Overview and Purpose

EERE National Laboratory Guiding Principles require all offices to pursue a merit review of direct-funded national laboratory work. In line with these Principles, the Vehicle Technologies Office (VTO) is issuing this lab call for Fiscal Year 2021 (FY 2021) funding. VTO will award only a portion of its total planned FY 2021 lab funding through this lab call process. Labs are also selected through the standard Financial Opportunity Announcement (FOA) process and are not restricted from applying to any FOAs.

Some labs also have continuing multi-year projects that have already gone through the merit review process. These will continue to be reviewed through the annual peer review process and labs should work with VTO project and program managers to ensure that ongoing projects are appropriately included in the AOPs to meet AOP deadlines. This lab call will only pertain to the new AOIs below.

Timeline and Process Logistics

Timeline:

- *LAB CALL RELEASE DATE:* **6/05/2020**
- *PROPOSAL DEADLINE AND DECISION TIMETABLES:*
  - *Submission Deadline*: **7/17/2020 at 11:59 PM Eastern**.
  - *Decision Deadline:* VTO currently plans to make decisions **by the end of August 2020 (subject to change).**

Process Logistics:

All communication to VTO regarding this lab call must use VTOLabCall@ee.doe.gov.

- *PROPOSAL SUBMISSIONS:* To apply to this Lab Call, lab personnel must register (and sign in) with their lab email address and submit application materials through EERE Exchange. Application materials must be submitted through EERE Exchange at https://eere-Exchange.energy.gov, EERE's online application portal. Frequently asked questions for this Lab Call and the EERE Application process can be found at https://eere-exchange.energy.gov/FAQ.aspx.
- *QUESTIONS DURING OPEN LAB CALL PERIOD:* Specific questions about this lab call should be submitted via e-mail to VTOLabCall@ee.doe.gov. VTO will provide answers related to this Lab Call via email or on EERE Exchange at: https://eere-exchange.energy.gov. Please note that you must first select the specific opportunity number for this Lab Call in order to view the questions and answers specific to this Lab Call. EERE will attempt to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website. Questions related to the registration process and use of the EERE Exchange website should be submitted to: EERE-ExchangeSupport@hq.doe.gov. To ensure fairness for all lab participants, please do not ask individual VTO staff questions directly.
- *NOTIFICATION OF SELECTION:* When selections are finalized, lab leads will receive an email from VTOLabCall@ee.doe.gov.

Lab Call Description – Key Considerations and AOIs

Key Considerations

AVAILABLE FUNDING: There is approximately **$27 million in annual funding** to fund **all** projects with the potential for future year funding pending appropriations, Program direction, and go/no-go decision points.

CRADAS AND FOA AWARDS: The call for proposals below should **NOT** be construed as requiring the renegotiation of an existing Cooperative Research and Development Agreement (CRADA) or previously-competed FOA award in which the lab is a prime or sub-recipient. Labs with CRADAs or FOA awards addressing any of the AOIs below may incorporate that work in proposals they submit in response to the lab call to demonstrate existing capability and leverage existing partnerships with industry and other partners. If the proposal is not selected for funding under this lab call, the work under the CRADA or FOA award will continue – there is no additional risk to the provision of DOE funding.

ELIGIBILITY: Applicants should pay close attention to eligibility restrictions listed in each AOI as they vary by AOI. For more information about VTO goals and targets, please see the Vehicle Technologies Office FY 2020 budget request, VTO web site, and/or U.S. DRIVE technology roadmaps.

EERE NATIONAL LABORATORY GUIDING PRINCIPLES: To ensure continued alignment with EERE Lab Engagement Principles, applicants should consider the following when developing their proposals:

- To the extent possible and appropriate, VTO encourages projects that bring together multiple labs in a consortia-based approach to meet a high-level strategic goal, leveraging multiple lab capabilities with strong, centralized leadership.
- To the extent possible and appropriate, VTO seeks lab projects that involve industry engagement or industry partners.

