

Department of Energy (DOE)
Office of Energy Efficiency and Renewable Energy (EERE)

**Fiscal Year 2020 Advanced Vehicle Technologies Research
Funding Opportunity Announcement**

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002197

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FOA Issue Date:	01/23/2020
Amendment 0001	01/29/2020
Submission Deadline for Concept Papers:	2/21/2020
Anticipated Date of Concept Paper Notifications:	3/17/2020
Submission Deadline for Full Applications:	4/14/2020
Anticipated Date for EERE Selection Notifications:	July 2020
Anticipated Timeframe for Award Negotiations:	August 2020

- Applicants must submit a Concept Paper by 5:00pm ET on the due date listed above to be eligible to submit a Full Application.
- To apply to this FOA, applicants must register with and submit application materials through EERE Exchange at <https://eere-Exchange.energy.gov>, EERE's online application portal.
- Applicants must designate primary and backup points-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award. It is imperative that the applicant/selectee be responsive during award negotiations and meet negotiation deadlines. Failure to do so may result in cancelation of further award negotiations and rescission of the Selection.
- Applicants must review Section III. A. for specific eligibility requirements.

AMENDMENTS

All changes to the Funding Opportunity Announcement as a result of this amendment are highlighted in yellow.

Amendment No.	Date	Description of Amendment
000001	01/29/2020	The purpose of this amendment is to clarify the responsibility for cost share.

NOTE: REGISTRATION/SUBMISSION REQUIREMENTS

Registration Requirements

There are several one-time actions you must complete in order to submit an application in response to this Announcement (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the System for Award Management (SAM), and register with EERE eXCHANGE.gov). Applicants who are not registered with SAM and Grants.gov, should start the process as soon as possible.

Applicants must register through the EERE eXCHANGE.

EERE eXCHANGE website: <https://eere-exchange.energy.gov/>

Applicants must obtain a DUNS number.

DUNS website: <http://fedgov.dnb.com/webform>

Applicants must register with the System for Award Management (SAM).

SAM website: <http://www.sam.gov/> If you had an active registration in CCR, you should have an active registration in SAM. More information about SAM registration for applicants is found at: [https://www.sam.gov/sam/transcript/Quick Guide for Grants Registrations v1.7.pdf](https://www.sam.gov/sam/transcript/Quick%20Guide%20for%20Grants%20Registrations%20v1.7.pdf). (Please note: the SAM links will not work on any Internet Explorer (IE) Versions older than IE11. Use an upgraded version of IE or another supported browser type (e.g., Chrome or Firefox) to access these SAM links).

Applicants must register with Grants.gov.

Grants.gov website: <http://grants.gov/>

Applicants must register with Grants.gov in order to receive automatic updates, in the event that Amendments to this FOA are posted. However, please note that applications will not be accepted through Grants.gov.

Applicants must register with FedConnect.

FedConnect website: www.fedconnect.net.

In the event that an application is selected for negotiation of award, Applicants must be registered with FedConnect to receive the award. For more information regarding registration with FedConnect review the FedConnect Ready, Set, Go! Guide at https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

Submission Requirements

All application submissions are to be made via the EERE eXCHANGE at <https://eere-exchange.energy.gov/>. To gain access to the EERE eXCHANGE system, the applicant must first register and create an account on the main EERE eXCHANGE site. This account will then allow the user to submit an application for open EERE Funding Opportunity Announcements (FOAs) that are currently in EERE Exchange. It is recommended that each organization or business unit, whether acting as a team or a single entity, utilize one account as the appropriate contact information for each submission.

Applicants will receive an automated response when the Application is received; this will serve as a confirmation of EERE receipt. Please do not reply to the automated response. A “User Guide” for the EERE eXCHANGE can be found on the EERE website at <https://eere-exchange.energy.gov/Manuals.aspx> after logging in to the system.

To receive notices via email regarding a FOA in EERE Exchange, such as amendments to the announcement or the posting of new questions and answers from eXCHANGE you must initiate an application submission to the FOA of interest. Please note that you must finalize and submit your application before the specified due date and time to be considered for award.

Questions

Questions related to the use of the EERE eXCHANGE website or technical issues concerning the application submittal should be submitted to: EERE-ExchangeSupport@hq.doe.gov.

Questions related to the content of the Funding Opportunity Announcement must be submitted to DE-FOA-0002197@netl.doe.gov and shall be submitted not later than three

business days before the Full Applications are due. Questions submitted after that date may not allow the Government sufficient time to respond.

All questions and answers related to the content of this FOA will be posted at <https://eere-exchange.energy.gov/FAQ.aspx>. Applicants are encouraged to check the FAQ prior to submitting a question. DOE will try to respond to questions within 5 business days. Applicants are encouraged to review the posted questions and answers daily. **Please note that you must first select this FOA Number in order to view the questions and answers specific to this FOA.**

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I. Funding Opportunity Description

A. Background and Context

The Office of Energy Efficiency and Renewable Energy (EERE) is issuing, on behalf of the Vehicle Technologies Office (VTO), a Funding Opportunity Announcement (FOA) entitled, “Fiscal Year 2020 Advanced Vehicle Technologies Research Funding Opportunity Announcement.”

Vehicles move our national economy. Annually, vehicles transport 11 billion tons of freight – more than \$35 billion worth of goods each day¹ – and move people more than 3 trillion vehicle-miles.² Growing our economy requires transportation, and transportation requires energy. The transportation sector accounts for about 30% of total U.S. energy needs³ and 70% of U.S. petroleum consumption.⁴ The average U.S. household spends nearly one-fifth of its total family expenditures on transportation, making it the most expensive spending category after housing.⁵

To strengthen national security, support American energy dominance, provide diversified fuel options, enable future economic growth, and increase transportation affordability (including reducing vehicle upfront and operating costs) for all Americans, VTO invests in research of a broad portfolio of technologies, generating the knowledge needed for industry to further develop and commercialize affordable, secure, and reliable transportation systems. In partnership with industry, VTO has established aggressive targets to focus research on cost-reduction, efficiency, and performance. VTO-funded research has reduced the cost of advanced batteries by 75% since 2008, and nearly every plug-in electric vehicle (PEV) on the road today uses VTO-developed battery technology. However, to enable greater affordability and PEV accessibility for all Americans, VTO seeks new battery chemistries and cell technologies to reduce costs even further, by more than half, to less than \$100/kWh, while increasing driving range to 300 miles and decreasing charge time to less than 15 minutes by 2028. In addition, building on prior research, VTO has identified opportunities to significantly increase the power density of electric drive systems. New innovations in motor technology – printable magnets, high-conductivity windings, and novel architectures – could lead to much smaller, very high energy density systems with twice the useful life that can enable more affordable, better performing PEVs.

¹ Bureau of Transportation Statistics, DOT, Transportation Statistics Annual Report 2018, Table 4-1.
<https://www.bts.gov/tsar>

² Transportation Energy Data Book 37th Edition, ORNL, 2019. Table 3.8 Shares of Highway Vehicle-Miles Traveled by Vehicle Type, 1970-2017.

³ Transportation Energy Data Book Edition 37, ORNL, Table 2.1 U.S. Consumption of Total Energy by End-Use Sector

⁴ Transportation Energy Data Book Edition 37, ORNL, Table 1.12.

⁵ Transportation Energy Data Book Edition 37, ORNL, Table 10.1.

Similarly, there are benefits to be gained with advanced combustion engine research. The co-optimization of engines and fuels – simultaneously manipulating combustion processes and fuel properties together – has the potential to achieve significantly higher efficiencies than possible with current fuels and engines, improving passenger fuel economy by as much as 35% by 2030 (vs. a 2015 baseline of 36 miles per gallon). In addition, the integrated research of advanced materials, such as high-temperature alloys, and combustion strategies can not only expand engine operating parameters but also enable lighter-weight engines for better performance and efficiency.

There are also efficiency opportunities beyond vehicle components and systems. Advances in connectivity and automation have the potential to dramatically improve transportation system-level energy efficiency, energy productivity, and affordability. Leveraging high performance computing resources unique to the national laboratory system, VTO has developed robust modeling, simulation, and big data analytics capabilities, while research of advanced sensing and perception technologies, system controls, and other connected and automated technologies has advanced rapidly. Partnerships between academia and industry can apply advanced computing and data analytics capabilities with new mobility technologies to create state-of-the-art testbeds that validate and support new, optimized, highly-efficient, and affordable transportation systems.

This FOA seeks research projects to address priorities in the following areas: advanced batteries and electrification in support of the recently-announced DOE Energy Storage Grand Challenge; advanced engine and fuel technologies, including technologies for off-road applications and alternative fueled engines; lightweight materials; new mobility technologies (energy efficient mobility systems); and alternative fuels technology demonstrations. Detailed technical descriptions of the specific areas of interest are provided in the sections that follow.

B. Areas of Interest

AOI Number	Area of Interest (AOI)
Battery R&D	
1a	Lithium Ion Batteries Using Silicon-based Anodes Research
1b	Lithium Ion Batteries Using Silicon-based Anodes Research, Development, and Validation
Electric Drive Technologies	
2	Low Cost Electric Traction Drive Systems Using No Heavy Rare Earth Materials
Electrification	
3	Utility Managed Smart Charging Research and Demonstration
Advanced Combustion Engine and Fuels R&D	
4	Platinum Group Metals (PGM) Content Reduction to Enable Cost-Effective Aftertreatment for Gasoline and Diesel Engines
5	Improved Efficiency of Medium- and Heavy-Duty Natural Gas and Propane (LPG) Engines
6a	Research to Transform the Efficiency of Off-Road Vehicles
6b	Efficient Agricultural Vehicle Research, Development, and Validation
7	Two-Stroke, Opposed Piston Engine Research and Development
Materials Technology	
8	Lightweight and High-Performance Fiber-Reinforced Polymer Composites for Vehicle Applications
Energy Efficient Mobility Systems	
9	Improving Transportation System Efficiency Through Better Utilization
10	Enabling Vehicle and Infrastructure Connectivity
11	Improving Mobility, Affordability, and Energy Efficiency Through Transit
Technology Integration	
12	Gaseous Fuels Technology Demonstration Projects
13	Alternative Fuel Proof-of-Concept in New Communities and Fleets
14	Electric Vehicle and Charging Community Partner Projects
15	Technology Integration Open Topic
Analysis	
16	Transportation and Energy Analysis

Lithium Ion Silicon-Based Anode Battery Research

Today's state-of-the-art automotive battery cells use graphite as the active material in the anode. Besides operating at a low 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 potential next-generation anode material, exhibits low operational voltage and 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.

