirements, diagnostics, safety controls, etc.
- Implementation of automated diagnostics and control systems fault response to prevent mishaps during commissioning or due to operations edge cases.

Instrumentation uncertainty analyses At SustainX, these efforts led to the successful shortening of the commissioning timeline, achieving mechanical completion to full power operation within just three weeks. At Altaeros, these efforts led to the successful design and operation of the world's first autonomous-flight aerial cell tower.

Critical Inputs Required from Recipient: Voucher recipients will need to provide Ridgeline Strategy with the following information in whatever extent that it exists:

- Concept of operations documents
- Stakeholder and system requirements
- Equipment requirements
- Commissioning and validation plans
- Test plans and procedures
- Hazard analyses
- Performance metrics
- Performance metric calculations and instrumentation plans

Geographic Constraints for Capability: Ridgeline Strategy will perform this voucher service at its office site in the Greater Boston Area and interface with the Voucher Recipient remotely. For Voucher Recipients in the Greater Boston Area, Ridgeline Strategy will meet with recipients at their site for portions of the project.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): This capability is best suited for an LDES technology developer in the design phases of a system that is the first of its kind at that scale.

How many weeks capability will take: 20

Midpoint Milestone Description: Interim report delivery, including an assessment of and advancement of Voucher Recipient's operability design.

Final Milestone Description: Final report delivery, including an assessment of and advancement of Voucher Recipient's design for commissioning and testing.

Sandia National Laboratories Deployment Technical Support (VO7-29)

<https://energy.sandia.gov/programs/energy-storage/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: Deployment Technical Support

Capability Title: Deployment Technical Support

Capability Summary: Sandia National Laboratories can work with a potential LDES deployment team to provide technical assistance over the deployment process. This starts with preliminary analysis of potential use cases to help size the system. Next, the Sandia team can provide technical assistance in designing a request for proposals as well as in evaluating proposals. After a project has been selected, Sandia can provide technical assistance evaluating the performance before the system leaves the factory and provide guidance on best practices for commissioning. Once operational, Sandia can assess the dispatch profile to make sure that the system is providing maximum value to the owners and stakeholders.

Capability Core Competencies: Sandia National Laboratories is the lead lab for the DOE OE energy storage program and has decades of experience with energy storage deployments.

Capability Qualifications and Credentials: Information on the capabilities of Sandia's energy storage demonstration team can be found on the website: <https://energy.sandia.gov/programs/energy-storage/demonstrations-and-validation/>

Capability Background: Sandia provides technical assistance for the DOE OE Energy Storage for Social Equity (ES4SE) initiative (<https://www.energy.gov/oe/articles/energy-storage-social-equity-initiative>)

Critical Inputs Required from Recipient: Load profile data, utility rate structure for behind the meter applications, initial goals for the energy storage system, budget constraints.

Geographic Constraints for Capability: No geographic limitations

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 4

Midpoint Milestone Description: Develop RFP in collaboration with the recipient

Final Milestone Description: Energy Storage Commissioning

Sandia National Laboratories Battery Safety and Reliability Analysis (VO7-30)

<https://energy.sandia.gov/programs/energy-storage/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)

Type of Technology: Battery Safety and Reliability Analysis

Capability Title: Battery Safety and Reliability Analysis

Capability Summary: Sandia National Laboratories has unique capabilities for evaluating battery energy storage safety and reliability. For safety, Sandia has an explosive test facility, referred to as the Battery Abuse Testing Laboratory (BATLab) where cell and module level destructive testing can be performed to assess the safety of a new technology (<https://energy.sandia.gov/keycapabilities/facilities/batlab/>). For reliability, Sandia has battery testers dedicated to long term cycle life evaluation. Depending on the applicant's requirements, Sandia can perform safety and reliability assessments of a new energy storage technology. The final deliverable will be a Sandia technical report (SAND report).

Capability Core Competencies: The capabilities of the BATLab are summarized here:

<https://energy.sandia.gov/keycapabilities/facilities/batlab/> The capabilities of the Safety & Reliability team are found here: <https://energy.sandia.gov/programs/energy-storage/safety-and-reliability/>

Capability Qualifications and Credentials: The qualifications of the Safety & Reliability team members are found here: <https://energy.sandia.gov/programs/energy-storage/staff/>

Capability Background: Sandia is the lead laboratory for the DOE OE energy storage program and has developed unique safety and reliability testing capabilities. As a national security laboratory, Sandia is also able to leverage facilities developed for national security missions (e.g., explosive test facilities capable of performing experiments on a wide range of energy storage technologies and sizes),

Critical Inputs Required from Recipient: Type of technologies they would like to evaluate, guidance on the focus (safety, reliability, or both), and samples of the technology for test (e.g., cells or modules)

Geographic Constraints for Capability: No geographic constraints except that the technology samples will be tested at the Sandia Albuquerque site.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 4

Midpoint Milestone Description: Develop test plan

Final Milestone Description: Deliver test results

Sandia National Laboratories Energy Storage Valuation (VO7-31)

<https://energy.sandia.gov/programs/energy-storage/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Mechanical (Other)
Compressed-Air Energy Storage (CAES)
Thermal Energy Storage
Other

Type of Technology: Energy Storage Valuation

Capability Title: Energy Storage Valuation

Capability Summary: Perform an assessment of potential value streams for a proposed long duration energy storage project. For market areas, this would include an optimization analysis of different market products (e.g., day ahead energy, day ahead ancillary services, etc.). For a vertically integrated utility, this will focus on operational cost savings that might be achieved by deploying the proposed long duration energy storage system. The assessment can also include an analysis of different sizes/configurations to help identify the required system size to meet the desired goals most economically. Different types of resilience/reliability analysis can be included if that is a priority. The final deliverable will be a presentation and a Sandia Technical report (SAND report).

Capability Core Competencies: Sandia National Laboratories is the lead laboratory for the DOE OE energy storage program and has significant experience performing techno-economic analysis of energy storage projects. A list of related publications can be found on the website (www.sandia.gov/ess). This includes the development of an open-source Python tool, QuEST, for making energy storage decisions which is available on github.

Capability Qualifications and Credentials: The Sandia energy storage analytics team consists of ~13 staff members, most with Ph.D.'s, and years of energy storage analysis experience (<https://energy.sandia.gov/programs/energy-storage/analytics/>).