Summary of AOIs

- AOI 1: Joining Core Program Phase 2
- AOI 2: Lightweight Metals Core Program
- AOI 3: Intermetallic Silicon –based Anodes
- AOI 4: Artificial Intelligence for Mobility
- AOI 5: High Power Charging Profiles
- AOI 6: Threat Mitigation and Operational Smoothing for Charging Stations

AOI Descriptions

AOI 1: Joining Core Program Phase 2

Eligibility: Restricted (ANL, ORNL, & PNNL) – multi-lab collaboration are strongly encouraged
Estimated DOE Funding Available: Up to $5 million per year total, annually, across all projects selected
Estimated Number of Projects Expected: 5 projects (AOI 1A – 2, AOI 1B – 1, AOI 1C – 1, AOI 1D - 1)
Estimated project duration: 36 months

The Materials Technology Program seeks proposals for a multi-lab effort to build upon knowledge gained during the first phase of the Joining Core Program. Projects will conduct research and development on joining of dissimilar lightweight materials, including advanced high strength steel, aluminum, polymer matrix composites, and magnesium, using methods suitable for low-cost, high volume automotive manufacturing. The second phase of the Joining Core Program will have four major thrusts, detailed below, that will enable vehicle weight reduction and efficiency improvement by broadening the applicability of individual joining methods, moving lab-scale joining methods towards industry readiness, addressing challenges with adhesion and corrosion, and providing the automotive industry confidence in the quality of dissimilar material joints.

Proposals should be multi-lab collaborations at the project/task level, focusing on the advances that will be made in technology rather than on consortium structure or teaming models. After proposals are merit reviewed and selected, a kick-off meeting will be held to identify critical hand-offs between labs, collaboration methods and frequency, and data sharing protocols. PNNL and ORNL may each submit up to three proposals for each task below (maximum of 6 proposals per task), with Argonne as collaborator for characterization on any submission. Joining methods and surface modification approaches that were not included in the first phase of the Joining Core Program may also be proposed as relevant to the tasks below. Results from the Joining Core Program Phase 2 should be communicated through journal articles, conference presentations, and presentation to the USDRIVE Material Tech Team.

AOI 1A: Extend Joining Methods to New Material Pairs - $2.5M total project size

The goal of this task is to increase the applicability of a joining method to a variety of material stack-ups that might be encountered in the assembly of a lightweight multi-material vehicle. A typical vehicle has more than 5000 spot joints and 150 meters of linear joints fabricated by over 300 robotic joining stations per line. To optimize productivity, automotive OEMs need to limit the number of unique joining technologies that are implemented on an assembly line.

Proposals should select a specific joining method that has been demonstrated to successfully join at least one dissimilar lightweight material pair at the laboratory scale and extend its applicability to additional dissimilar material stack-ups. Investigations could include expanding the design space for material thickness, product form (sheet, casting, extrusion), number of materials joined (2T or 3T), as well as material type. Proposals may include investigations of joints between substantially different alloys of the same material (ie. 5XXX to 6XXX Al, Usibor 1500 to DP590) but all proposals should include a discussion of how the selected design space is relevant to current state-of-the-art or future lightweight vehicle designs.

It is expected that modifications to joining methods may be necessary to accommodate a wide variety of material stack-ups. Examples of this include the scribe feature for friction stir welding or variations in fastener geometry or material. However, a single robotic welding station may be used for joining multiple material stack-ups even in assembling one vehicle. Therefore, proposers should consider whether the modifications proposed for the new material stack-ups could be easily interchanged during production, and thus considered a single joining method.

Projects should include predictive modeling with experimental validation, utilizing process to property relationships where possible, to decrease development time for joining new stack-ups. The project will be considered successful if:

- The team can demonstrate a clearly defined expanded design space, including bounding limits, where the joining method can be used. (For example: Process X can join 6XXX series Al (0.8 – 3.6 mm thickness) to cast Mg alloys with ductility greater than 12% (3 – 5 mm thickness) in 2T configurations.)
- Models can correctly predict if a joint can be formed within the allowable process parameter range, and which parameter trends (i.e. increased pressure) will increase joint strength, in a previously un-tested stack-up.

AOI 1B: Advance Joining Method toward Industrial Readiness - $3.5M total project size

It is well known that the point at which National Laboratories consider a technology ready for adoption by industry can be vastly different from when industry thinks a technology is ready for adoption. The goal of this task is to close the gap between those two points for a joining technology that has already proven to be applicable to a wide range of material stack-ups at the coupon or plaque level. Projects should advance the joining method from bench-top scale to repeatable, component level demonstrations with a clear path to automation.

Proposals should include a letter of support from an industry partner to provide component level requirements (i.e. maximum flange width, spot spacing, desired surface profile, and insight into manufacturing constraints and challenges).