A strategy to improve the energy density of automotive lithium ion cells is to mix a small fraction, typically < 5-10%, of silicon in a composite electrode with the majority of the active material being graphite. While this increases the specific energy of the cell, it has negative effects on both calendar and cycle life.

This AOI aims to eliminate these drawbacks while increasing the silicon component in composite electrodes to at least 30% with a preference towards electrodes with the majority (70-100%) of the anode being silicon. Successful technology approaches that enable the use of increased silicon content will enable increased battery energy density and ultimately lower battery cost.

AOI 1 will consist of two subtopics (1a and 1b). Both subtopics will address and propose strategies to improve the stability of the electrolyte at the silicon surface while mitigating the mechanical strain of the silicon material and electrode structure. There are three major differences between the two subtopics. The first is that AOI 1a is restricted to universities, colleges, and non-profit research institutions which operate as divisions under colleges or universities. The second is that the strategies, tasks, and deliverables proposed in AOI 1a should be lower in Technology Readiness Level (TRL) than those proposed in AOI 1b. The third is that AOI 1b has a battery delivery requirement and AOI 1a does not.

AOI 1a: Lithium Ion Batteries using Silicon-based Anodes Research

Objective

The objective of this area of interest is to research, fabricate, and test lithium battery cells that implement $\geq 30\%$ silicon content electrodes with commercially available cathode technology (i.e. cathode technologies capable of greater than 1,000 cycles and 10-year calendar life when paired with graphite) **and have the potential to achieve** cell performance identified in the table below.

Performance Targets

Beginning of Life Characteristics at 30°C	Cell Level	
Useable Specific Energy @ C/3	>350 Wh/kg	
Useable Energy Density @ C/3	>750 Wh/L	
Calendar Life (<20% energy fade) ⁽¹⁾	>5 Years	>10 Years
Cycle Life (C/3 deep discharge to 350Wh/kg, <20% energy fade) ⁽¹⁾	>3,000	>1,000

Note (1): Applications may propose either “5 years and 3,000 cycles” or “10 years and 1,000 cycles”

Anticipated technology approaches include, but are not limited to:

- Novel strategies to stabilize the silicon surface when exposed to electrolyte (or the electrolyte when next to the silicon surface).
- Engineering structures or composites that prevent the silicon surface from interacting with electrolyte that are capable of being produced at automotive scale and cost.
- Solutions to mitigate volume expansion and the continual cracking of the SEI during lithiation and delithiation.

General Requirements

Applications **must**:

1. Identify the cell components' composition/construction with a focus on the anode and/or electrolyte being developed, but also describe and justify the choice of cathode material(s) and electrolyte solution(s) composition.
2. Identify major issues impeding the proposed cell chemistry and the particular barrier(s) that will be the target of the research effort.
3. Identify the differences between the proposed technical approach and commercially available products or solutions.
4. Describe how the proposed effort is different than past and current research efforts.
5. Include supporting theoretical predictions and/or relevant experimental data supporting performance claims.
 - Indicate if data is from half-cells or paired with a cathode material.
 - Full cell data is preferred, however in the event only half-cell data is available coulombic efficiency must be included.

- Include the electrode loading (mAh/cm²) of all cell performance data.
 - Indicate what temperature the experiments were performed at as well as the upper and lower voltage used for cycling the cell.
6. Identify performance targets that represent the highest risk for achievement during the project and the strategies to mitigate these risks.
 7. Describe the testing and diagnostics planned to characterize, investigate, and mitigate issues.
 8. Include a plan to participate in the Annual Merit Review held in Washington DC as well as the annual USDRIVE meeting (Southfield, MI or Washington, DC).

Specific Requirements

None.

Teaming Arrangements

None.

Applications Discouraged

Applications that propose significant development of the cathode are discouraged.

Special Deliverables

None.

AOI 1b: Lithium Ion Batteries using Silicon-based Anodes Research, Development, and Validation

Objective

The objective of this area of interest is to research, fabricate, and test lithium battery cells that implement $\geq 30\%$ silicon content electrodes with commercially available cathode technology (i.e. cathode technologies capable of greater than 1,000 cycles and 10-year calendar life when paired with graphite) **and achieve** cell performance identified in the table below.

Performance Targets

<u>Beginning of Life</u> Characteristics at 30°C	Cell Level	
Useable Specific Energy @ C/3	>350 Wh/kg	
Useable Energy Density @ C/3	>750 Wh/L	
Calendar Life (<20% energy fade) ⁽¹⁾	>5 Years	>10 Years
Cycle Life (C/3 deep discharge to 350Wh/kg, <20% energy fade) ⁽¹⁾	>3,000	>1,000

Note (1): Applications may propose either “5 years and 3,000 cycles” or “10 years and 1,000 cycles”

General Requirements

Applications **must**:

1. Identify the cell components’ composition/construction with a focus on the anode (and/or electrolyte) being developed, but also describe and justify the choice of cathode material(s) and electrolyte solution(s) composition.
2. Identify major issues impeding the proposed cell chemistry and the particular barrier(s) that will be the target of the research effort.
3. Identify the differences between the proposed technical approach and commercially available products or solutions.
4. Describe how the proposed effort is different than past and current research efforts.
5. Include supporting theoretical predictions and/or relevant experimental data supporting performance claims.
 - Indicate if data is from half-cells or paired with a cathode material.
 - Full cell data is preferred, however in the event only half cell data is available coulombic efficiency must be included.
 - Include the electrode loading (mAh/cm²) of all cell performance data.
 - Indicate what temperature the experiments were performed at as well as the upper and lower voltage used for cycling the cell.
6. Identify performance targets that represent the highest risk for achievement during the project and the strategies to mitigate these risks.
7. Describe the testing and diagnostics planned to characterize, investigate, and mitigate issues.

8. Discuss how the proposed solution can be cost effective when scaled to automotive production volumes.
9. Include a plan to participate in the Annual Merit Review held in Washington DC as well as the annual USDRIVE meeting (Southfield, MI or Washington, DC).

Specific Requirements

None.

Teaming Arrangements

None.

Applications Discouraged

Applications that propose significant development of the cathode are discouraged.

Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Requirements Checklist, the following deliverables are required for awards made under this topic:

1. Fifteen (15) baseline cells of a minimum capacity of 0.2 Ah and delivery to a to-be-designated DOE testing laboratory for performance testing. Test procedures will be agreed to between the applicant, the test lab, and DOE. (Baseline deliverable cells may be eliminated from the SOPO during project award negotiations if it is determined that a baseline cell is irrelevant or provides little value. Cells must be delivered within 9 months of program start)
2. Fifteen (15) interim cells of a minimum capacity of 0.2 Ah and delivery to a to-be-designated DOE testing laboratory for performance testing. Test procedures will be agreed to between the applicant, the test lab, and DOE. (Cells must be delivered between months 16-20 of program start)
3. Fifteen (15) final cells of a minimum capacity of 0.5 Ah and delivery to a to-be-designated DOE testing laboratory for performance testing. Test procedures will be agreed to between the applicant, the test lab, and DOE. (Cells must be delivered before the end of the project period of performance)
4. At least one month of testing data for all deliverable cell builds will be carried out by the Applicant following test protocols approved by the DOE. This data will be shared with DOE and the testing lab prior to deliverable shipment to the testing laboratory.

Note: All cell deliverables must be greater than 200 mAh; 1Ah or larger are preferred but not required. It is acceptable to deliver cells that do not meet performance targets, as long as the cell components (electrodes with similar active material content, porosity, thickness, loading, etc. and separator thickness) in the delivered cells, when scaled to automotive size (40Ah or greater) are capable of meeting the targets: i.e., an applicant will not be penalized for packaging inefficiencies of small cells, but needs to deliver cells with automotive relevant electrodes, separators, and electrolyte volume. If the

deliverable cells do not meet performance targets, a model validating the proposed scaling factors will also be required for baseline, interim, and final cells.

All cells shall be provided to the DOE for validation testing at a to-be-designated DOE National Laboratory. Non-Destructive Performance Validation testing will be conducted on the cells to validate performance. This testing will be conducted outside the scope of the proposed project and should not be included in the total estimated project costs included with the application. Participation by a DOE National Laboratory in test planning and execution will be addressed by a Non-Disclosure Agreement (NDA) between the National Laboratory and the Applicant. Test procedures will be provided by the Applicant and shall incorporate specifications and limits supplied by the manufacturer for the specific technology such as voltage and current limits, state of charge, charging, and temperature recommendations, number of test sequences, and/or other relevant test conditions as appropriate. The results of the DOE national laboratory testing may be documented in a publicly releasable Summary Test Report (approved by both DOE and the Applicant prior to release) that validates performance of the deliverables relative to the end item performance targets as well as the technology deployment impact relative to DOE strategic goals. The Summary Test Report will be approved by the DOE (Vehicle Technologies Office) and the Applicant. Test cells or special test equipment supplied by the end item manufacturer for the purposes of the test will be returned at the conclusion of testing at no cost to the project.

AOI 2: Low Cost Electric Traction Drive Systems Using No Heavy Rare Earth Materials

Introduction

The majority of production Electric Traction Drive Systems (ETDS) use permanent magnet (PM) motors which contain NdFeB magnets. These magnets account for 20 to 30 percent of the total electric motor costs in today's production systems. This is in large part due to the high prices of heavy rare-earth elements (neodymium and dysprosium) which are needed to prevent demagnetization at high temperatures. While the heavy rare-earth prices have reduced over the past several years, there is still significant potential for price volatility along with significant dependency on these critical materials across the on-road electric drive sector. Alternatives that reduce or eliminate the impact of these critical materials can have a substantial positive impact on electric vehicle deployment.

Objective

The objective of the area of interest is to research, develop, and test a heavy rare-earth mineral free motor and inverter traction drive system that meets the key VTO cost target of \$7/kW for use in light, medium, or heavy-duty vehicle applications capable of the following;

Electric Traction Drive System Technical Targets ⁽²⁾	
Parameter	Target
Cost ⁽¹⁾	≤ \$7/kilowatt (kW)
Power Density ⁽²⁾	≥ 12 kW/liter
Operating Voltage	≥ 600 V

Notes:

- (1) Calculate cost based on 2020 equivalent dollars. The cost is not required to include any cases or shielding, or external connectors/connections.
- (2) Calculate;
 - a. Power based on peak power capability for a duration of at least 10 seconds
 - b. Volume based on overall outer bounding dimensions. For example, a simple bounding box (or simple shape) volume for power electronics and stator outside diameter (or maximum diameter) and overall length for motors. Volume is not required to include any cases or shielding, or external connectors/connections.

Approaches that minimize, or eliminate, the use of all rare-earth materials are also encouraged.

General Requirements

Applications **must**:

1. Identify a current baseline electric traction drive system design for comparison purposes
2. Describe how the proposed R&D will lead to specific improvements in comparison to the baseline system and address the technical targets, with particular emphasis and details on cost reduction.