Capability Background: Examples of recently completed efforts:

- (a) Picuris Pueblo, <https://doi.org/10.2172/1893291>
- (b) Levelock, Alaska, <https://doi.org/10.2172/2005374>
- (c) 2023 IEEE PES GM paper, R. D. Trevizan, T. A. Nguyen, A. F. Bastos, H. Guan, S. Atcitty and A. J. Headley, "Data-Driven Techno-Economic and Resilience Analysis of Community Energy Storage," 2023 IEEE Power & Energy Society General Meeting (PESGM), Orlando, FL, USA, 2023, pp. 1-5, doi: 10.1109/PESGM52003.2023.10253460.

Critical Inputs Required from Recipient: Historical load data, rate structure information for behind the meter applications, production cost modeling data for vertically integrated utility applications.

Geographic Constraints for Capability: There are no geographic constraints.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 4

Midpoint Milestone Description: Presentation of preliminary results

Final Milestone Description: Final presentation and delivery of technical report

Octet Scientific, Inc., Battery electrolyte optimization: New and better additive chemistry (VO7-32)

Octet Scientific, Inc. Battery electrolyte optimization: New and better additive chemistry (VO7-32)

<https://www.octetsci.com>

Applicable Technology Area(s):

Flow Batteries

Lead-acid Batteries

Zinc Batteries

Batteries (Other)

Thermal Energy Storage

Type of Technology: We boost battery performance by optimizing electrolyte chemistry, particularly by applying novel organic additives.

Capability Title: Battery electrolyte optimization: New and better additive chemistry

Capability Summary: We work closely with battery developers and manufacturers to find electrolyte additive chemicals and formulations that optimize battery performance. We have been able to achieve a variety of measurable improvements with our current customers including: capacity increases up to 25%, cycle-life improvements of 100% or more, and reductions in gassing of more than 60%. We apply our collection of nearly 300 (and growing) new organic electrolyte additives to find an optimal condition while working in close collaboration/iteration with our customer partners. At the end of the voucher project, we provide the battery manufacturing customer with an electrolyte formulation and materials that will unlock hidden performance potential in their energy storage product.

Capability Core Competencies: We are the aqueous electrolyte experts, having already created six new patent families and nearly 300 candidate molecules for zinc, iron, lead, and other water-based battery technologies. With roots in the electroplating industry, our company commands a unique position in the aqueous battery field by being the first company dedicated to developing and scaling novel electrolyte additives specifically for water-based batteries. No other company designs, creates, tests and produces new additives for this promising class of safe and sustainable energy storage technology.

Our methods have proven to create substantial value for our customers by bringing big performance improvement from an add as simple as a low-concentration "drop-on" electrolyte additive. We work closely with our customers to develop/apply additives that we can be sure will translate performance to their cells and bring substantial improvement and significant value. We have the ingredients for your perfect battery.

Capability Qualifications and Credentials: New Electrolyte Additive Molecules: We design, synthesize, and analyze organic molecules for use as battery electrolyte additives. We have full synthetic wet lab capabilities to create and modify novel molecules for this purpose. We have access to NMR, GC-MS, FTIR, and various forms of chemical analyses. We also have manufacturing partners to scale new molecules to production volumes of 100,000 kg/yr or more. Testing Capability: To verify performance we have a wide range of electrochemical analyses available including high frequency EIS, CV, Potentiometry, Temperature controlled cells, Hull cells, Corrosion analysis, and Gassing tests. We also can fabricate coin cells and have temperature controlled cyclers to test them, over thirty high-precision channels. Materials Metrology: Through our partnerships with local universities, we can also perform high precision materials analysis such as SEM, XRD, XPS and AFM.

Octet Scientific, Inc., Battery electrolyte optimization: New and better additive chemistry (VO7-32)

Octet Scientific, Inc., Battery electrolyte optimization: New and better additive chemistry (VO7-32)

Capability Background: We have worked with over 30 battery manufacturers around the world to test and iterate our products into their batteries. Though strictly bound by thorough NDAs, we can say that we have seen customer data to confirm that our electrolyte additives have increased battery capacity by 25% (with an addition of < 2 wt% of our product to the electrolyte) in one case, extended life cycle by more than 100% in another, and reduced cell gassing by 67% in a third (with an addition of our product of less than 0.1 wt%).

Also, we are currently piloting with a large battery manufacturer in the US and expect two more pilots later in 2024.

Critical Inputs Required from Recipient: Voucher recipients are expected to disclose their desired base electrolyte formulation recipe; identify their anode, cathode and separator materials; and provide Octet with desired battery performance goals. If voucher recipients utilize any unique or proprietary materials in their battery (e.g. a specialty-made anode), we would request the recipient to share that material for testing, if possible. We would also ask that voucher recipients engage in biweekly or monthly progress report meetings to keep the work focused and efficient.

Geographic Constraints for Capability: Our facilities are in Cleveland, OH, but we can work with companies from anywhere in the US or the world.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): We cannot work with non-aqueous batteries (i.e. lithium-ion). We can only work with water-based electrochemical systems.

How many weeks capability will take: 2

Midpoint Milestone Description: Evaluation testing protocol set between Octet and Voucher Recipient, and first successful baseline data is collected.

Final Milestone Description: Electrolyte Additive Samples and formulation details are transferred from Octet to Voucher Recipient for testing in Recipient batteries.

UL Fire and Combustion Laboratories at Case Western Reserve University , In-Situ Gas Analysis during Thermal Runaway and Fire of Lithium-Ion Batteries (VO7-33)

UL Fire and Combustion Laboratories at Case Western Reserve University In-Situ Gas Analysis during Thermal Runaway and Fire of Lithium-Ion Batteries (VO7-33)
<https://engineering.case.edu/research/labs/computational-fire-dynamics>

Applicable Technology Area(s):

Lithium-ion Batteries

Type of Technology:

Capability Title: In-Situ Gas Analysis during Thermal Runaway and Fire of Lithium-Ion Batteries

Capability Summary: We perform tests to collect time-resolved data on various parameters of LIBs before, during, and post-thermal runaway of Lithium-ion battery (LIB) cells. In each test, a LIB cell will be conditioned to a desired state-of-charge (SOC) and placed in an environmental chamber (volume ~ 600 L). The LIB cell is then forced into thermal runaway by an electrical heating tape at a constant heating rate. The chamber is connected to a FTIR gas analyzer for real-time concentration measurements. Camcorders are used to record the major events such as cell venting, thermal runaway, and subsequent burning process. Thermocouples are used to monitor the surface temperatures of the cell. The real-time mass and voltage of the cell are also recorded. With the data obtained, cell pseudo-properties, venting gas compositions, and venting mass rate can be deduced as functions of cell temperature and cell SOC. The collected data can be used to evaluate and improve the safety of the LIB cells. They can also be used to guide the Research and Development of safer new LIB cells.