The project will be considered successful if the following targets are met:

- Cycle time of 1s for spot joints and 3 m/min for linear joints
- Mechanical properties meet industry partner requirements
- Variation in mechanical properties within acceptable limits (n>100)
- Design completed for application to robot

AOI 1C: Surface Modifications for Improved Joining and Corrosion Resistance - $3M total project size

Galvanic corrosion in dissimilar material joints continues to be a significant challenge to the implementation of lightweight materials in vehicles. The primary method of corrosion mitigation is coatings such as zinc applied to steel coils through galvanization and electrocoating of components and assemblies. There are two main challenges to joining coated components. First, the coating may change the surface characteristics of the substrate such that the joining method is no longer effective. One example of this is the increased contact resistance of electrocoated surfaces which precludes resistance spot welding. The second challenge is that the

process of joining often creates defects in the coatings which serves as a nucleation site for corrosion and allows contact of the dissimilar materials.
Recent research has shown that some non-coating surface modification techniques may be effective in mitigating corrosion. At the same time, surface modifications that increase surface energy are often desired for improved adhesion. In this task, we seek to better understand the impact of surface modifications on joining and vice versa.

Proposals for this task should discuss the following:

1) Current understanding of efficacy of proposed surface modifications for
   a) Mitigation of both bulk substrate corrosion and galvanic corrosion
   b) Increased adhesion
2) Which surface modified substrates and joining methods will be evaluated and how the effects will be characterized
3) How the proposed surface modifications could fit into high volume automotive production
   a) Applied to coils/pre-forms or components
   b) Shelf life considerations of surface modification in production environment
   c) Compatibility of surface modification with lubricants, pre-treatments, and coatings

AOI 1D: Automated Joint Quality Monitoring and Control - $3.5M total project size

This task is intended to build directly on the efforts started during the last year of phase 1 of the Joining Core Program and will not start until the currently funded work has concluded. As such, it is recognized that the research proposed here may need to be modified based on the outcomes of phase 1.
Proposals should include validations of the predictions made during the first phase of this task as well as extend the machine learning framework to additional joining methods. The joining method selected should currently be used for automotive production with the opportunity for near term implementation of quality monitoring and control algorithms for dissimilar material pairs.

Project work could include

- Predictions and validations of weld quality
- Development of hardware and/or control systems as necessary
- Demonstration of real time implementation

AOI 2: Lightweight Metals Core Program (LMCP):

Eligibility: Must be a Multi-Lab Team, a single lab can be on no more than 3 proposals.

Estimated DOE Funding: Up to $5 Million/year (Max $15 Million Total)

Estimated Number of Awards: 1

Estimated Duration: 36 Month Period of Performance

The Vehicle Technologies Office (VTO) Materials Program enables improved energy efficiency across the transportation system through the judicious use of enhanced materials and materials processing methods. The Lightweight Metals Program accomplishes this goal by reducing the vehicle weight in a cost-effective manner, improving fuel economy and freight efficiency in the process. Typical lightweight metals utilized in this process include third-generation advanced high-strength steels, magnesium, and aluminum. These materials may be utilized as either sheet or castings depending on component property requirements.

In order to provide the maximum amount of lightweighting, the automotive industry today takes the approach of implementing the right material in the right place. For lightweight metals, this has resulted in the proliferation of new aluminum and steel alloys with specialized properties. Unfortunately, this creates challenges for automakers by increasing the complexity of supply chains, storage of materials, and recycling of scrap metal. This tension may result in less than optimal lightweighting solutions being implemented to achieve a more manageable production environment.

The Materials Program seeks proposals for a multi-lab Lightweight Metals Core Program (LMCP) to develop scalable processing methods to locally enhance the properties of aluminum and magnesium. The project objectives are to enable broad implementation of existing lightweight alloys in the ground transportation (passenger cars, trucks, and buses) industry by improving their overall performance through cost effective localized property enhancement.

It is envisioned that the LMCP will have a primary thrust for each material family (Aluminum or Magnesium) and a supportive thrust representing the characterization and computational tools that the primary thrust will need to accelerate the developmental process and validate component performance.

Proposals should describe the following:

- A multi-lab team approach to addressing the needs of each material family
- A specific thrust by clearly describing a management plan, with key roles and responsibilities
- A clear roadmap with specific performance targets, metrics, and go/no-go decision points.
- The supportive thrusts including capabilities at each of the labs on the team, accessibility of those capabilities to the team including any competitive requirements for access, and clear descriptions of how the entire team can gain access to the full suite of capabilities necessary to accomplish the goals of the primary thrusts.
- How the team will maximize existing capabilities while minimizing unnecessary duplication and cost.
- The current DOE Technology Readiness Level (TRL) of the technologies/approaches being proposed and show that the proposed technologies have a clear pathway to it least a high TRL 4, scalable near production ready solution.

- A technology transition plan including descriptions of how they will use industry participation such as CRADAs to rapidly move from lab scale prototypes to broad industrial commercialization.

Thrust one: Localized property enhancements for sheet aluminum applications.