3. Describe the plan for validating the system technical targets through final system testing and characterization.
4. Describe how the proposed technology addresses typical and/or application-specific vehicle conditions and limitations such as cooling, voltages, temperatures, and speeds.
5. Include the following within the application U.S. Manufacturing Plan (USMP) at a minimum;
 - a. Description of applicable process steps, supporting suppliers and/or materials, and equipment appropriate for high volume manufacturing of the proposed technologies for vehicle applications at low cost and high volumes.
 - b. Project team manufacturing capabilities in the United States and describe how the proposed technologies could be integrated into existing or expanded manufacturing processes.
6. Participate in the Annual Merit Review held in Washington DC.

Specific Requirements

None.

Teaming Arrangements

Applicant teams that include participation by Electric Traction Drive System manufacturers in the United States are highly encouraged.

Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Requirements Checklist, the following deliverables are required:

1. Test plan to validate final drive system performance to technical targets
2. Listing of estimated manufacturing equipment and equipment cost required to produce the final drive system design
3. Modular or indentured bill of materials for the final machine design

AOI 3: Utility Managed Smart Charging Research and Demonstration

Introduction

As the U.S. Transportation Sector rapidly approaches a large number of Plug-in Electric Vehicles (PEV) connecting to the electricity grid to recharge, addressing the need to manage the charging load is becoming more important. If completely unmanaged, PEVs plugging into the grid to recharge when people return home or fleet PEVs return to their business at the end of the day could create additional evening peak loads that utilities would have to meet. Simple management techniques could be employed to shift these loads to later in the night when electricity demand is lower, while still meeting the need of the PEV owners to have their vehicles fully recharged. Smart Charge Management (SCM) can not only shift these loads to more desirable times for the grid, but can be used to provide grid services such as peak load shaving, demand charge mitigation, voltage support, frequency support, and renewable generation integration, to name a few. These grid services can not only provide benefit to the grid operator, but also to the PEV owner and charging network operator through lower or more predictable charging cost.

While current projects resulted in tools and platforms that overcame many of the barriers associated with SCM for a large number of PEVs connected to electric vehicle supply equipment (EVSE) either at individual charging locations or congregated charging locations across a large distribution network, further work is needed to optimize and deploy these or similar SCM systems.

Objective

The objective of this area of interest is to research, develop, and conduct a wide-scale demonstration of Smart Charge Management (SCM) systems that will enable grid services from PEVs that provide benefit to electricity grid operators, energy services providers, charging network operators, and PEV owners. These SCM systems should be applicable to charging at either or both residential and public locations such as workplaces, multi-unit dwellings, or retail establishments. Cybersecurity of the system should be properly developed and implemented to ensure that the system is hardened from attacks, is able to detect attacks in real time, and can take mitigation actions to limit impacts of attacks on the distribution grid, the charging network, and the PEVs. The SCM system should also be fully interoperable so that it can be used with EVSE from multiple vendors and any PEV that charges at the EVSE.

General Requirements

Applications ***must*** include:

1. A description of the technology and platform that forms the basis of the SCM System proposed
2. A description of the cybersecurity measures that will be utilized by the proposed SCM System for defense, detection, and mitigation
3. A description of the capabilities of the SCM System including the grid services it will enable and how these services will be achieved
4. A description of the charging locations, i.e., residential, multi-unit dwelling, workplace, retail establishment, other, that the SCM System will cover
5. A description of the communications and controls that will be implemented in the proposed SCM System

6. An estimation of the benefits to the distribution network, charging network operators, and PEV owners provided by the proposed SCM System
7. A description of the scalability of the proposed SCM system as EV volumes increase into the millions
8. A detailed demonstration plan, including the distribution grid, charging locations, types and power rating, the PEVs that will participate in the demonstration including the allowable charge rate, and how the benefits of the SCM System will be quantified
9. The anticipated applicability of the proposed SCM System to other distribution networks and utilities
10. Participation in the Annual Merit Review held in Washington DC

Specific Requirements

The proposed project should consist of two phases:

1. **Phase 1: Smart Charge Management (SCM) System Research and Development** - not to exceed two budget periods. This phase should culminate in a Go/No-Go decision point based upon demonstrated results from laboratory or simulated vehicle charging testing and analysis.
2. **Phase 2: Wide-scale SCM System Demonstration** - at least one budget period but not to exceed two budget periods. This phase should conduct a wide-scale demonstration of the SCM System developed in Phase 1 across the utility team member's distribution network. It should include a large enough number of PEVs and EVSE to prove the benefits to grid operations, charging network operations, and PEV charging provided by the grid services enabled by the SCM. This Phase must also include a demonstration of the cybersecurity protections of the system for the grid, as well as the participating EVSEs and PEVs.

Teaming Arrangements

The application **must** identify and include an electric utility as an active participant on the project team.

Applicants are encouraged to include the following entities on their teams:

- Charging equipment manufacturers and/or charging network operators,
- PEV Original Equipment Manufacturers (OEM),
- DOE National Laboratory or other entity with SCM expertise,
- A team member that has and will utilize strong cybersecurity expertise

Special Deliverables

None.

AOI 4: Platinum Group Metals (PGM) Content Reduction to Enable Cost-Effective Aftertreatment for Gasoline and Diesel Engines

Introduction

Global auto PGM usage in 2019 is projected to be 13 million ounces at a cost of \$25 billion. This demand is driven by increasing global production of vehicles with internal combustion engines, increasingly stringent emissions standards, and higher emission control system durability requirements. With new PGM sources developing slowly, demand is outstripping supply. Palladium production will not meet automotive sector demand for at least the next ten years, and rhodium is also projected to also be in deficit.

Objective

The objective of this area of interest is to research, develop, and validate technologies for reduction and/or substitution of platinum, palladium and rhodium content in three-way catalytic converters used to control hydrocarbon, carbon monoxide and oxides of nitrogen emissions from stoichiometric gasoline and natural gas engines, and oxidation catalysts for lean-burn aftertreatment systems used in diesel engine systems.

Anticipated technology approaches include, but are not limited to:

- Thermal and chemical aging mitigation and activity enhancement of PGM and wash coat components
- Active site optimization including optimal dispersion, single atom versus ensemble, and zirconia alternatives
- Improved wash coat promoters and stabilizers
- Palladium and rhodium substitution with other Platinum group metals (Ru, Ir), base metals, and other elements/compounds/alloys

General Requirements

Applications ***must*** include:

1. A description of current PGM content levels and inefficiencies and how the proposed technology reduces them.
2. A description of the proposed technical approach and how the proposed approach addresses current inefficiencies.
3. An estimation of component-level cost reductions for the PGM reduction and/or substitution strategy when compared to the baseline production component.
4. An estimation of the vehicle-level cost, performance, reliability, and emissions impacts projected for the proposed modified aftertreatment system when compared to the baseline system in a production light-duty vehicle.
5. An estimation of the applicability and cost savings benefits of the proposed technology across the light-duty on-road sector.

6. Participation in the Annual Merit Review held in Washington DC.

Specific Requirements

Technology research and development should culminate in a Go/No-Go decision point on feasibility based upon measured results from laboratory analysis. This should be followed by integration of the technology onto a vehicle and validation in a relevant drive cycle. Work with bench simulated exhaust gasses should also be included. Data should be collected and analyzed to evaluate performance characteristics, projected durability and PGM reduction.

Teaming Arrangements

The application **must** identify and include a vehicle Original Equipment Manufacturer (OEM) and/or Tier 1 supplier serving the market with volume production of engines or emission control catalyst systems for on-road light-duty vehicles as an active participant on the project team.

Special Deliverables

None.

AOI 5: Improved Efficiency of Medium- and Heavy-Duty Natural Gas (NG) and Propane (LPG) Engines

Objective

The objective of the area of interest is to research, develop, and validate emission standard compliant technologies for medium- and heavy-duty truck natural gas or LPG engines which enable near-diesel engine efficiency.

Technology approaches are anticipated to include, but are not limited to:

- Advanced ignition systems – e.g., prechamber, plasma, etc.
- Improved injectors for direct injection engines
- Systems enabling multi-mode SI/advanced compression ignition combustion
- Enabling low temperature NG or LPG combustion using novel technologies such as plasma assist and/or SACI (high dilution, advanced spark, end-gas controlled combustion)
- Reduced-cost, in-cylinder pressure sensors
- Real time methane number sensing and compensation systems
- Technologies enabling improved air-fuel mixing
- Dynamic cylinder deactivation
- Development of predictive simulation tools (data- & physics-driven) for NG or LPG direct injection, combustion, and emission modeling
- Application of thermal barrier coatings to improve efficiency
- Improvements to catalyst manufacturing which improve utilization of platinum group metals (PGMs) or technologies to reduce the need for PGMs in three-way catalysts
- Low temperature methane oxidation
- Lean-NOx emission control

General Requirements

Applications **must**:

1. Identify a baseline stoichiometric, spark-ignition natural gas or LPG engine using commercial three-way catalyst aftertreatment
2. Identify vehicle emission standards applicable to the project period
3. Identify barriers to improved natural gas engine efficiency improvements
4. Identify technology approaches to overcome these barriers during the project period
5. Identify the projected efficiency of the developed natural gas or LPG engine as well as the increase in efficiency when compared to the baseline engine

6. Identify metrics and measures to be used to track project progress
7. Identify the plan for testing and validating both natural gas engine efficiency and emission compliance
8. Include a credible cost-effectiveness analysis showing that the total cost of ownership for a vehicle employing the proposed enabling technology will be reduced, if the technology is applied at commercial scale (modeled).
9. Participate in the Annual Merit Review held in Washington, DC.

Specific Requirements

None.

Teaming Arrangements

None.

Special Deliverables:

None.

AOI 6: Energy Efficient Off-Road Vehicles

Off-road vehicles account for 8% of the total energy consumed in the US transportation sector and are a substantial source of harmful emissions, including nitrogen oxides and fine particulate matter. Improving the efficiency of commercial off-road vehicles can reduce fuel consumption and provide decreased operating costs.

AOI 6a: Research to Transform the Efficiency of Off-Road Vehicles

Introduction

Off-road vehicles are all highly reliant on compression-ignition engines which use complex emission control devices to meet regulations. The power requirements of off-road vehicles often necessitate the use of fluid-power to the work and/or drive circuits of these vehicles. Technologies that represent a breakthrough in the efficiency and/or reduce the cost, complexity, and energy penalty associated them are needed to transform off-road vehicles.

Objective

The objective of the area of interest is to research and develop technology concepts capable of significantly decreasing energy use, harmful emissions, and total cost of ownership across the entire off-road vehicle sector (e.g. construction, mining, forestry, etc.).