Capability Core Competencies: The UL Fire and Combustion Laboratories at CWRU uses numerical modeling and experimentation to study basic fire science and fire dynamics in specific situations (e.g., forests) or in situations with unique chemistry (e.g., lithium-ion batteries). By combining the capabilities experiments with numerical modeling, our lab explores various fire phenomena and proposes new theories and correlations in fire dynamics. Our research has been supported by various funding agencies including NSF, NASA, CASIS, Lubrizol, and UL.

Capability Qualifications and Credentials: The UL Fire and Combustion Laboratories at CWRU is a 2,200 square feet laboratory. It contains the following equipment: cone calorimeter, smoke density chamber, micro-combustion calorimeter, Fourier Transform Infrared Spectroscopy (FTIR) gas analyzer, Thermal Protective Performance (TPP) tester, analytical balances, generator, fume hoods, various environmental chambers, and high-pressure gas supply systems. Imaging equipment includes infrared (FLIR) cameras, high-definition video camcorders, and SLR digital camera. Laser diagnostics include two planar laser-induced fluorescence (PLIF) systems, particle image velocimeter (PIV), Nd-YAG lasers, dye lasers, optical tables, a wide range of optics and optic mounts, and data acquisition systems. In addition to the UL Fire and Combustion Laboratories, we have access to the Thermal Analysis Laboratory in the Center for Advanced Polymer Processing at CWRU. The Thermal Analysis Laboratory features a suite of TA Instruments including thermal equipment (DMA, DSC, TGA, and rheometer).

Capability Background: Our lab worked with the UL Electrochemistry Safety Research Institute to develop this proposed test capability between 2021 and 2023. During our collaboration, we performed single-cell tests on various 18650 cylindrical cells and pouch cells. We also performed tests to study thermal runaway propagation between two LIB cells. In addition, we have on-going research collaboration with Lubrizol to study gas release of LIB immersed in different Battery Thermal Management Fluids.

Critical Inputs Required from Recipient: The voucher recipients will provide the LIB cells to be tested.

UL Fire and Combustion Laboratories at Case Western Reserve University , In-Situ Gas Analysis during Thermal Runaway and Fire of Lithium-Ion Batteries (VO7-33)

UL Fire and Combustion Laboratories at Case Western Reserve University , In-Situ Gas Analysis during Thermal Runaway and Fire of Lithium-Ion Batteries (VO7-33)

Geographic Constraints for Capability: We will be able to provide the service anywhere in the country. The work will be done in our facility at Case Western Reserve University.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Currently, we can only perform tests at cell level. We cannot perform tests on battery packs or battery modules.

How many weeks capability will take: 4

Midpoint Milestone Description: Perform 20 tests and deliver the data to the voucher recipient.

Final Milestone Description: Perform additional tests when needed. Work with the voucher receiver on data analysis and quantify safety performance of tested cells.

Grand Summit Group, LLC Product Commercialization and Launch Support Package (VO7-34)
<https://www.grandsummit.co/>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: Any LDES technology that consists of physical hardware that must be manufactured.

Capability Title: Product Commercialization and Launch Support Package

Capability Summary: The proposed Product Commercialization and Launch Support Package will provide a set of detailed research, analysis, and custom strategies to a LDES technology innovator to ensure their commercial success upon entry into the market. The scope will include five report deliverables consisting of a Customer Needs, Wants, and Requirements Assessment; a Product Economic and Pricing Assessment; a Product Cost Assessment; a Product Validation and Certification Strategy; and a Product Supply Chain Strategy. The goal of this package is to: Aide the client to document customer wants, needs, and requirements for the product to inform continued design development and validation plans. Evaluate product and project economics to analyze how the client product impacts overall project economics factoring in price, performance, and O&M impacts. Generate a costed Bill of Materials including key component cost-volume curves, and identify opportunities to reduce cost of goods sold. Develop a certification program plan that identifies what testing should be performed at what stage of product development. Create a customized Supply Chain strategy resulting in capital efficient manufacturing scale up. A detailed breakdown of the package scope and estimated effort has been included in the attached Work Sample document for more information.

Capability Core Competencies: Grand Summit Group offers expert consulting services to technology innovation companies to help them get from a lab prototype to a commercial product working in the field. We guide companies through the final leg of commercial product development, ensuring that all customer requirements are understood with a validation and certification plan in place. We provide detailed product pricing and cost of goods sold (COGS) analysis and improvement to help companies plan for economic success of their product. We identify critical manufacturing processes and vendors required to produce the product, and develop supply chain strategies that are capital efficient and appropriate for the stage of scale up. Finally, we help companies execute on project development activities unique to deploying first of a kind technologies into a demonstration project environment. This suite of expertise is critical to assuring success at even the earliest phases of technology development.

Capability Qualifications and Credentials: Peter Ciulla, founder and principal partner of Grand Summit Group, has over 20 years of experience in hardware product development, transition to production, and product deployment. For the first decade of his career, Peter worked for several Fortune 500 multi-industry product manufacturing companies like Textron and ITT where he worked as both a hardware engineer and as a Lean Six Sigma Black Belt. For the next decade, Peter has worked with

Grand Summit Group, LLC, Product Commercialization and Launch Support Package (VO7-34)

Cleantech companies such as eSolar, Heliogen, and CarbonCapture develop and launch multiple innovative products. Prior to consulting, Peter has been a founding team member at a startup with a multi-billion dollar exit, an executive team member, and a founder & CEO. For several years, he has worked as an industry reviewer of DOE grants, and has a Masters of Science in Mechanical Engineering from UC San Diego.

Capability Background: We have helped many organizations including eSolar (SCS 5 Heliostat), Heliogen (PV Booster, Heliogen Heliostat), CarbonCapture (Direct Air Capture Machine), and Continuum Renewables (LDES Product) achieve success on their product development journey from early technology to commercially deployed product. Our most recent work and perhaps most relevant is a current engagement with CarbonCapture to perform a detailed Design to Cost analysis with the goal of fully defining and optimizing near term cost of goods sold. Despite the differing technology of each company, the framework for requirements definition, project modeling, cost of good sold analysis, validation planning, and supply chain strategy remains consistent and is our core competency. All of the tasks proposed in this package have been implemented successfully for these companies' projects and are "tried and true."

Critical Inputs Required from Recipient: For the project to be successful, we will need from the recipient any background information from customer discovery, market requirements, technology performance, and project economics. Any gaps will be filled as a part of the proposed scope. Additionally, we will need enough information about the technology to create a detailed Bill of Materials with at least a conceptual description of each major component for cost estimation.