These localized property enhancements may include stiffness, strength improvements, support structures, and ductility. Proposals should include approaches to achieve these improvements through methods such as thermomechanical processes to improve performance through local optimization of microstructure. Proposals should demonstrate the ability to modify parts at various stages along manufacturing process and illustrate how this would be adopted by industry. Proposals should also show how computational methods will be utilized to predict the localized properties and resultant component level performance in the vehicle system. Proposals should also identify how characterization and testing facilities within the team will be utilized by the task to validate materials and component performance at the appropriate length scales.

Thrust two: Localized property enhancements for cast structural aluminum applications.

These localized property enhancements may include fatigue life, fracture toughness, strength improvements, support structures, and ductility. Proposals should include approaches to achieve these improvements through methods such as thermomechanical processes to improve performance through local optimization of microstructure. Proposals should demonstrate the ability to modify parts at various stages along manufacturing process and illustrate how this would be adopted by industry. Proposals should also show how computational methods will be utilized to predict the localized properties and resultant component level performance in the vehicle system. Proposals should also identify how characterization and testing facilities within the team will be utilized by the task to validate materials and component performance at the appropriate length scales.

Thrust Three: localized property enhancements for cast magnesium applications.

These localized property enhancements may include corrosion resistance, energy absorption, fatigue life, fracture toughness, strength improvements, support structures, and ductility. Proposals should include approaches to achieve these improvements through methods such as thermomechanical processes to improve performance through local optimization of microstructure. Proposals should demonstrate the ability to modify parts at various stages along manufacturing process and illustrate how this would be adopted by industry. Proposals should also show how computational methods will be utilized to predict the localized properties and resultant component level performance in the vehicle system. Proposals should also identify how characterization and testing facilities within the team will be utilized by the task to validate materials and component performance at the appropriate length scales.

Supportive Thrust: Characterization, Testing, and Computational Capabilities:

Proposals should include a description of the capabilities and expertise that will be supporting each of the Primary Thrusts. These capabilities and expertise may include tensile and fatigue life test frames, fracture toughness testing, multiscale microscopy (Atomistic to optical), tomography, optical examination tools, finite element analysis, atomic scale modeling, and the personnel with expertise in utilizing the different tools available to the team. Proposals should include the availability and applicability of each of the tools to the thrusts that they will be supporting. Proposal should also include any competitive requirements associated with access to any of the capabilities listed: For example is availability of the high-performance computing tools dependent on being awarded time at one of the DOE high-performance computing centers? Proposals should identify the location of each of the facilities/capabilities included in the proposal and explain how these resources will be made available to each thrust area team.

Additional Requirements:

- All proposals should identify any implications on high-quality material recyclability that the proposed technologies may represent to the transportation industry.
- Proposals should include a detailed project management plan showing milestones; go no go decision points, and a risk mitigation strategy.
- Proposals should include descriptions of the team management organization (including key contacts for each Laboratory/facility) and communication structure that will be utilized to ensure efficient operation of the program.
- Proposals should include an annual budget plan showing how funding needs will be allocated by Thrust and National Laboratory.

Submission Length Limitations:

- 20 Page Technical Document, 4 pages per each of the 4 Thrusts, and 4 pages for management, risk mitigation, and budget plans.
- 10 pages of supporting documentation and/or letters of industry support.
- 1 page resume for each key participant

Exclusions:

- Proposals should not include any new alloy development R&D but general material enhancements that are required to address gaps in fundamental material performance and potentially improve program impact and material recyclability are allowable and should be clearly communicated in the proposal.
- Proposals should not include task for the enhancement of advanced high-strength steels.
- Proposals should not include technologies that result in components which would not be easily recycled at end of vehicle life.

AOI 3a: Silicon Anode Research Consortium Topic

Eligibility: Restricted (NREL). Multi-lab collaboration are strongly encouraged

Estimated DOE Funding: Up to $7.5 Million/year

Estimated Number of Awards: 1

Estimated Duration: 60 Month Period of Performance

Today's state-of-the-art automotive battery cells use graphite as the active material in the anode. Besides operating at a low operating voltage, graphite has a relatively large reversible capacity of ~350 mAh/g. These properties combined with the fact that graphitic based systems have been able to form stable interfaces between the electrolyte and graphite particles have resulted in batteries capable of achieving greater than 10 years of calendar life and thousands of cycles.

Silicon, a promising next generation anode material, while also exhibiting low operational voltage can theoretically store >3500 mAh/g; an order of magnitude greater than that of graphite. Unfortunately, wide-spread adoption of silicon based anodes is hindered by non-favorable chemical reactions between the electrolyte solution and the reducing environment of the low potential intermetallic alloy. These unfavorable reactions result in unacceptable calendar life for automotive applications and are exacerbated by the large volume change experienced upon lithiation and delithiation of silicon.