The following technology approaches are highly encouraged:

- Technologies that represent a breakthrough in the efficiency of fluid power systems and are widely applicable across the off-road sector.
- Technologies that increase the efficiency of compression-ignition engines and/or reduce the cost, complexity, and energy penalty associated with emission control over a typical drive cycle for off-road vehicles.

General Requirements

Applications ***must*** include:

1. Estimation of the applicability of the proposed technology across the off-road sector.
2. Identification of common inefficiency sources across the off-road sector than can be addressed with the technology.
3. Estimation of efficiency improvement when compared to the baseline off-road sector vehicle
4. Estimation of emissions and comparison to emission requirements
5. A cost analysis of the proposed technologies that validates a reduction in the total cost of ownership.
6. Validation of technology performance in a lab-scale apparatus that closely simulates how the technology will function in the vehicle application.
7. Participation in the Annual Merit Review held in Washington DC.

Specific Requirements

None.

Teaming Arrangements

Proposed teams are encouraged to include an off-road vehicle Original Equipment Manufacturer (OEM) and/or Tier 1 supplier.

Special Deliverables

None.

AOI 6b: Efficient Agricultural Vehicle Research, Development, and Validation

Introduction

Modern agriculture has evolved dramatically in recent decades, and it remains a key domestic industry. Fuel use in farm equipment represents a significant expense for farmers. Improving the efficiency of commercial agricultural vehicles can reduce fuel consumption and provide decreased operating costs for American farms. These vehicles experience unique challenges with respect to energy-efficiency enhancements and achieving emission requirements, including the requirement for high level of durability and reliability and performance in harsh environments. Many agricultural vehicles are reliant on fluid-power (i.e. hydraulics) for their work and drive circuits due to their ability to supply high specific power density and tolerate harsh conditions. However, current fluid-power systems have poor efficiency.

Objective

The objective of the area of interest is to research, develop, and validate technologies that can improve the work-specific energy-efficiency of commercial agricultural vehicles while meeting prevailing emissions regulations without negatively impacting durability and productivity requirements of the application.

Technology approaches with the highest potential impact across the agricultural sector are highly encouraged. Technologies are anticipated to include, but are not limited to, new hydraulic system architectures, advanced combustion engines and emission control, energy recovery, thermal management, electrification and hybridization, and connectivity and automation of vehicles and/or work implements that exhibit greater energy efficiency.

General Requirements

Applications **must** include:

1. Estimation of the applicability of the proposed technology across the agricultural sector.
2. Identification of common inefficiency sources across the agricultural sector than can be addressed with the technology.
3. Description of current inefficiencies and how the proposed technology overcomes them.
4. Estimation of efficiency improvement when compared to the baseline agricultural vehicle
5. Estimation of durability impacts of the technology along with a comparison to current technologies (if applicable).
6. A detailed test plan, including duty cycle, to validate the energy-efficiency benefit of the developed technology, the proposed validation period, and a description of the data planned to result from testing.
7. A description of the vehicle(s) to be used in the validation.
8. A cost analysis of the proposed technologies that validates an operating cost payback of less than 2 years.
9. Participation in the Annual Merit Review held in Washington DC.

Specific Requirements

Technology research and development should culminate in a Go/No-Go milestone to provide proof-of-concept and validation of efficiency improvement in a laboratory or simulated vehicle. This should be followed by integration of the technology onto a commercial off-road vehicle and validation in a relevant work environment. Vehicle data should be collected and analyzed to evaluate performance, cost, and usage characteristics.

Teaming Arrangements

Proposed teams **must** include an off-road agricultural vehicle Original Equipment Manufacturer (OEM) serving the market with engines sized ≥ 75 hp.

Special Deliverables

None.

AOI 7: Two-Stroke, Opposed Piston Engine Research and Development

Introduction

Engines with an opposed-piston configuration have the potential for higher efficiency due to lower heat-loss since they do not need a cylinder head. Combining this configuration with a two-stroke cycle, with twice as many power-strokes per revolution as the more common four-stroke cycle, could lead to higher power density. Furthermore, pairing these engines with electric machines in a hybrid configuration could reduce the complexity of this architecture and help smooth engine transients.

Objective

The objective of this area of interest is to facilitate development of two-stroke, opposed piston engines designed for use (in either a conventional or hybrid configuration) in light-, medium-, or heavy-duty vehicles using liquid fuels, to significantly improve fuel economy and meet emissions standards over the relevant drive cycle.

General Requirements

1. The project should result in a working prototype system suitable for operation over a simulated, representative duty cycle.
2. Applications should describe how the proposed R&D will improve the current state-of-the-art of two-stroke, opposed-piston engines.
3. The proposed system must show fuel economy improvement and ability to meet prevailing emissions standards in the application for which it is intended. Ability to improve fuel economy and meet emissions standards may be validated through engine dynamometer test data, used as input to a vehicle simulation for a vehicle-based standard (e.g., light duty), or direct measurement for an engine-based standard (e.g., heavy duty). The standard test cycles and emissions test levels are provided in the table below, along with current VTO targets for fuel economy improvement (over a 2015 baseline) and brake-thermal efficiency (BTE).
4. The application must include a cost analysis of the proposed technologies that validates an operating cost payback of less than 2 years.
5. The team must plan to participate in the Annual Merit Review held in Washington DC.

Vehicle Size Class	Emissions Compliance	Target Vehicle Fuel Economy Improvement/ BTE	Test Cycle
Class 1-2 (Midsize Cars and Crossovers)	Tier 3/LEV III	25% Fuel Economy (FE)*	FTP 75
Class 3-6 (Midsize Trucks)	CI Engines: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZZ.pdf SI Engines: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100OA01.pdf	10% Fuel Economy (FE)*	Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-duty Engines and Vehicles Phase 2 (40, 49 CFR)
Class 7-8 (Heavy-Duty Trucks)	CI Engines:	55% Brake Thermal Efficiency (BTE)	Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-duty Engines and Vehicles Phase 2 (40, 49 CFR)

*Compared to a comparable 2015 baseline vehicle

Teaming Arrangements

Applicant teams must be led by a vehicle/engine manufacturer or developer, but may include national laboratories, universities, research organizations, and non-profit institutions as sub-applicants, if appropriate. The participation of a vehicle OEM is highly encouraged.

Special Deliverables

None.

AOI 8: Lightweight and High-Performance Fiber-Reinforced Polymer Composites for Vehicle Applications

Introduction

High-performance lightweight materials currently used in automotive industry include advanced high-strength steels, aluminum alloys, magnesium alloys, and carbon fiber-reinforced polymer composites (CFRP). Of the four types of lightweight materials, CFRP have the potential to provide the most significant weight savings (up to 60-70%), while providing high specific strength, high specific stiffness, and excellent chemical/corrosion resistance which are important in a vehicle operational environment. However, the high cost of CFRP precludes adoption across the automotive industry. Enabling the use of lightweight materials across the automotive industry through the development of novel materials, composite preforms and intermediates, manufacturing processes, and components for high-volume, high-performance, and affordable polymer composite vehicle applications is a key enabler for increasing fuel economy and reducing the environmental impact of vehicles.

Objective

The objective of this area of interest is to research, develop, and test novel materials, composite preforms and intermediates, manufacturing processes, and components for low cost, high-volume and/or high-performance polymer composite vehicle component applications capable of achieving the following;

Parameter	Measure
Weight Reduction (Component Level)	$\geq 25\%$ ⁽¹⁾
Cost of Materials ⁽²⁾	$\leq \$5/\text{pound}$ (2010 dollars)
Cost of the Component	$\leq \$5/\text{pound-saved}$ ⁽¹⁾
Cycle Times	< 3 minutes
Production Volume	$\geq 85,000$ units/year
Model Error	$\leq 15\%$
Strength ⁽³⁾	$\geq 250\text{Ksi}$
Modulus ⁽³⁾	$\geq 25\text{Msi}$
Strain ⁽³⁾	$\geq 1\%$

Notes: (1) Compare to a 2015 baseline, (2) Carbon Fiber cost only, (3) Reinforcements

Vehicle components are anticipated to include, but are not limited to:

- Body-in-White frame;
- Ladder frame for light/heavy-duty trucks;
- Closures/Interiors;
- Suspension systems; and
- Engine blocks.

Approaches are anticipated to include, but are not limited to:

- Novel materials such as low cost, high production fiber feedstocks; lower cost, higher performing resins (e.g., fast cure resins or corrosion-countering functional resins); and low-cost, high-volume composite preforms and intermediates
- Composite processing (e.g., high speed compression molding, compression molding flow, injection molding long-fiber thermoplastics, high-pressure resin transfer molding (HP-RTM), tool-less prototype of thermoplastic composites)
- Hybrid manufacturing for complex structures (e.g., additive and subtractive)
- Innovative fiber architecture (e.g., fiber orientation control, comingled fibers, and/or recycled fibers)
- Innovations enabled by structural health monitoring, machine learning and artificial intelligence for manufacturing processes; and
- Improved integrated computational materials engineering (ICME) framework for predictive modeling of advanced composites - from fiber to components.

General Requirements

Applications **must**:

1. Identify a specific vehicle component application.
2. Include a plan to complete a cost analysis at the conclusion of the project.
3. Include a plan to move development from raw materials through component production
4. Include a plan to verify the performance of the vehicle component
5. Incorporate materials reuse and recycling into component design
6. Participate in the Annual Merit Review held in Washington DC.

Specific Requirements

1. Composite reinforcements may include a non-metallic, non-ceramic form of continuous and discontinuous fibers or nanomaterials such as graphene, nano-carbon fiber, carbon nanotubes, etc.
2. Matrix development may include different types of resin systems (polymer matrices such as thermosets, thermoplastics, vitrimers, or hybrid thermoplastic/thermoset).

Teaming Arrangements

Applications **must** include the following membership on proposed project teams:

- At least one automotive or heavy-duty original equipment manufacturer (OEM) or Tier 1 supplier to provide automotive performance, cost, and manufacturing requirements. For the purposes of this area of interest, an OEM is defined as a commercial manufacturer that sells at least 500 vehicles annually.
- At least one team member with manufacturing expertise and scale-up capability in materials development.
- At least one material supplier with expertise in the production of structural polymer composites.

Applicants are encouraged but not required to utilize the Carbon Fiber Technology Facility (CFTF) at Oak Ridge National Laboratory during the project. However, as with any other team member, work at CFTF must be included in the overall project plan, project budget, and applicable cost share.