Geographic Constraints for Capability: Located in the Los Angeles region of California, Grand Summit Group has worked effectively with clients across the US and globally. By leveraging a suite of remote collaboration tools (including Microsoft Teams, OneDrive, and SharePoint), we are confident that we can effectively service clients throughout the US. Additionally, our Pacific home time zone enables easy coordination with both Eastern time zones and the further west time zones of Alaska and Hawaii.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Our best fit client would be a company with a highly innovative technology that would benefit from a deeper understanding of customer and market requirements, project economics, product costs, product validation and certification, and supply chain strategies.

How many weeks capability will take: 24

Midpoint Milestone Description: Completion of the Customer Needs, Wants, and Requirements Assessment and Product Economic Pricing Assessment.

Final Milestone Description: Completion of the Product Cost Assessment, the Product Validation and Certification Strategy, and the Product Supply Chain Strategy.

Turbine Monitoring and Support Services, LLC Technology Risk Assessment (VO7-35)
turbineologic.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: Identify integration risks and mitigation activities for LDES technology

Capability Title: Technology Risk Assessment

Capability Summary: Technology landscapes today are filled with innovations that, while technically advanced in isolation, face integration challenges in broader systems. Our service addresses these integration challenges. Recognizing that individual technology readiness levels (TRLs) are not comprehensive indicators of system-wide performance, we offer detailed assessments that delve beyond TRLs. The result of this assessment is a score of the Technology, Integration, and System Readiness Levels of the technology with respect to integration in a target system. This provides an assessment matrix which is used to identify key development and integration risks that are often not identified in early technology development. LDES technologies rely on integration. A final result is a itemized, detailed set of integration and development risks along with recommended risk reduction activities. Process: Initial Consultation: Review current models, identify technology and integration assumptions, and establish the scope of the assessment. Engage directly with technology developers, investors, and potential users to grasp challenges, expectations, and risks. Conducting the Assessment: Evaluate design, manufacturing, controls, and testing and evaluation facets of the technology. Feedback and Iteration: Refining the assessment to ensure all concerns are addressed. Final Report & Recommendations: Deliver technology assessment report.

Capability Core Competencies: Turbine Logic is a specialized engineering consulting firm with a focus on total power plant monitoring and diagnostics. Our core competencies encompass: Digital Twins including Physics-based Model Design, Construction, and Auditing Technology Assessment and Impacts Modeling Direct Monitoring Engineering Consulting Custom Software & Monitoring Solutions Development Gas Turbines Energy Storage Systems Thermal Energy Storage Chemical Energy Storage Lithium Ion Batteries Hydropower/Pumped Storage Hydro Photovoltaics (PV)Hydrogen and Alternative Fuels Combustion Our expertise lies in a comprehensive grasp of energy systems, with a strong foundation in modeling, simulation, and technological advancement. We prioritize understanding client requirements and have the ability, as a smaller entity, to adjust project scopes dynamically.

Capability Qualifications and Credentials: Our team brings to the table decades of cumulative experience in modeling, simulation, and technological innovation within the energy systems arena. Our personnel have prior experience developing models and state-of-the-art hardware for organizations such as NASA, the FAA, the DOE, and an array of leading OEMs in the aerospace and energy sectors.

Capability Background: Our team has a proven track record in developing digital twins for monitoring and predicting performance across various energy sectors, including gas turbines, PV, wind, aerospace, renewables, and hydropower, including hybrid storage technology assessments. Our models are designed to predict system health and overall performance, characterizing the total system efficiency, charge and discharge rates, and any associated emissions. Our professionals have leveraged digital twins for technological impact modeling for organizations like NASA, the FAA, and the DOE.

Critical Inputs Required from Recipient: Our assessments can be performed for any energy storage technology in conjunction with any existing asset.

Geographic Constraints for Capability: This service is available nationwide, covering the entire US.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Our assessments can be performed for any energy storage technology in conjunction with any existing asset.

How many weeks capability will take: 52

Midpoint Milestone Description: Initial Assessment – Meet to Close Gaps

Final Milestone Description: Deliver Final Model and Presentation on Its Use

Turbine Monitoring and Support Services, LLC, Parametric Remaining Life and Maintenance Prediction (VO7-36)

Turbine Monitoring and Support Services, LLC Parametric Remaining Life and Maintenance Prediction (VO7-36)
turbinelogic.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: Predicting remaining life and maintenance requirements using parametric means

Capability Title: Parametric Remaining Life and Maintenance Prediction

Capability Summary: Our Life Prediction Service utilizes collected data to model life and associated risks of failure for LDES devices. Taking advantage of Bayesian statistics and traditional life prediction approaches, we accurately predict energy storage system lifetimes and financial risks of failure while accounting for uncertainty in new systems development. The service also helps to understand the impact of various unit metrics on system lifetime by using them as covariates in the prediction modeling while incorporating probabilistic forecasting. This allows operators to push the limits of a specific system using common performance metrics as a basis for their life expectations. The modeling works well with both a wealth and shortage of historical data and can be set up to learn as field or test experience is gathered. Process: Initial Consultation: Review current technology & data collection approaches Failure History: Review failure history, beliefs on system lifetimes, financial costs of failure vs a regular maintenance event. Model Development: Create a life prediction model using the relative collected data and prior failure history. Feedback and Iteration: Add additional data to the model, refine the model to ensure all concerns are addressed.

Capability Core Competencies: Turbine Logic is a specialized engineering consulting firm with a focus on total power plant monitoring and diagnostics. Our core competencies encompass: Digital Twins including Physics-based Model Design, Construction, and Auditing Technology Assessment and Impacts Modeling Direct Monitoring Engineering Consulting Custom Software & Monitoring Solutions Development Gas Turbines Energy Storage Systems Thermal Energy Storage Chemical Energy Storage Lithium Ion Batteries Hydropower/Pumped Storage Hydro Photovoltaics (PV) Hydrogen and Alternative Fuels Combustion Our expertise lies in a comprehensive grasp of energy systems, with a strong foundation in modeling, simulation, and technological advancement. We prioritize understanding client requirements and have the ability, as a smaller entity, to adjust project scopes dynamically.

Capability Qualifications and Credentials: Our team brings to the table decades of cumulative experience in modeling, simulation, and technological innovation within the energy systems arena. Our personnel have prior experience developing models and state-of-the-art hardware for organizations such as NASA, the FAA, the DOE, and an array of leading OEMs in the aerospace and energy sectors.