This lab call hopes to draw the resources from a multidisciplinary team to better understand the fundamental nature of the silicon electrolyte interface, propose new solutions to stabilize this structure, and build lab scale cells utilizing silicon containing anodes. Suggested topics of interest include but are not limited to surface and bulk material modifications and electrolyte alternatives to carbonate solvents and $LiPF_6$.
At the completion of the 5 year period of performance, the team should have developed lab scale cells containing silicon electrodes that will meet the following cell level objectives:

Table I. Cell Level Beginning of Life Performance Targets

Beginning of Life Characteristics at 30°C	Cell Level
Useable Specific Energy @ C/3	> 375 Wh/kg
Useable Energy Density @ C/3	> 750 Wh/L
Calendar Life (<20% energy fade w/ acceptable power performance)	> 10 Years
Cycle Life (C/3 deep discharge, <20% energy fade w/ acceptable power performance)	> 1,000

Lab scale cells will be greater than 2 Ah. It is acceptable that cells do not meet the energy goals in Table I, as long as the cell components (electrodes with similar active material content, porosity, thickness, loading, etc. and separator thickness) in the cells, when scaled to automotive size (40Ah or greater) are capable of meeting the goals. i.e. The team will not be penalized for packaging inefficiencies of small cells, but needs to deliver cells with automotive relevant electrodes, separators, and electrolyte. If the lab cells do not meet the goals in Table 1, a model showing the reasonable scaling factors will also be required.

Cells should include a commercially available cathode. This is not intended to be a cathode development project. If expected cathode performance improvements are not realized in this time horizon prohibiting cell level targets the team can work with the DOE program manager to adjust goals as appropriate.

At the completion of year 3, the team should have developed lab scale cells containing silicon electrodes that will meet the following cell level objectives:

Table 2. Cell Level Beginning of Life Performance Targets: Year 3 Milestone

Beginning of Life Characteristics at 30°C	Cell Level
Useable Specific Energy @ C/3	> 350 Wh/kg
Useable Energy Density @ C/3	> 700 Wh/L
Calendar Life (<20% energy fade w/ acceptable power performance)	> 5 Years
Cycle Life (C/3 deep discharge, <20% energy fade w/ acceptable power performance)	> 1,000

Lab scale cells will be greater than 2 Ah. It is acceptable that cells do not meet the energy goals in Table I, as long as the cell components (electrodes with similar active material content, porosity, thickness, loading, etc. and separator thickness) in the cells, when scaled to automotive size (40Ah or greater) are capable of meeting the goals. i.e. The team will not be penalized for packaging inefficiencies of small cells, but needs to deliver cells with automotive relevant electrodes, separators, and electrolyte. If the cells do not meet the goals in Table 1, a model showing the scaling factors will also be required.

AOI 3b: Silicon Anode Seedling Projects (Single PI)

Eligibility: Open (Each lab can submit a maximum of 3 Concept Papers. Concept papers should be no more than 3 pages. Concept Papers will then be selected and an AOP will be developed with program manager direction.)

Estimated DOE Funding: $1M per year

Estimated Number of Awards: 2-3

Estimated Duration: Up to 36 Months (projects will be reviewed on an annual basis)

This is an 'open' topic outside of the silicon consortium. It allows single PI's to attempt 'out of the box' solutions to achieving the goals of the silicon consortium topic. It is not expected that each singular project awarded under this topic will deliver cells that meet the goals in tables I and II, however, it is expected that successful ideas will produce technologies and strategies that when scaled have the potential to satisfy these performance requirements.

Clear project goals and expected project outcomes are expected in each concept paper.

Topic 4: Artificial Intelligence for Mobility (AIM)

Eligibility: No restricted eligibility. Multi-lab proposals and single lab proposals will be equally considered. However, an individual lab can be on no more than 4 proposals total (multi-lab or single).

Estimated DOE Funding: Up to $5 Million per year, total across all projects (Max $10 Million Total over 24 months)

Estimated Number of Awards: 2-5

Estimated Duration: Up to 24 Months (projects will be reviewed on an annual basis)

Topic Overview

The Energy Efficient Mobility Systems (EEMS) Program conducts early-stage R&D at the vehicle, traveler, and system levels, creating new knowledge, tools, insights, and technology solutions that increase mobility energy productivity for individuals and businesses.