Applications Discouraged

- Applications which utilize metal or ceramic reinforcements
- Applications which largely focus on development of reinforcement fibers

Special Deliverables:

In addition to the deliverables required in the Federal Assistance Reporting Requirements Checklist, the following deliverables are required for awards made under this area of interest:

1. Details of cost model that shows a pathway for future commercialization on the selected specific components,
2. Documentation of the projects weight savings and cost compared to DOE baseline components.

AOI 9: Improving Transportation System Efficiency Through Better Utilization

Introduction

Current vehicle design and transportation networks have evolved over decades, and play a critical role in providing mobility that enhances the prosperity and quality of life for all Americans. As new technologies and transportation services enter the market, an opportunity exists to create a more optimized mobility system for the future. Despite significant advances in communications, vehicle systems, and connected mobility service models, average vehicle occupancy has remained steady over the last two decades. The rapid growth of transportation network companies (TNCs) has also impacted energy use and vehicle utilization within the transportation system. Research evaluating the impacts of future transportation technologies and services has shown a wide variation in the potential energy use of future mobility technologies. Additional studies have identified important levers that will lead to more energy efficient outcomes by better utilizing the vehicles that provide mobility to individuals and businesses.

Objective

This area of interest seeks projects to research and develop novel and innovative solutions to address the barriers related to the key levers to improve vehicle utilization and transportation efficiency (productive travel miles per unit of energy), particularly:

- Increased vehicle occupancy (e.g., technology or human-factors methods to improve rideshare and carpooling)
- Improved repositioning to reduce deadheading (miles driven with no passenger or payload) for taxi, freight, and transportation network companies
- Improved vehicle routing for energy efficiency
- Energy efficient improvements for mobility

Applications should consider (a) technical barriers to improving overall transportation system efficiency, (b) human factors issues related to the adoption and use of new transportation technologies and services, or (c) both technical and human factors-related topics.

Technical barriers are those that inhibit the cost, performance, reliability, or feasibility of mobility solutions that enable more efficient use of the vehicles within the transportation network. This may include the design, operation, and utilization of vehicles and their supporting infrastructure.

Human-factors-related issues are those that relate to consumer preference and traveler behavior. Future mobility solutions should provide travelers with increased choice. However, the success of new transportation technologies and services will be determined by consumers' willingness to adopt new technologies, increased complexity of new mobility technologies, and uncertainty regarding the availability of transportation modes, among others. Proposed work may include novel methods to collect and analyze traveler behavior and preference data including, but not limited to, value of travel time, willingness to wait, and flexibility in travel schedule.

General Requirements

Applications should include phases for technology development, implementation, and real-world validation. Proposals should include detail on the expected energy efficiency and affordability improvements of the proposed technology solution.

Applications **must**:

1. Clearly describe the technology to be developed and technical barriers to be overcome for successful implementation.
2. Clearly identify metrics of the proposed project, including baseline performance and end of project targets.
3. Quantify the expected energy, mobility, and/or affordability benefits that would result from the deployment of the technology to be developed, supported by analysis, modeling, or simulation results.
4. Include three project phases for technology development, implementation, and validation.
5. Include analysis showing the cost-effectiveness of the proposed technology.
6. Describe how the project team will share the data on expected energy/mobility/affordability improvements with DOE and its National Laboratories.
7. Describe how data generated by the project will quantify the energy and mobility gains that result from the proposed technology, and how the project team will share this data with DOE and its national laboratories.
8. Participate in the Annual Merit Review held in Washington, DC.

Specific Requirements

None.

Teaming Arrangements

Teams are encouraged to include research partners from industry, transportation network companies, and/or National Laboratories, as appropriate.

Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Requirements Checklist, VTO will require recipients to provide all testing and validation data produced in the project validation phase to the SMART Mobility National Lab Consortium (<https://www.energy.gov/eere/vehicles/energy-efficient-mobility-systems>) through the Livewire Data Platform (<https://livewire.energy.gov>) in a timely manner. Data that the project teams do not wish to be made public will be protected through a Non-Disclosure Agreement with the relevant laboratories in the Consortium.

AOI 10: Enabling Vehicle and Infrastructure Connectivity

Introduction

Connected vehicle applications have the potential to improve energy efficiency in light-duty, medium-duty, and heavy-duty vehicles. However, the effectiveness of vehicle connectivity in achieving efficiency benefits in all operating environments (e.g., mixed traffic consisting of both connected and unconnected vehicles) is not fully known. Past research and development efforts have produced several promising connected vehicle applications; however, recent breakthroughs in sensing, perception, and computing have resulted in an industry emphasis on vehicle automation rather than connectivity. Vehicle automation without connectivity may limit, or in some cases negate, the energy efficiency benefits of connected and automated technologies. For example, research has shown that in some cases, adaptive cruise control (ACC) results in a drive profile that increases fuel consumption, while connectivity-enabled cooperative adaptive cruise control (CACC) may reduce it.

Objective

The objective of this area of interest is to research, develop, and validate vehicle connectivity (i.e., vehicle-to-infrastructure [V2I] and/or vehicle-to-vehicle [V2V] communication) to reduce the energy consumption and emissions and to improve mobility in the transportation system at multiple scales (e.g., intersection, corridor, and/or region).

General Requirements

Applications **must**;

1. Select an infrastructure-based and/or vehicle-based project approach and discuss the rationale for selection;
2. Identify the baseline transportation system and quantify the current energy, mobility, and emissions baseline;
3. Consider mixed traffic environments that include both connected and unconnected vehicles;
4. Characterize communication latency and transmission range;
5. Specify plans to use human-driven and/or automated vehicles;
6. Describe the technology to be developed and technical barriers to be overcome for successful implementation;
7. Quantify the expected energy, emission, mobility, environmental and/or safety benefits that would result from the deployment of the technology to be developed, supported by analysis, modeling, or simulation results;
8. Include three project phases for technology development, implementation, and validation;
9. Include analysis demonstrating the cost-effectiveness of the of the proposed technology;
10. Include development of a test plan and a description of the proposed testing to be performed in the validation phase, as well as description of data that will result from test plan execution (test plans for concepts that require large-scale deployment to achieve their expected benefits may incorporate other validation methods, including hardware-in-the-loop simulation, small-scale testing and validation, or other means to operate the solution in the same manner as it would function in a transportation system);

11. Describe how data generated by the project will quantify the energy and mobility gains that result from the proposed technology;
12. Be consistent with, and not duplicate, previous and current Federal activities related to vehicle connectivity and automation, specifically by the U.S. Department of Transportation (USDOT), including the principles summarized in Automated Vehicles 3.0 (<https://www.transportation.gov/av/3>); and
13. Participate in the Annual Merit Review held in Washington, DC.

Specific Requirements

None.

Teaming Arrangements

Teams are encouraged to include research partners from universities or national laboratories as appropriate.

Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Requirements Checklist, recipients are required to provide all testing and validation data produced in the project validation phase to the SMART Mobility National Lab Consortium (<https://www.energy.gov/eere/vehicles/energy-efficient-mobility-systems>) through the Livewire Data Platform (<https://livewire.energy.gov>) in a timely manner. Data that project teams do not wish to be made public will be protected through a Non-Disclosure Agreement with the relevant laboratories in the Consortium.

AOI 11: Improving Mobility, Affordability, and Energy Efficiency Through Transit

Introduction

Transit can provide mobility and access for individuals and enables essential connections across communities where people live and work, delivering an effective and efficient means of transportation. However, low ridership of many transit systems in the United States means many are underutilized for a variety of reasons, including long waits and travel times. The barriers to transit system use, which lead to system inefficiencies, vary by individual and location.

Objective

The objective of this area of interest is to research, develop, apply, and validate technology and/or data solutions to improve the efficiency and effectiveness of transit so that it better meets Americans' transportation demands.

Approaches may include, but are not limited to:

- Utilize data collection by transit agency to enhance operations as well as connections to new mobility providers
- Make data available to travelers to enable more informed mode choice
- Utilize machine learning to optimize transit and/or mobility-linked routing and schedule

General Requirements

Applications ***must***:

1. Identify and describe the baseline transit system and quantify the current energy and environmental impact baseline
2. Describe the technology or innovation to be developed and technical barriers to be overcome for successful implementation;
3. Quantify the expected energy, mobility, and/or affordability benefits that would result from the deployment of the technology or system, and describe how it would enhance the traveler experience and promote mobility for all travelers, supported by analysis, modeling, or simulation results
4. Include three project phases for technology development, implementation/application, and validation
5. Include analysis showing the cost-effectiveness of the proposed innovation and how it aligns with transit authority budgets and purchasing decisions
6. Describe how data generated by the project will quantify the energy and mobility gains that result from the proposed technology;
7. Be consistent with, and not duplicate, previous and current Federal transit research currently administered by the Federal Transit Administration (transit.dot.gov/research-innovation); and
8. Participate in the Annual Merit Review held in Washington DC.

Specific Requirements

None.

Teaming Arrangements

Applicant teams must include at least one transit agency. Project participation by industry and/or National Laboratories is highly encouraged.

Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Requirements Checklist, recipients are required to provide all testing and validation data produced in the project validation phase to the SMART Mobility National Lab Consortium (<https://www.energy.gov/eere/vehicles/energy-efficient-mobility-systems>) through the Livewire Data Platform (<https://livewire.energy.gov>) in a timely manner. Data that project teams do not wish to be made public will be protected through a Non-Disclosure Agreement with the relevant laboratories in the Consortium.

AOI 12: Gaseous Fuels Technology Demonstration Projects

Introduction

Gaseous fuels, such as Natural Gas (NG), Propane (LPG) and Hydrogen (H₂) continue to make in-roads as viable alternative fuel choices in the transportation sector. Examples of this are evident in a variety of fleets from package, food and beverage delivery to school and transit buses. As the transportation sector continues to grow, diversified affordable solutions will ensure resiliency and affordability, while meeting increasing energy demands. Gaseous fuels are poised to play a key role as a versatile, low-emission fuel and are an increasingly attractive alternative to conventional diesel fuel. Renewable natural gas (RNG) is well positioned to further increase the interest in and motivation for expanding the use of natural gas in the transportation sector. However, there are still technological challenges that need to be overcome in order to advance the adoption and commercialization of these gaseous fuels technologies.

Objective

The goal of this area of interest is to demonstrate technologies that can help to reduce costs and advance the commercialization of gaseous fuel (H₂, NG, and LPG) vehicles and refueling infrastructure. Topics of interest include, but are not limited to; energy efficiency improvements, emissions, refueling, maintenance costs, operating costs, and new engine demonstrations. Vehicle platforms can include medium and heavy-duty on-road vehicles. In addition, rail or marine projects that demonstrate or validate the use of compressed/liquefied natural gas or propane are also encouraged. Infrastructure projects that develop and demonstrate cost-effective, reliable, and replicable bio-gas cleanup systems to enable more widespread use of RNG in vehicles are also of interest.