Turbine Monitoring and Support Services, LLC, Parametric Remaining Life and Maintenance Prediction (VO7-36)

Turbine Monitoring and Support Services, LLC, Parametric Remaining Life and Maintenance Prediction (VO7-36)

Capability Background: Our team has a proven track record in developing digital twins for monitoring and predicting performance across various energy sectors, including gas turbines, PV, wind, aerospace, renewables, and hydropower, including hybrid storage technology assessments. Our models are designed to predict system health and overall performance, characterizing the total system efficiency, charge and discharge rates, and any associated emissions. Our professionals have leveraged digital twins for technological impact modeling for organizations like NASA, the FAA, and the DOE.

Critical Inputs Required from Recipient: Voucher recipients will need to provide the following information: System layout, Balance of plant details, Material and process flows information, Intended concept of operations, Functional performance data, Failure history of technology

Geographic Constraints for Capability: This service is available nationwide, covering the entire US.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Useful for anyone with uncertain life and maintenance characteristics

How many weeks capability will take: 52

Midpoint Milestone Description: Review First Model and Preliminary Studies

Final Milestone Description: Deliver Final Model and Presentation on Its Use

Turbine Monitoring and Support Services, LLC Digital Twin Creation Service (VO7-37)
turbinelogic.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: Creation of digital twin model

Capability Title: Digital Twin Creation Service

Capability Summary: Our Digital Twin Creation service specializes in crafting tailored physics-based Digital Twin System Models. These models offer insights into scaling issues, expected benefits, and how operations might perform under non-ISO or fault conditions. They also highlight the mechanical and financial impacts of integrating with existing assets. They can be used for ‘what-if’ scenarios, design decisions, operational monitoring, fault monitoring, and entitlement studies to predict customer impacts. With close ties to electric utilities, our models reflect real-world scenarios enriched by valuable customer feedback. Precision is our core strength, with digital twins consistently aligning within +/- 0.5% of real systems. Each project begins with a customized physics-based model, focusing on LDES and integrated power assets. We use probabilistic forecasting to deliver precise insights, particularly on carbon management and capacity expansion. Our collaborative approach is a hallmark of our service. Working closely with clients, we utilize available tests, data, and assumptions to ensure our digital twins are highly effective. These models can quantify the value of integrating existing assets and the grid, simulating usage scenarios and assessing the impact on current assets. Compatibility with operating conditions can also be evaluated.

Capability Core Competencies: Turbine Logic is a specialized engineering consulting firm with a focus on total power plant monitoring and diagnostics. Our core competencies encompass: Digital Twins including Physics-based Model Design, Construction, and Auditing Technology Assessment and Impacts Modeling Direct Monitoring Engineering Consulting Custom Software & Monitoring Solutions Development Gas Turbines Energy Storage Systems Thermal Energy Storage Chemical Energy Storage Lithium Ion Batteries Hydropower/Pumped Storage Hydro Photovoltaics (PV) Hydrogen and Alternative Fuels Combustion Our expertise lies in a comprehensive grasp of energy systems, with a strong foundation in modeling, simulation, and technological advancement. We prioritize understanding client requirements and have the ability, as a smaller entity, to adjust project scopes dynamically.

Capability Qualifications and Credentials: Our team brings to the table decades of cumulative experience in modeling, simulation, and technological innovation within the energy systems arena. Our personnel have prior experience developing models and state-of-the-art hardware for organizations such as NASA, the FAA, the DOE, and an array of leading OEMs in the aerospace and energy sectors.

Capability Background: Our team has a proven track record in developing digital twins for monitoring and predicting performance across various energy sectors, including gas turbines, PV, wind, aerospace,

Turbine Monitoring and Support Services, LLC, Digital Twin Creation Service (VO7-37)

renewables, and hydropower, including hybrid storage technology assessments. Our models are designed to predict system health and overall performance, characterizing the total system efficiency, charge and discharge rates, and any associated emissions. Our professionals have leveraged digital twins for technological impact modeling for organizations like NASA, the FAA, and the DOE.

Critical Inputs Required from Recipient: Voucher recipients will need to provide the following information: System layout, Balance of plant details, Material and process flows information, Intended concept of operations, Functional performance data

Geographic Constraints for Capability: This service is available nationwide, covering the entire US.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): At the end of the project, the following deliverables will be provided: Digital twin model and report of associated predictions on performance, emissions, impacts, and technical risk areas (i.e., which technology assumptions drive implementation risk).

How many weeks capability will take: 52

Midpoint Milestone Description: Preliminary digital twin model and report of associated predictions on performance, emissions, impacts, and technical risk areas.

Final Milestone Description: Digital twin model and report of associated predictions on performance, emissions, impacts, and technical risk areas.

Fedsprout, Partnering and Financing: Transition from Lab to Marketplace (VO7-38)

Fedsprout Partnering and Financing: Transition from Lab to Marketplace (VO7-38)

<https://www.fedsprout.com>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: All Energy Storage Technologies

Capability Title: Partnering and Financing: Transition from Lab to Marketplace

Capability Summary: Fedsprout offers a service focused on partnering and collaboration to facilitate the transition of a product to market. This includes identifying and establishing partnerships with key stakeholders such as suppliers, distributors, and strategic partners, and exploring opportunities for joint ventures, licensing, or other forms of collaboration. Additionally, Fedsprout leverages its artificial intelligence-based tool to develop a list of government and other funding opportunities and potential financiers, ensuring comprehensive support for the product's market entry and growth. This service provides biweekly reports on new funding opportunities as well as updated lists of financiers and introductions to these financiers.

Capability Core Competencies: Fedsprout identifies partners and collaborators for firms seeking to perform R&D and D&D activities. We also develop funding roadmaps for organizations seeking funding for R&D, D&D, and production of new technologies. Fedsprout provides Commercialization Assistance Planning (CAP) and Technical and Business Assistance (TABAs) support as part of SBIR/STTR projects. We also support large businesses with planning federally funded R&D and D&D activities for developing and commercializing technologies, including selecting manufacturing and demonstration locations and identifying rural and disadvantaged communities that can benefit, especially those where environmental justice issues prevail. We also support our clients in developing DEI, PIER, and CBP plans for DOE-funded projects.

Our team comprises experts from diverse backgrounds, including energy storage research, successful clean startup entrepreneurs, community engagement professionals, sustainability specialists, and former utility and municipality managers who have pioneered new energy technology deployments.