The technology landscape that EEMS operates in is complex and rapidly evolving, which provides both tremendous opportunities and formidable challenges. Significant changes in the mobility landscape are underway due to the advent of vehicle and infrastructure connectivity, autonomous driving, and rapid passenger- and freight-vehicle electrification. The rapid evolution of artificial intelligence (AI)—enabled by high-performance computing (HPC)—is unlocking the promise of data-driven modeling, simulation, and optimization, driving new approaches to mobility research that will lead to a more affordable, efficient, safe, and accessible transportation future.

Previously EEMS-funded R&D, as well as research from the many other academic, private, and public-sector organizations in the transportation and vehicle space have identified a number of challenges. While the capabilities for artificial intelligence have exploded in the just the past decade, and is being applied to fields as diverse as bioengineering, space exploration, and drug discovery, the transportation sector continues to be one of the largest users of energy in the US, and urban congestion remains a significant problem for large portions of the country.

The objective of this Lab call topic is to apply National Lab AI tools in HPC, advanced analytics, and complex systems to develop significantly improved transportation systems planning and operation modeling, simulation and analysis. Areas of research include development of tools, techniques, and methodologies that can be applied by relevant stakeholders in areas such as, but not limited to:

- Mobility Data Ingestion and Verification
- Simulation, Modeling, Analysis, Computation
- New methodology and controls for situational awareness, operations, and planning and decision making.

The tools, techniques, and methodologies to be developed should consider:

- Geospatial scalability
- Predictability
- Robustness
- Ability to be used in near real time

VTO will coordinate with AITO to ensure Lab Call and selected projects are aligned with DOE-wide AI activities[1] and the Office of Science[2] priorities and activities.

ALL proposals must describe:

- Baseline performance of system to be researched and improved
- How the proposed R&D overcomes current limitations and problems of the system under consideration. In particular,
  - Explain what AI tools and techniques (e.g. machine learning, higher performance computing) will be developed and/or used
  - Explain the rationale for the proposed approach
  - Explain the novelty and innovation of the proposed technologies against current state of the art approaches
- What data sets will be used
- Validation process for the proposed technology to be developed
- Implementation strategy / technology transition plan to allow external users and stakeholders to utilize the technology developed
- Clear final project outcomes and deliverables (with quantified targets and metrics where appropriate)
- How the project meets the goals of the EEMS program.

Competitive proposals will have external partners, either as research collaborators, or as end-users, or both.

[1] https://www.energy.gov/science-innovation/artificial-intelligence-and-technology-office
[2] https://science.osti.gov/ascr

AOI 5: High Power Charging (HPC) Charge Profiles

- Eligibility: Open – strongly encourage multi-lab collaboration
- Estimated DOE Funding Available: Up to $2 million per year ($6M total)
- Estimated Number of Projects Expected: Up to 2 multi-lab projects (with 1 preferred)
- Estimated project durations: 36 months

For this project, multiple national laboratories are encouraged to partner, and assessment and validation of HPC system charge profiles should be achieved through testing, hardware-in the-loop, and potentially modelling.

Successful deployment of high-power charging (HPC) (> 200 kW up to 1+ MW) for light, medium, and heavy-duty electric vehicles offer numerous benefits including greater vehicle utilization, extended range, and recharging times comparable to refueling for conventional vehicles. HPC systems must be intelligently integrated with the grid and distributed energy resources (DER) to mitigate grid impacts, lower overall system costs, and maximize the potential for grid services. To achieve effective smart charge management and optimal integration with the grid, a thorough understanding of HPC charging profiles is required.

Unlike L2 or DCFC systems, HPC charging profiles are likely to vary widely across vehicle classes, charging power levels, and specific vehicle manufacturers. This includes significant differences in maximum power draws and durations, and ramp-up/ramp-down strategies. Additionally, HPC utilizes thermal management systems to cool critical components and maintain safe operating conditions. This increases the electrical requirements from the grid, with higher ambient temperatures necessitating greater electrical demands.

Understanding the unique HPC charge profiles is key to the effective integration of HPC within local charging facilities and the wider utility grid. This project should assess the likely portfolio of HPC systems and compatible light, medium, and heavy-duty electric vehicles that are expected to utilize HPC. Efforts should:

- Assess the overall HPC systems charge profiles including the vehicle charge profile, the HPC profile including thermal management requirements, and the overall charging load as seen by the grid.
- Charge profiles should be assessed for representative electric vehicle/HPC charger combinations at baseline operating conditions and high and low ambient temperatures.
- Testing while the vehicle is charging shall include assessment of vehicle/charger response to grid disturbances (i.e. voltage and frequency deviations).
- Exploration of charge profiles should include both conductive and wireless power transfer systems, with development of appropriate test procedures therein.
- Activities shall also include work with electric vehicles and charger OEMs to optimize charging interoperability.
- Data from this project shall help validate models and feed future modelling studies. It will also be provided to teams developing Smart Charge Management solutions for HPC applications.