General Requirements

Applications must do the following:

1. Identify the baseline technology and cost assumptions, including all aspects of total cost of ownership;
2. Identify technologies, designs, or approaches that will result in cost savings and/or improved affordability;
3. Include total cost of ownership reduction estimates (including up front purchase cost, maintenance cost and fuel cost and any fueling infrastructure cost) and the methodology/basis used to justify estimates;
4. Technology development projects must include an on-road or in-service field-test or demonstration phase in a practical application and describe a viable pathway to commercialization;
5. Include a data gathering/sharing plan to document performance improvements and impact of critical variables;
6. Identify a commercialization pathway for any new designs or equipment developed under the project;
7. Engine/vehicle conversion systems must be compliant with all applicable Federal and state safety and emissions standards for the states in which they are intended to operate. New (original

equipment manufacturer, or OEM) factory-produced alternative fuel vehicles or converted vehicles that have been up-fitted by OEM authorized/warranted Qualified Vehicle Modifiers (QVMs) are strongly preferred; and

8. Participate in the Annual Merit Review held in Washington DC.

Specific Requirements

None.

Teaming Arrangements

Project teams that include the following partners are highly encouraged:

- Clean Cities coalition(s) (<https://cleancities.energy.gov/coalitions/locations/>)
- Compressed natural gas (CNG)/liquefied natural gas (LNG)/H2/LPG fuel tank manufacturers/suppliers
- Engine manufacturers
- Relevant marine/rail equipment manufacturers
- Gaseous Fuel Infrastructure/Fueling Station Suppliers
- Vehicle/equipment OEMs and qualified vehicle manufacturers (QVMs)
- Academic institutions and research/technology partners with relevant gaseous fuel experience
- Vehicle and sub-assembly manufacturers
- Research/technology partners with relevant gaseous fuel experience
- Fleets and end-user groups with related field experience

Applications Discouraged:

None.

Special Deliverables

None.

AOI 13: Alternative Fuel Proof-of-Concept in New Communities and Fleets

Introduction

Small, targeted proof-of-concept demonstrations of alternative fuel vehicles (AFVs) and fueling infrastructure can give fleets the experience needed to make technology adoption decisions, helping them understand cost, operational issues, and performance attributes before making a significant investment. These projects also allow the sharing of data, best practices, and lessons learned with other fleets in their areas. Small demonstrations in fleets with little or no alternative fuel and advanced technology vehicle experience also provide an efficient way to increase adoption by reducing the risk of a first adoption.

Objective

The objective of this area of interest is to demonstrate an alternative fuel or advanced technology fleet of five or fewer vehicles and supporting infrastructure in communities, fleets, or areas that have no or little experience with these technologies.

General Requirements

Applications **must** include:

1. A discussion of how the project will lead to broader technology adoption in that area
2. A description of the commercially-available, on-road alternative fuel and/or advanced technology light-, medium-, or heavy-duty vehicles to be demonstrated under the proposed project, including the number of vehicles the project will involve.
3. A description of the type of alternative fuel to be used and the rationale for selection, as well as infrastructure plans for refueling or recharging of up to five vehicles.
4. Identification of at least one project site and one fuel retailer if fueling infrastructure is included. If a fuel retailer cannot be identified within the application, the application should identify the methodology, approach, and timeline to select the project site(s) and obtain project commitments.
5. A fleet data management plan that addresses data collection, analysis, terms and conditions for use, privacy and security provisions, public dissemination, and all limitations on public dissemination.
6. An outreach plan to communicate project results, including lessons learned, best practices, and case studies, to educate fleets in the same geographic area.
7. A plan for continuing project activities beyond project completion to include gaining future commitments.
8. Participation in the Annual Merit Review held in Washington DC.

Specific Requirements

Vehicles: Alternative Fuel Vehicles must be used 100% for the project scope

1. Funding for up to five new OEM AFVs or the conversion of up to five new conventional vehicles to run on alternative fuels.

2. Original equipment manufacturer (OEM) factory-produced alternative fuel vehicles must be new.
3. Alternative fuel vehicle conversions are allowable when performed by OEM-authorized/warranted Qualified Vehicle Modifiers.
4. All vehicles must be certified by the U.S. Environmental Protection Agency (EPA) and/or the California Air Resources Board and meet applicable Federal Motor Vehicle Safety Standards for on-road use
5. If vehicle leases are planned, the monthly commercial vehicle lease price should be used to determine project costs.

Fuels: Alternative fuels must comply with the Energy Policy Act definition (<http://www.afdc.energy.gov/fuels>)

Infrastructure: All types of fueling infrastructure are acceptable and may include new dispensing facilities, additional equipment or upgrades, and improvements to existing alternative fuel fueling sites.

Teaming Arrangements

- Applicants are strongly encouraged to include active participation by at least one Clean Cities coalition with clearly documented roles, responsibilities, and budgets.
- Applicants are strongly encouraged to include a public or private vehicle fleet for the demonstration.
- Applicant Teams that include OEMs or other vehicle and/or infrastructure equipment providers, fuel suppliers, and experienced data collection partners (e.g., universities or other academic/research organizations) are encouraged.

Applications discouraged

None.

Special Deliverables

Recipients **must** provide all sharable data to a to-be-designated DOE national laboratory.

AOI 14: Electric Vehicle and Charging Community Partner Projects

Introduction

DOE's Technology Integration (TI) Program, through its Clean Cities activities for 25 years, has encouraged robust local and regional partnerships to ease barriers and encourage the use of new transportation technologies. Strong local partnerships may include electricity providers, station hosts, electric vehicle dealerships, original equipment manufacturers (OEMs), non-profit organizations, government agencies and other major stakeholders that work together to support and demonstrate plug-in electric vehicles and related infrastructure. These community partnerships are needed to efficiently cut through regulatory and market barriers to technology introduction. In addition, partners' collection of real world operating data from innovative vehicle and infrastructure demonstrations allow researchers to evaluate how to scale demonstrations to the next level. Strong outreach and educational efforts are essential to disseminate lessons learned and best practices that can be used to encourage more local innovation and to reduce barriers in other geographic areas. Effective outreach and education by local partnerships regarding technology demonstration experiences can not only help inform fleets and consumers about the practical effects of using new technologies but also help reduce costs and increase efficiency as much as possible.

Objective

The objective of this area of interest is to encourage strong local and/or regional partnerships to create an enduring local ecosystem in a given geography to support increased business and consumer use of electric vehicles. By concentrating multiple sub-projects in a geographic area, partnerships are encouraged to demonstrate various plug-in electric vehicle applications, such as those described below, collect and disseminate data, and document and share project learnings and best practices with researchers and others.

Anticipated applications may include, but are not limited to, the following approaches:

- Electric vehicle corridor development
- Workplace charging infrastructure and policies
- Electrification of on-road and off-road vehicles at ports and airports and supporting infrastructure
- Electrification of freight vehicles and infrastructure
- Multi-unit dwelling and curbside charging
- Electrification of public and/or private transit buses and infrastructure as well as multi-modal electrified transportation hubs
- Electrification of ride hailing vehicles, taxis, car sharing and/or rental vehicles
- Charging co-located with retail, medical clinics, hospitals and/or other businesses or government entities (e.g., museums, DMVs and other) where EV drivers may have dwell times.
- Infrastructure and EV availability in under-served areas (i.e., areas that currently are devoid of or have very little available EV infrastructure)

- Destination charging and electric transportation services to recreation facilities and other attractions that attract a large number of visitors (e.g., parks, forests, wildlife refuges, historical sites)

General Requirements

Applications **must** include:

1. A description of the planned geography of the proposed project
2. A discussion of how the project will impact broader plug-in vehicle technology adoption and how the technologies may reduce costs for end users
3. A description of the commercially-available light-, medium-, and/or heavy-duty plug-in electric vehicles technologies to be demonstrated; including the number of vehicles the project will involve.
4. A plan for strategic deployment of Level 2 and DC fast charging (DCFC) charging infrastructure to support existing electric vehicles and those in this project. The plan should identify commitments from charging host partners and provide a timeline for completion of charging site locations. If the commitments and locations of sites are not included, the methodology, approach and timeline for site development should be provided.
5. A plan to collect data for project-related vehicles and infrastructure that includes analysis, terms and conditions for use, privacy and security provisions, public dissemination, and any limitations on public dissemination.
6. An outreach plan to broadly communicate project results, including lessons learned, best practices, case studies, and success stories to serve as templates for other communities in scaling up adoption of plug-in electric vehicles.
7. A plan for continuing related activities beyond project completion and gaining future commitments.
8. To the greatest extent possible, projects should leverage ongoing, or propose new, smart mobility or smart cities initiatives.
9. Participation in the Annual Merit Review held in Washington DC.

Specific Requirements

Vehicles:

1. Electric Vehicles must be used 100% for the project scope
2. Vehicles must be new, original equipment manufacturer (OEM) factory-produced
3. All vehicles must be certified by the U.S. Environmental Protection Agency (EPA) and/or the California Air Resources Board and meet applicable Federal Motor Vehicle Safety Standards for on-road use
4. For vehicle leases, the monthly commercial vehicle lease price should be used to determine project costs.

Infrastructure:

- Electric Vehicle Supply Equipment (EVSE) must be Level 2 and above and may include new charging facilities, additional equipment at existing sites, and improvements to existing charging sites.

Teaming Arrangements

- Applicants are encouraged to include strategic partners such as utilities and other electricity suppliers; community-based groups or local/regional governments; charging station hosts; auto, truck and equipment dealerships; retailers; public or private fleets, and recharging equipment installers, dealers and manufacturers.
- Applicants are strongly encouraged to include active participation by at least one Clean Cities coalition with clearly documented roles, responsibilities, and budgets.

Applications Discouraged

None.

Special Deliverables

Recipients **must** provide all sharable data to a to-be-designated DOE national laboratory.

AOI 15: Technology Integration Open Topic

Introduction

The open topic allows stakeholders the opportunity to explore novel solutions to transportation and energy deployment challenges that have not been addressed by other areas of interest in this announcement. This topic provides Clean Cities coalitions an opportunity to address challenges and explore solutions to transportation energy problems that foster broader adoption of alternative fuel vehicles and installation of supporting infrastructure.

Objective

The objective of this area of interest is to develop and demonstrate innovative solutions to current transportation challenges that impact efficiency and affordability, are broadly replicable, and accelerate or enable more widespread access to alternative fuels (plug-in electric, natural gas, propane, hydrogen, E85 flex fuel [51% to 83% ethanol blended with gasoline], and B20 or higher blends of biodiesel). Projects are also of interest that address difficult technology integration challenges and barriers or problems that are identified in the field (e.g., challenges imposed by hot or cold weather conditions, etc.).