Capability Qualifications and Credentials: Fedsprout's expert team has Ph.D.s in energy storage, including electrochemical technologies, mechanical engineering, and chemical engineering. Our business commercialization experts possess MBAs. Our team has access to numerous subject matter experts and contacts outside our organization, including large organizations such as IEEE, EPRI, NRECA, CEATI, etc. We work with end users of long-duration energy storage systems and have contacts within utilities, charging station manufacturers, and vehicle manufacturers. We are also members of several associations and are familiar with financiers of energy technologies, including accelerators and banks. We have developed inhouse, proprietary tools for finding funding opportunities for our clients. This lets us gain insights into the best approaches to finance new technologies. We connect technology developers with users, which helps accelerate market adoption.

Capability Background: A few examples of past and current efforts include:

1. Assisting a BESS manufacturer to identify communities and funding opportunities to demonstrate new technology and repurpose brownfields.
2. We are assisting a foreign energy storage manufacturer in finding University research partners for new R&D initiatives. We are also helping them find funding opportunities to deploy their mature solutions and identifying communities and partners to positively impact disadvantaged communities.
3. We are helping a small business that is developing new technology for improving electric distribution reliability by finding partners and determining approaches such as licensing, joint ventures, and manufacturing. They were awarded a project under the ARPA-E GOPHURRS program.

Critical Inputs Required from Recipient: Do you have an idea what type of strategic partners would be best for commercializing your technology? Do you have an estimated idea of how much funding you will require to be able to start selling your product? What is the estimated timeframe for you to obtain funding? This service is useful if you are seeking funding within 3-12 months.

Geographic Constraints for Capability: We will assist with finding partners and collaborators only in the U.S. We will only find funding opportunities that are available in the U.S. and benefit the U.S. economy. We already provide our services across all U.S. states and have no restrictions of geographic location within the U.S.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Companies that are seeking to accelerate the deployment of their technologies through partnering and collaboration and through funding and financing opportunities can avail this service. Organizations that are specifically unfamiliar with the CBP pillars can learn and gain insights into how to ensure their technologies can make an equitable impact.

How many weeks capability will take: 4

Midpoint Milestone Description: Report describing potential partners. Biweekly reports covering relevant funding opportunities and financiers.

Final Milestone Description: Updated report describing potential partners. Biweekly reports covering relevant funding opportunities and financiers.

Fedsprout, Go to Market Strategy and Financial Projections: Transition from Lab to Marketplace (VO7-39)

Fedsprout Go to Market Strategy and Financial Projections: Transition from Lab to Marketplace (VO7-39)

<https://www.fedsprout.com>

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Lead-acid Batteries
Zinc Batteries
Batteries (Other)
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage
Other

Type of Technology: All Energy Storage Technologies

Capability Title: Go to Market Strategy and Financial Projections: Transition from Lab to Marketplace

Capability Summary: Fedsprout's comprehensive approach encompasses several key tasks to ensure successful deployment of energy storage assets. We will begin by identifying the most suitable marketing channels, to effectively reach the target audience. This may involve contacting and talking to experts in the field, industry organizations, and potential future users. We will determine the optimal distribution channels, whether through direct sales, online platforms, or strategic partnerships. Fedsprout will develop tailored marketing strategies and tactics, establish a pricing strategy, and create a detailed timeline for the product launch, covering pre-launch preparations, the launch itself, and post-launch activities. Additionally, we will provide proforma financial projections to facilitate informed decision-making and strategic planning. Through our structured methodology and expertise, Fedsprout aims to reduce risks, lower costs, boost investment, and accelerate the scalable deployment of the energy storage asset. We will provide a business plan that captures the work performed.

Capability Core Competencies: Fedsprout provides Commercialization Assistance Planning (CAP) and Technical and Business Assistance (TABAs) support as part of SBIR/STTR projects. We also support large businesses with planning federally funded R&D and D&D activities for developing and commercializing technologies, including selecting manufacturing and demonstration locations and identifying rural and disadvantaged communities that can benefit, especially those where environmental justice issues prevail. We also support our clients in developing DEI, PIER, and CBP plans for DOE-funded projects. Our team comprises experts from diverse backgrounds, including energy storage research, successful clean startup entrepreneurs, community engagement professionals, sustainability specialists, and former utility and municipality managers who have pioneered new energy technology deployments. Our approach involves employing the skillsets of our diverse team to ensure that our clients will succeed in planning their projects and creating new products that add significant value while simultaneously achieving federal agencies' objectives.

Capability Qualifications and Credentials: Fedsprout's expert team has Ph.D.s in energy storage, including electrochemical technologies, mechanical engineering, and chemical engineering. Our business commercialization experts possess MBAs. Our team has access to numerous subject matter experts and contacts outside our organization, including large organizations such as IEEE, EPRI, NRECA, CEATI, etc. We work with end users of long-duration energy storage systems and have contacts within

Fedsprout, Go to Market Strategy and Financial Projections: Transition from Lab to Marketplace (VO7-39)

Fedsprout, Go to Market Strategy and Financial Projections: Transition from Lab to Marketplace (VO7-39)

utilities, charging station manufacturers, and vehicle manufacturers. All of this combined allows us to gain insights into the best approaches for sales and marketing. We connect technology developers with users, which helps accelerate market adoption, and our contacts within the industry give us a realistic view of potential sales numbers.

Capability Background: A few examples of past and current efforts include:

1. We are assisting a foreign-based battery manufacturer in finding locations for demonstration and deployment in the U.S. We are also assisting them in finding partners for research and development. They would like to bring both technology and production into the US to help address supply chain issues for long-duration energy storage. This company has technology has significant advantages over the state-of-the-art and can make energy storage cheaper and more accessible.
2. Community benefits plan development: Multiple utility and business customers, including electric co-operatives nationwide and businesses seeking funding for R&D and D&D activities for clean energy and resilience initiatives.
3. Pipeline inspection and repair robot (DOE SBIR project): Performed market research, market sizing, competitive analysis, value proposition development, go-to-market strategy development, and generated proforma financial projections.

Critical Inputs Required from Recipient: Will you be licensing your technology, manufacturing, distributing, or retailing the product? If you will be licensing the technology, then this service may not be required. Is the goal of acquiring this service to obtain financing/funding? Is there specific outcomes or information that you will need as a result of this service that is more important for your fundraising goals?

Geographic Constraints for Capability: We will only develop sales and marketing strategies as it pertains to the U.S. Product launch will also be planned for the U.S. only. We already provide our services across all U.S. states and have no restrictions of geographic location within the U.S.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Companies that are seeking to accelerate their market adoptions and obtain realistic plans and projections while developing strategies around accessing these markets should consider our services. This is because we always engage industry and end users to develop plans. Organizations that are specifically unfamiliar with the CBP pillars can learn and gain insights into how to ensure their technologies can make an equitable impact.