Preference will be given to project proposals that do not require program funding for vehicle acquisition and minimize funding requirements for HPC charging system acquisition, through partnerships/agreements with industry stakeholders.

AOI 6: Threat Mitigation and Operational Smoothing for EV Charging Stations

- Eligibility: Open – strongly encourage multi-lab collaboration
- Estimated DOE Funding Available: Up to $1.5 million per year ($4.5M total)
- Estimated Number of Projects Expected: 1 multi-lab project
- Estimated project duration: 36 months

Projects should incorporate multi-lab teams as appropriate and shall conduct modelling, hardware component development, and testing and evaluation to validate approaches.

Electric vehicle charging stations are increasingly evolving toward the gas station model where multiple banks of chargers are available at power levels ranging from L2, DCFC, and high power charging (HPC) (up to 400+kW for light-duty vehicles and up to 1+ MW for medium and heavy-duty vehicles). Due to multiple charging ports and the high overall power demand from these stations, the potential exists to significantly impact grid operations. This could result from several events, including inappropriate station charge management, malfunctioning equipment, and/or cyber-physical security breaches.

As a result, there is a strong need to identify, in real-time, when a station is acting out of the norm or has suffered a cyber breach and immediately implement mitigation procedures to reduce/eliminate negative impacts to the grid. Potential abnormalities and incursions should be fully detected, while minimizing the occurrence of false positives. Real-time detection and agile controls are essential to optimize this response, as any delay will increase the likelihood of damage to the grid.

Projects should develop strategies and techniques for EV charging stations for light, medium, and heavy-duty vehicles following the gas station or centralized depot fueling models to enhance station resilience and mitigate potential negative impacts to the grid. Proposals should include the following:

- Emphasis R&D focused on charging control technologies, processes, and protocols.
- Develop methodologies and tools to accurately and reliably detect abnormal behavior of individual chargers and the charging station.
- Consider conductive and wireless charging systems, with use cases defined and assessed to properly balance appropriate actions.
- Include station response as a major focus including the potential for multi-phase isolation (i.e. using a microgrid strategy) in a step-by-step fashion. Station response may include several aspects such as shedding loads, isolating chargers, ramping up energy storage, and/or isolation from the grid.
- Soft drop-off strategies should be explored including leveraging stationary energy storage (including secondary use battery packs and ultracapacitors).
- Exploration of open architectures should also be pursued, identification of power electronics needs therein, and integration of station and smart charge management.

Furthermore, it is highly desirable for a station to maintain the ability to safely operate in a limited/degraded mode, where the station is still connected but isolated, and limited emergency charging capacity is still available. Here, parts of the station can still draw power from the grid to charge stationary energy storage with the express purpose to charge vehicles at a lower rate, while maintaining system isolation. This could include approaches such as nested or partitioned microgrids.

Application and Submission Information

Application Process

Proposals must be submitted via EERE Exchange by the submission deadline **7/17/2020 at 11:59 PM Eastern.**

Proposal Length (not including information required by the EERE Exchange template)

For all AOIs, except AOI 2 and AOI 3b, the proposal length shall not exceed 8 pages.

For AOI 2 (Lightweight Metals Core Program) and AOI 3b (Silicone Anode Seedling Projects), please refer to the topic description.

To apply to this lab call, applicants must register with their lab email address and submit application materials through EERE Exchange at https://eere-Exchange.energy.gov, EERE's online application portal.

All submissions must conform to the guidelines for format and length, and be submitted at or prior to the deadline listed.

Applicants will be required to include project information and details in Exchange that will be used to develop and accelerate negotiations of FY2021 AOPs if selected. Appendix A provides a worksheet to guide applicants through this process in Exchange. Please be aware that any information the applicant considers to be of significance for the review process must be included in the proposal as reviewers will not have access to the AOP development information entered in Exchange.

General Proposal Requirements

Individual proposals must be submitted in PDF format as a single file (do not bundle multiple proposals in a single file).

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

Proposals

Proposal content aligns with content required in the EERE AOP project forms, with additional information to assist reviewers in evaluating technical details. The proposal narrative should build on the information provided as part of the EERE Exchange template. **Applicants must include all content they wish to have reviewed in the proposal (proposal reviewers will not review any information provided in Exchange for AOP development).** References do not count toward the page limit.

General Information

This section summarizes the basic information about the proposed project: title; VTO program, activity, and sub-activity the project serves; and project principal investigator (with contact information).