Potential focus areas include (but are not limited to):

- **Level-2 EVSE demonstration/deployment projects** that install cost effective level-2 EVSE to increase convenience and visibility of EV charging in populated areas. This could include public spaces, street side and multi-family residential properties.
- **Auxiliary school/transit bus heating systems** for electric vehicles – Projects that develop CNG or propane powered high efficiency low-emission cabin heater systems to reduce/eliminate impact on electric vehicle driving range during cold weather. Of particular interest are applications within fleets that already have CNG or propane fueling infrastructure. These projects must include an on-road demonstration phase to validate performance and benefits.
- **Innovative CNG fuel tank business models** – tank leasing, performance contracting, or other innovative business approaches that significantly reduce or eliminate the up-front cost of CNG fuel tanks... possibly in conjunction with public utility led demand side management or integrated resource plan incentive programs
- **Alternative Fuel maintenance cost studies** – detailed analysis and studies based on actual/documented operating and maintenance costs of alternative fuel vehicles (plug-in electric, natural gas, propane, hydrogen, E85 flex fuel [51% to 83% ethanol blended with gasoline], and B20 or higher blends of biodiesel) in real world applications compared to conventional gasoline and/or diesel vehicles in similar applications and operating conditions. Studies based on fleets that track and maintain accurate maintenance and operating records are of particular interest.

Alternative fuel projects that include the following are also of interest:

- “Multiple” EVSE level-2 charging positions clustered in strategic locations to serve fleets, employees, building tenants, and the general public.
- EVSE that are free to use or for a nominal fee
- Innovative technology to increase the use of LNG and CNG
- Projects that track and report alternative fuel and vehicle utilization, user feedback, etc.
- Outreach & education activities and campaigns designed to increase awareness and /or provide incentives to increase utilization of alternative fuel or charging infrastructure equipment being installed.
- Double-use applications (e.g., EVSE used to charge fleet vehicles overnight, but are made available for employee workplace charging during the work day)
- Projects that include fueling or charging infrastructure installations designed to accommodate persons with special needs (ADA compliance)

General Requirements

Applications **must**:

1. Identify technologies, approaches, or activities that can result in significant improvements to domestic energy security and efficiency through fuel diversification, provide mobility gains, accelerate and/or enable more widespread access to affordable alternative fuels, highly efficient vehicles, and mobility systems.
2. Identify specific challenges, barriers, or problems that will be addressed
3. Clearly identify roles and responsibilities of Clean Cities coalition partners and allocate adequate funding to support those activities.
4. For infrastructure development projects:
 - a. Equipment and installation must be compliant with all applicable codes and standards
 - b. Must be coordinated with the Alternative Fuel Data Center (AFDC) for station locator and tracking purposes
 - c. The project must include an ongoing operating and maintenance plan to keep refueling/charging equipment in good working order
5. Projects must be structured to produce results and insights that are replicable in other areas across the country. Applicants will produce a final technical report that documents project information, analyses, and insights that support project replicability. Reports, analyses, and other deliverables that are developed under this award must be publicly releasable.
6. Technology Development projects – must include an on-road or in-service demonstration phase to validate performance and benefits of alternative fuel and advanced technology vehicles
7. Engine/vehicle conversion systems must be compliant with all applicable Federal and state safety and emissions standards for the states in which they are intended to operate. New

(original equipment manufacturer, or OEM) factory-produced alternative fuel vehicles or converted vehicles that have been up-fitted by OEM authorized/warranted Qualified Vehicle Modifiers (QVMs) are strongly preferred.

- Participate in the Annual Merit Review held in Washington DC.

Specific Requirements

None.

Teaming Arrangements

Applicant teams **must** include at least one designated/active Clean Cities coalition as a lead applicant or key/primary partner. The combined work performed by the Clean Cities Team Member(s) must total to at least 30% of the total project costs. (<https://cleancities.energy.gov/coalitions/locations/>).

Project teams that include the following partners are highly encouraged:

- Consortiums that include multiple Clean Cities coalitions
- Vehicle, Fuel & Infrastructure Providers, Utility Companies, EV charging network providers, EVSE equipment suppliers
- Fleets & End-user Groups with related field experience
- Relevant Industry Trade Associations or property management organizations that represent large groups of site operators or popular destinations that serve target markets and desired locations (e.g., RV parks, camp-grounds and large fleet/workplace campuses for level-2 EVSE projects, travel plazas and truck stops, etc.).
- Local/Regional/State Governments, Transit Agencies, Metropolitan Planning Organizations

Applications Discouraged:

None.

Special Deliverables

None.

AOI 16: Transportation and Energy Analysis

Introduction

The Analysis Program provides a cross-cutting, overarching, and convening role within VTO in its support for and application of energy, environmental, and economic models and tools. These tools serve to estimate benefits and identify and evaluate gaps, opportunities, and challenges for VTO-relevant technologies, including electrification, advance combustion, materials technology, and energy-efficient mobility systems.

Conventionally, VTO has relied on national laboratory expertise and methods for model development and application; however, given recent and ongoing developments in electrification, connectivity and automation, and the shared economy and their potential to transform the U.S. transportation system, the Analysis Program recognizes the timely opportunity to solicit the development of new models and tools as a complement or improvement to conventional methods.

Objective

Accordingly, VTO seeks projects that use real-world data (or representative synthetic data) to develop and/or apply new analytical models and tools or a novel application of an existing model(s) to estimate energy use and associated impacts along with illustrative application(s) of that new or existing model/tool to identify novel transportation technology opportunities and insights, especially in terms of potential energy impacts.

Example topics of interest include, but are not limited to, the following:

- Personal Mobility Beyond Vehicles (e.g., bike share, scooters, etc.)
- Electrification of and/or Infrastructure For Medium- and Heavy-Duty Vehicles
- Electro-Fuels and Grid Services
- Other Movement of People and Goods

General Requirements

In general, applications must do at least one the following:

1. Develop and validate market segmentation, agent-based, or other modeling approaches capable of estimating the potential energy impacts of emerging personal mobility modes (e.g., bike share, scooters, etc.).
2. Develop, integrate, and validate a combination of commodity flow, vehicle travel, and infrastructure scenario analysis, in conjunction with techno-economic analysis and other novel approaches to identify optimal medium- and heavy-duty vehicle electrification routes.
3. Develop, integrate, and validate models, simulations or analysis for various combinations of light-, medium-, and heavy-duty vehicles; excess intermittent renewable power; fast-charging; battery second-use; and battery recycling considerations to quantify the potential economic benefits of grid-connected vehicles.
4. Develop and validate novel analytical methods and illustrative applications for light vehicles, heavy trucks, and/or other transportation modes (or systems of multiple modes) either to

estimate energy use and associated impacts and/or to identify novel transportation technology opportunities.

Additionally, all applications must do the following:

5. Describe the real-world data (or representative synthetic data) that will power proposed models and tools; using open-source data or collecting and/or making available new data are especially encouraged;
6. Result in a new model or tool (or a novel application of an existing model or tool) that can subsequently be accessed and re-applied by DOE and future potential collaborators; and
7. Include participation in the Annual Merit Review held in Washington, DC.

Specific Requirements

None.

Teaming Arrangements

Project teams that include some combination of the following partners are highly encouraged:

- Universities and other academic institutions
- Non-profit “think tanks”
- Engineering and/or economic analysis organizations
- Shared mobility partners, transportation network companies, taxi companies, transit agencies
- State/local governments, transit agencies, metropolitan planning organizations
- (Note: National Laboratories are permitted as part of a broader team)

EERE highly discourages applications that include the following:

- Include an illustrative application of a new or existing model or tool
- Result in proprietary or confidential models and tools
- Promote a specific brand, product, or invention
- Analyze novelty vehicles, restricted-use low-speed vehicles, and other off-road recreational or sport vehicles

Special Deliverables

None.

C. Applications Specifically Not of Interest

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (See Section III.D of the FOA):

All AOIs

- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics)

For AOI 1:

- Applications that propose significant development of the cathode

For AOI 3:

- Applications that include novelty vehicles and other recreational or sport vehicles.

For AOI 8:

- Applications which utilize metal or ceramic reinforcements
- Applications which largely focus on development of reinforcement fibers

For AOI 11:

- Applications that propose to only perform modeling and simulation of a connected and automated system solution without physical implementation and validation

For AOI 12:

- Applications for projects with the primary purpose of subsidizing the cost of vehicles, infrastructure, construction, hardware, and equipment
- Applications for projects that include rebates or incentives on equipment purchases
- Applications for projects that include converting or re-powering engines/vehicles under EPA's "Outside of Useful Life" criteria
- Applications for projects that promote a specific brand
- Applications for projects that include novelty vehicles and other off-road recreational or sport vehicles

For AOI 13:

- Applications in geographic areas where alternative fuel technology is prevalent or applications involving fleets that already have experience or are using the fuel being proposed; and
- Applications for projects that do not include sharing or disseminating project data across the geographic region at a minimum.

- Applications that do not include a plan to provide all sharable data to a designated DOE national laboratory
- Applications that include rebates or incentives.
- Applications for projects that use vehicles that are not certified by the U.S. Environmental Protection Agency (EPA) and/or the California Air Resources Board or meet applicable Federal Motor Vehicle Safety Standards
- Applications that use pre-commercial vehicles and light-duty gasoline hybrid electric vehicles
- Applications that use alternative fuels that do not comply with the Energy Policy Act definition: <http://www.afdc.energy.gov/fuels>
- Applications that do not plan to use project vehicles solely for the project scope
- Applications for projects that use vehicles converted using EPA's "Outside of Useful Life" criteria

For AOI 14:

- Applications that include rebates or incentives
- Applications that include the purchase of land
- Applications for projects that use an EVSE that does not comply with applicable performance and safety certifications from an approved Nationally Recognized Testing Laboratory (NRTL)
- Applications for projects that use EVSE installations that do not comply with applicable installation codes and standards
- Applications for projects that use EVSE installations and signage that do not comply with the Americans with Disabilities Act (ADA)

For AOI 15:

- Applications that "promote" a specific brand, product, invention, or company or that include equipment or infrastructure that is only compatible with a single brand of vehicle
- Applications that include novelty vehicles, restricted use low-speed electric vehicles (LSEV), neighborhood electric vehicles (NEV), golf carts, all-terrain vehicles (ATV), E-bikes and E-scooters.
- Applications that include EVSE installations in private homes or single family residences
- Applications that include bi-directional charging, vehicle to grid (V2G), or other general grid backup and emergency power applications

- Applications for projects that use vehicles converted using EPA's "Outside of Useful Life" criteria

D. Authorizing Statutes

The programmatic authorizing statutes are Public Law 102-486, Energy Policy Act (EPA) of 1992, amended by Public Law 109-58, EPACT 2005, Title IX, Subtitle A, Section 911 and the Energy Independence and Security Act of 2007, P.L. 110-140 (EISA 2007).