How many weeks capability will take: 4

Midpoint Milestone Description: Report covering marketing channels, sales distribution channels, and pricing strategy

Final Milestone Description: Report covering launch timeline and financial projections

Fedsprout, Market Assessment: Transition from Lab to Marketplace (VO7-40)

Fedsprout Market Assessment: Transition from Lab to Marketplace (VO7-40)

www.fedsprout.com

Applicable Technology Area(s):

Lithium-ion Batteries
Flow Batteries
Batteries (Other)
Lead-acid Batteries
Zinc Batteries
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: All Energy Storage Technologies

Capability Title: Market Assessment: Transition from Lab to Marketplace

Capability Summary: Fedsprout will carry out a thorough market assessment to build confidence in the performance and demand for the long duration energy storage asset, thereby reducing risks, lowering costs, boosting investment, and speeding up scalable deployment. We begin by identifying potential customers and gathering their contact information, then develop and conduct a primary market research survey. The survey results will be summarized and used for further analysis. Additionally, we will identify and review secondary market research reports, purchasing one if necessary. A detailed market research report, including market sizing and segmentation with assumptions, will be created. A special emphasis will also be placed on identifying niche as well as markets that can positively impact disadvantaged communities. The competitive landscape will be assessed to pinpoint key players and strategies, and a SWOT analysis will identify strengths, weaknesses, opportunities, and threats. A value proposition report will be formulated based on market needs and competitive advantages. Finally, the product or service will be clearly defined based on our research and customer feedback. By leveraging our structured approach, we will achieve a comprehensive understanding of the market, ensuring strategic decision-making that significantly enhances the likelihood of successful deployment of the energy storage asset.

Capability Core Competencies: Fedsprout provides Commercialization Assistance Planning (CAP) and Technical and Business Assistance (TAB) support as part of SBIR/STTR projects. We also support large businesses with planning federally funded R&D and D&D activities for developing and commercializing technologies, including selecting manufacturing and demonstration locations and identifying rural and disadvantaged communities that can benefit, especially those where environmental justice issues prevail. We also support our clients in developing DEI, PIER, and CBP plans for DOE-funded projects. Our team comprises experts from diverse backgrounds, including energy storage research, successful clean startup entrepreneurs, community engagement professionals, sustainability specialists, and former utility and municipality managers who have pioneered new energy technology deployments. Our approach involves employing the skillsets of our diverse team to ensure that our clients will succeed in planning their projects and creating new products that add significant value while simultaneously achieving federal agencies' objectives.

Capability Qualifications and Credentials: Fedsprout's expert team has Ph.D.s in energy storage, including electrochemical technologies, mechanical engineering, and chemical engineering. Our business commercialization experts possess MBAs. Our team has access to numerous subject matter experts and contacts outside our organization, including large organizations such as IEEE, EPRI, NRECA,

Fedsprout, Market Assessment: Transition from Lab to Marketplace (VO7-40)

Fedsprout, Market Assessment: Transition from Lab to Marketplace (VO7-40)

CEATI, etc. We work with end users of long-duration energy storage systems and have contacts within utilities, charging station manufacturers, and vehicle manufacturers. All of this combined allows us to gain insights into the use cases for new technologies and the value proposition. We connect technology developers with users, which helps accelerate market adoption.

Capability Background: A few examples of past and current efforts include:

1. Pipeline inspection and repair robot (DOE SBIR project): Performed market research, market sizing, competitive analysis, value proposition development, go-to-market strategy development, and generated proforma financial projections.
2. Medium Voltage splice (ARPA-E GOPHURRS program): Performing market research, identifying collaboration partners, developing the value proposition
3. Navy undersea robot (for Nou Systems Inc.): Market research and analysis to identify dual-use applications, market sizing, and competitor evaluations culminating in a report.
4. Community benefits plan development: Multiple utility and business customers, including electric co-operatives nationwide and businesses seeking funding for R&D and D&D activities for clean energy and resilience initiatives.

Critical Inputs Required from Recipient: Do you have a good idea about the expected performance and functional features of your product that can be used to assess its value and competitiveness? For very early stage projects (TRL 1-3), this service may not be very useful if your proposed solution/specification/features will change significantly. Is the goal of acquiring this service to obtain financing/funding? If so, is there specific outcomes or information that is more important for your fundraising?

Geographic Constraints for Capability: We will only perform market research and assessment as it pertains to the U.S. We already provide our services across all U.S. states and have no restrictions of geographic location within the U.S.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Companies that are seeking to accelerate their market adoptions and discover niche markets while developing strategies around accessing these markets should consider our services. Organizations that are specifically unfamiliar with the CBP pillars can learn and gain insights into how to ensure their technologies can make an equitable impact.

How many weeks capability will take: 4

Midpoint Milestone Description: Market research report including primary and secondary market research results and market sizing and segmentation.

Final Milestone Description: Report on competition and SWOT analysis, value proposition, and product/service definition

Strategen Consulting Inc. Market Assessment and Commercialization Strategy (VO7-41)

<https://www.strategen.com/>

Applicable Technology Area(s):

Batteries (Other)
Zinc Batteries
Lead-acid Batteries
Flow Batteries
Lithium-ion Batteries
Pumped Storage Hydropower (PSH)
Compressed-Air Energy Storage (CAES)
Mechanical (Other)
Thermal Energy Storage

Type of Technology: This scope of work is relevant for any type of long duration energy storage technology.

Capability Title: Market Assessment and Commercialization Strategy

Capability Summary: The goals of this task are to define target application parameters, identify typical use cases, and determine target specifications for energy storage products, leveraging market research, technology and energy system expertise and primary interviews. For a specified geography and technology, Strategen will evaluate the current status of long duration energy storage (LDES) technology and market, identify and describe three to five use cases, and approximate the value and market size for the given use cases. Based on these results, Strategen will provide recommendations for the technology developer which will provide a commercialization strategy encompassing a marketing approach, stakeholder engagement, pathways to meeting regulatory requirements, and recommended focus areas (regions and use cases) for deployment.