Project Overview

This section should contain a concise narrative that captures the problem statement, the major R&D challenges, and any context needed to provide the reader with a complete understanding of the project and how it supports office, program, and activity goals. If this is a multi-performer project, this section should include a description of each performer's role and responsibility.

Project Objectives

This section should describe the project-specific goals, objectives, and expected outcomes. The proposal should include a clearly defined, aggressive and quantitative end-of-project goal that supports larger VTO programmatic goals. Details on the technical aspects of the goals, objectives, and outcomes should be included in this section to explain the specific technical areas to be addressed and the scientific merit of the work as well as specifically how the approach is different from VTO's current portfolio. The proposer should include the technology barriers addressed by the work and how the project addresses them.

Project Management

This section should define the key milestones to be addressed by the project (1 go/no-go at 12 months and quarterly progress measures), with dates and specific descriptions of what should be accomplished to meet the milestones.

Project Approach/Tasks

This section should list the key tasks and provide brief descriptions for each task, including roles and responsibilities of any partners. A cost estimate (total) for each phase should be provided here.

Application Review Information

Merit Review and Selection Process

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

Technical Review Criteria

Below are the specific technical review criteria against which the proposals will be reviewed.

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

- 1(a) Degree to which the project addresses program barriers, contributes to Office targets/goals, and has potential to advance the state-of-the-art.
- 1(b) Extent to which the proposed project presents an innovative, early stage R&D approach and is different from what VTO is already funding and what the research community is advancing.
- 1(c) Sufficiency of technical detail supporting the proposed work is scientifically meritorious.

Criterion 2: Project Approach (Weight: 30%)

- 2(a) Relevance and appropriateness of the approach and critical path and description of key tasks, metrics (including baseline), and milestones leading to an impactful outcome.
- 2(b) Degree of likelihood that the work plan will succeed in meeting project goals.

Criterion 3: Team, Resources, and Inter-Lab Collaboration (Recommended Weight: 20%)

- 3(a) Degree to which the project leverages a core or enabling capability.
- 3(b) Capability of the Principal Investigator(s) and team to address all aspects of the work – qualifications, expertise, and time commitment of the team.
- 3(c) Sufficiency of the facilities to support the work.
- 3(d) Reasonableness of budget and spend plan for proposed project and objectives.
- 3(e) Sufficiency of the budget for the innovation proposed.
-

Selection Notification

VTO anticipates completing the project selection process and notifying labs of selections by the end of **August 2020 (subject to change).**

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

Questions/Agency Contacts

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

Appendix A: Lab Call Full Application Worksheet for Exchange

Lab Call Full Application Worksheet

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

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

Project General Information

Control Number:

Applicant (Name and Email Address):

Organization:

Project Title:

Topic:

Project Start Date:

Project End Date:

Partner Laboratories:

Partner Laboratory	Email	First Name	Last Name

Is this a continuation of an existing project?

WBS Number:

Fiscal Year Existing Project:

Project Overview (Multi-year):

Project Objectives (Multi-year):

Contact Information

Lab Lead Point of Contact and Business Contact Information

Name:

Email:

Title:

Address:

Phone:

Fax:

Financials

Please add a separate table for each partner laboratory.

Lead Laboratory Name:

Year		Planned Project Costs
2021		
2022		
2023		
Subtotal:		

Partner Laboratory (If Applicable) Name:

Year	Planned Project Costs
2021	
2022	
2023	
Subtotal:	

Total Planned Project Costs:

Performers

Please add a separate table for each partner laboratory.

Lead Laboratory Name:

Subcontractor Name	Sub Type	Start Date	End Date	2020 Planned Costs	2021 Planned Costs	2022 Planned Costs	Total Funding
Subcontractor Subtotal:							

Partner Laboratory (If Applicable) Name:

Subcontractor Name	Sub Type	Start Date	End Date	2020 Planned Costs	2021 Planned Costs	2022 Planned Costs	Total Funding
Subcontractor Subtotal:							

Total Planned Project Costs:

Project Plan

Project Tasks:

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

Project Milestones:

Item Number	Type	Title	Description	End Date	Team Members	Criteria

Risks

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

Modalities/TRL

Modalities:

Modality Number	Modality	FY20 Weight (%)	FY20f Planned Costs ($)
Total:			

Current TRL of the proposed technology (1-9):
Estimated TRL the technology will reach at project end (2-9):

Project Impacts

Deliverable/Product or “Output” Description:

Audience/Customer:

Audience/Customer Use:

Communications/Outreach Strategy:

Does this project involve significant industry engagement?

Description of Engagement:

Associated CRADAs?

CRADA Text