Capability Core Competencies: Strategen is a globally connected, impact-driven consulting firm focused on providing innovative solutions and trusted guidance to navigate energy system transformation. We help our clients create bankable value propositions, business models, and supportive market structures that allow leading edge clean energy technologies to both compete and be fairly compensated for the full range of services provided. Strategen provides corporate strategy insight and market and regulatory intelligence that is actionable, forward looking, and customized to our clients' unique goals, objectives, and inherent competitive advantages. Our team has advised major Fortune 500 companies in identifying and validating strategic opportunities and developing winning long-term strategies. Our direct involvement in clean energy market transformation through management of several impactful associations- the Green Hydrogen Coalition, the Vehicle Grid Integration Council, and the California Energy Storage Alliance- affords us a vast network of connections that we leverage to inform our client's winning long-term strategies.

Capability Qualifications and Credentials: The Strategen team will be led by Jennifer Potter, a former Commissioner with the Hawaii Public utilities Commission and advised by Janice Lin, Strategen's CEO. Jennifer has a deep understanding of resource deployment, customer equity, and stakeholder perspectives. Janice co-founded the California Energy Storage Alliance in 2009, where she successfully served as Executive Director for ten years, growing the organization into the definitive voice for energy storage in the state and beyond with over 100 active members. Janice also co-founded and for seven years chaired the annual Energy Storage North America conference and expo, the only mission-driven and the leading standalone grid-connected energy storage event in North America. Strategen has also composed a robust support team of analyst-level staff to implement this scope of work guided by the in-

depth expertise of core, senior team members. Strategen will prioritize allocation efficiency via the use of lower cost resources when possible.

Capability Background: Strategen has extensive experience developing studies on energy storage. For example, Strategen has led the development of state level roadmaps on behalf of state energy offices including the Pennsylvania Energy Storage Assessment and the Virginia Energy Storage Study of which the goal was to provide recommendations for policymakers on ways to advance energy storage in the respective states. On behalf of our clients, Strategen has conducted detailed economic analysis of storage use cases, modeled the value proposition and potential market size for energy storage at different customer and grid locations across the country, both for behind-the-meter and in-front-of-the-meter applications, and synthesized this information into workshops, reports, and other outreach materials for diverse stakeholders, ranging from the general public to informed policy makers.

Critical Inputs Required from Recipient: To develop an effective market assessment and commercialization strategy, the following is required from our clients: 1) a defined geographic region for project focus; 2) a summary of the technology or product of focus; 3) if applicable, summary of community engagement conducted to date and relevant points of contact; and 4) at least 1 point of contact with decision-making ability to work with on a regular cadence.

Geographic Constraints for Capability: We can support projects in the continental US.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): N/A

How many weeks capability will take: 25

Midpoint Milestone Description: A detailed outline of the Market Assessment and Commercialization Strategy report with initial results and draft findings.

Final Milestone Description: Market Assessment and Commercialization Strategy report detailing priority use cases and markets to pursue.

CPFD Software, Barracuda Virtual Reactor Simulation, Validation, Testing and QuickStart (VO7-42)

CPFD Software Barracuda Virtual Reactor Simulation, Validation, Testing and QuickStart (VO7-42)
cpfd-software.com

Applicable Technology Area(s):

Lithium-ion Batteries
Thermal Energy Storage
Batteries (Other)

Type of Technology: Design and optimization of battery materials and technology for greater capacity and stability

Capability Title: Barracuda Virtual Reactor Simulation, Validation, Testing and QuickStart

Capability Summary: CPFD Software will work in conjunction with the voucher recipient to create high fidelity, three dimensional models of the chemical and thermal reactors used to develop battery materials, thermal energy storage, and associated technology. These models greatly assist in the design, scale up, optimization, and troubleshooting of battery manufacturing and recycling processes.

Capability Core Competencies: CPFD Software develops multiphase simulation software. Our flagship product, Barracuda Virtual Reactor, is a physics-based and GPU-accelerated engineering software package that simulates 3D, transient, fluid-particle hydrodynamics, heat balance, and chemical reactions in reactors and process units. This technology enables the digital twin and solves some of the most complex engineering challenges in energy, sustainability and industrial decarbonization.

Capability Qualifications and Credentials: Barracuda Virtual Reactor is an industry-standard tool for simulating the complex behaviors of multiphase processes. Our clients use simulation to effectively communicate technological capabilities and data to partners, customers and investors so they can deploy and scale with confidence. BVR has been used by scientists and researchers at national labs (including NETL, ORNL, INL, Sandia), industrial companies (such as Shell, Dow, GE, SK Innovation) and startups (such as Skeleton Technologies, SunGas Renewables, Aurora Hydrogen, Aloha Carbon). At the 2020 Hydrocarbon Processing Awards, Barracuda Virtual Reactor was named Best Software Technology. Our team has expertise in software development and process engineering, with a total of 270 years of industry experience.

Capability Background: Lithium-ion batteries are produced using a variety of manufacturing techniques, with fluidized bed technology playing a crucial role in certain stages. This technology is particularly effective in the production of cathode and anode materials, such as lithium iron phosphate and other lithium transition metal oxides, ensuring uniform particle size and high purity. Fluidized bed processes are also utilized for coating active materials, granulation, thermal energy storage, alternative battery materials, and in the heat treatment of materials. Barracuda Virtual Reactor, with its advanced capabilities in simulating fluidized beds, including multiphase chemical reactions, fluid dynamics, particle physics, and heat transfer, can effectively model these critical processes. Optimizing and scaling up the production of lithium battery materials and broader battery technology will ensure higher efficiency and performance in the final products, while bringing new technology to market faster at lower risk.

Critical Inputs Required from Recipient: We would need the following inputs from voucher recipients: initial design concept, material properties, process parameters and initial range of operating conditions;

CPFD Software, Barracuda Virtual Reactor Simulation, Validation, Testing and QuickStart (VO7-42)

CPFD Software, Barracuda Virtual Reactor Simulation, Validation, Testing and QuickStart (VO7-42)

physical test or operational data for overall model calibration and validation, when available; a workstation computer with an NVIDIA GPU (or access to cloud computing resources); and at least one primary user to receive software training and utilize the models created hereunder. Chemical reactions and suitable kinetics from lab-testing or literature are beneficial, but not strictly required.

Geographic Constraints for Capability: We have no geographic constraints. Our headquarters are in Houston, Texas, and we operate globally. We can provide this service to voucher recipients located anywhere in the US.

Provide any other critical details that may help with matching (including equipment specifications where appropriate): Our technology is best suited for processes that involve fluidized beds and/or gas-particle / liquid-particle systems.

How many weeks capability will take: 52

Midpoint Milestone Description: Delivery of calibrated model of the voucher recipient's reactor or other fluid-particle process

Final Milestone Description: The voucher recipient uses the calibrated model for virtual testing and for exploring the full parameter space of design options