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulations (CFR) Part 200 as amended by 2 CFR Part 910.

II. Award Information

A. Award Overview

i. Estimated Funding

EERE expects to make a total of approximately \$133,200,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 45-78 awards under this FOA. EERE may issue one, multiple, or no awards under each area of interest. Individual awards may vary between \$200,000 and \$7,500,000.

The anticipated total federal funding and the approximate maximum and minimum federal Share for any one individual award made under this announcement are set forth in the table below. EERE may issue awards in one, multiple, or none of the following areas of interest:

AOI Number	Area of Interest	Anticipated Number of Awards	Anticipated Minimum Award Size for Any One Individual Award (Fed Share)	Anticipated Maximum Award Size for Any One Individual Award (Fed Share)	Approximate Total Federal Funding Available for All Awards	Anticipated Period of Performance
1a	Lithium Ion Batteries using Silicon-based Anodes Research	3-5	\$0.6M	\$1M	\$3M	39 months
1b	Lithium Ion Batteries using Silicon-based Anodes Research, Development, and Validation	3-5	\$2.4M	\$4M	\$12M	39 months
2	Low Cost Electric Traction Drive Systems Using No Heavy Rare Earth Materials	2-3	\$3.33M	\$5M	\$10M	39 months
3	Utility Managed Smart Charging Research and Demonstration	3-4	\$3.75M	\$5M	\$15M	39- 51 months
4	Platinum Group Metals (PGM) Content Reduction to Enable Cost-Effective Aftertreatment for Gasoline and Diesel Engines	2-3	\$1.67M	\$2.5M	\$5M	39 months
5	Improved Efficiency of Medium- and Heavy-Duty Natural Gas and Propane (LPG) Engines	2-3	\$2.5M	\$3.75M	\$7.5M	39 months
6a	Research to Transform the Efficiency of Off-Road Vehicles	2-3	\$1.67M	\$2.5M	\$5M	39 months

6b	Efficient Agricultural Vehicle Research, Development, and Validation	1-2	\$2.5M	\$5M	\$5M	39 months
7	Two-Stroke, Opposed Piston Engine Research and Development	1-2	\$2.5M	\$5M	\$5M	39 months
8	Lightweight and High-Performance Fiber-Reinforced Polymer Composites for Vehicle Applications	2-4	\$3.75M	\$7.5M	\$15M	39 months
9	Improving Transportation System Efficiency Through Better Utilization	3-4	\$1.5M	\$2M	\$6M	39 months
10	Enabling Vehicle and Infrastructure Connectivity	2-3	\$1.33M	\$2M	\$4M	27 - 39 months
11	Improving Mobility, Affordability, and Energy Efficiency through Transit	2-3	\$1.2M	\$1.75M	\$3.5M	39 months
12	Gaseous Fuels Technology Demonstration Projects	1-3	\$1.2M	\$3.5M	\$3.5M	39 months
13	Alternative Fuel Proof-of-Concept in New Communities and Fleets	7-14	\$0.5M	\$1M	\$6.5M	39 months
14	Electric Vehicle and Charging Community Partner Projects	3-5	\$4M	\$6.67M	\$20M	39 months
15	Technology Integration Open Topic	3-6	\$1M	\$2M	\$6M	39 months
16	Transportation and Energy Analysis	3-6	\$0.2M	\$0.4M	\$1.2M	15 - 39 months

ii. Period of Performance

EERE anticipates making awards up to 51 months in length, comprised of the following budget periods.

Budget Period	Budget Period Length
1	15 months
2	12 months
3	12 months
4	12 months

Funding for all budget periods, including the initial budget period, is not guaranteed. Project continuation will be contingent upon satisfactory performance and Go/No-Go decision review. At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, and overall contribution to the program goals and objectives. As a result of this evaluation, EERE will make a determination to continue to fund the project, recommend re-direction of work under the project, place a hold on federal funding for the project or discontinue funding the project.

iii. New Applications Only

EERE will accept only new applications under this FOA. EERE will not consider applications for renewals of existing EERE-funded awards through this FOA.

B. EERE Funding Agreements

Through Cooperative Agreements and other similar agreements, EERE provides financial and other support to projects that have the potential to realize the FOA objectives. EERE does not use such agreements to acquire property or services for the direct benefit or use of the United States Government.

i. Cooperative Agreements

EERE generally uses Cooperative Agreements to provide financial and other support to prime recipients.

Through Cooperative Agreements, EERE provides financial or other support to accomplish a public purpose of support or stimulation authorized by federal statute. Under Cooperative Agreements, the Government and prime recipients share responsibility for the direction of projects.

EERE has substantial involvement in all projects funded via Cooperative Agreement. See Section VI.B.ix of the FOA for more information on what substantial involvement may involve.

ii. Funding Agreements with Federally Funded Research and Development Center (FFRDCs)

In most cases, FFRDC are funded independently of the remainder of the Project Team. The FFRDC then executes an agreement with any non-FFRDC Project Team members to arrange work structure, project execution, and any other matters. Regardless of these arrangements, the entity that applied as the prime recipient for the project will remain the prime recipient for the project.

III. Eligibility Information

To be considered for substantive evaluation, an applicant's submission must meet the criteria set forth below. If the application does not meet these eligibility requirements, it will be considered ineligible and removed from further evaluation.

A. Eligible Applicants

i. Restricted Eligibility

The National Energy Technology Laboratory is ineligible to participate as a prime applicant or as a team member/sub-recipient on any application because of its role in developing the requirements for this announcement.

Entities applying as the prime applicant under AOI 1a entitled, "Lithium Ion Batteries using Silicon-based Anodes-Research," are restricted to universities, colleges, and non-profit research institutions which operate as divisions under colleges or universities. All other entities that submit an application as a prime applicant to this AOI will be considered non-responsive and the application will not be reviewed. The restricted eligibility does not apply to entities applying as a subrecipient.

Entities applying as the prime applicant under AOI 7 entitled "Two-Stroke, Opposed-Piston Engine Research and Development" are restricted to vehicle/engine manufacturers and developers. All other entities that submit an application as a prime applicant to this AOI will be considered non-responsive and the application will not be reviewed. The restricted eligibility does not apply to entities applying as a subrecipient.

ii. Individuals

U.S. citizens and lawful permanent residents are eligible to apply for funding as a prime recipient or subrecipient.

iii. Domestic Entities

For-profit entities, educational institutions, and nonprofits that are incorporated (or otherwise formed) under the laws of a particular State or territory of the United States and have a physical location for business operations in the United States are

eligible to apply for funding as a prime recipient or subrecipient. Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995, are not eligible to apply for funding.

State, local, and tribal government entities are eligible to apply for funding as a prime recipient or subrecipient.

FFRDC/National lab eligibility is as follows:

AOI Number	Area of Interest	Restricted Eligibility	DOE/NNSA FFRDC and/or Federal National Labs allowed as Recipient	DOE/NNSA FFRDC and/or Federal National Labs allowed as Subrecipient	Limit on total DOE/NNSA FFRDC and/or Federal National Lab participation as subrecipient(s) as a % of total project costs
1a	Lithium Ion Batteries using Silicon-based Anodes Research	Restricted to universities, colleges, and non-profit research institutions which operate as divisions under colleges or universities	No	Yes	10%
1b	Lithium Ion Batteries using Silicon-based Anodes Research, Development, and Validation	None	No	Yes	10%
2	Low Cost Electric Traction Drive Systems Using No Heavy Rare Earth Materials	None	No	Yes	25%
3	Utility-Managed Smart Charging Research and Demonstration	None	No	Yes	25%
4	Platinum Group Metals (PGM) Content Reduction to Enable Cost-Effective Aftertreatment for	None	No	Yes	25%

	Gasoline and Diesel Engines				
5	Improved Efficiency of Medium- and Heavy-Duty Natural Gas and Propane (LPG) Engines	None	Yes	Yes	No Limit
6a	Research to Transform the Efficiency of Off-Road Vehicles	None	Yes	Yes	No Limit
6b	Efficient Agricultural Vehicle Research, Development, and Validation	None	No	Yes	25%
7	Two-Stroke, Opposed Piston Engine Research and Development	Restricted to vehicle/engine manufacturers or developers	No	Yes	25%
8	Lightweight and High-Performance Fiber-Reinforced Polymer Composites for Vehicle Applications	None	No	Yes	25%
9	Improving Transportation System Efficiency Through Better Utilization	None	No	Yes	25%
10	Enabling Vehicle and Infrastructure Connectivity	None	No	Yes	25%
11	Improving Mobility, Affordability, and Energy Efficiency through Transit	None	No	Yes	25%
12	Gaseous Fuels Technology Demonstration Projects	None	No	Yes	25%
13	Alternative Fuel Proof-of-Concept in New Communities and Fleets	None	No	Yes	25%
14	Electric Vehicle and Charging Community Partner Projects	None	No	Yes	25%
15	Technology Integration Open Topic	None	No	Yes	25%
16	Transportation and Energy Analysis	None	No	Yes	25%

Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

iv. Foreign Entities

Other than as provided in the “Individuals” or “Domestic Entities” sections above, all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States and have a physical location for business operations in the United States. If a foreign entity applies for funding as a prime recipient, it must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed) under the laws of a State or territory of the United States to be the prime recipient. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate.

A foreign entity may receive funding as a subrecipient.

v. Incorporated Consortia

Incorporated consortia, which may include domestic and/or foreign entities, are eligible to apply for funding as a prime recipient or subrecipient. For consortia incorporated (or otherwise formed) under the laws of a State or territory of the United States, please refer to “Domestic Entities” above. For consortia incorporated in foreign countries, please refer to the requirements in “Foreign Entities” above.

Each incorporated consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium must provide a written description of its internal governance structure and its internal rules to the EERE Contracting Officer.

vi. Unincorporated Consortia

Unincorporated Consortia, which may include domestic and foreign entities, must designate one member of the consortium to serve as the prime recipient/consortium representative. The prime recipient/consortium representative must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. The eligibility of the consortium will be determined by the eligibility of the prime recipient/consortium representative under Section III.A of the FOA.

Upon request, unincorporated consortia must provide the EERE Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should discuss, among other things, the consortium’s:

- Management structure;
- Method of making payments to consortium members;
- Means of ensuring and overseeing members' efforts on the project;
- Provisions for members' cost sharing contributions; and
- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

B. Cost Sharing

The cost share must be at the required percentages identified in the table below and is calculated based on the total allowable costs (i.e., the sum of the Government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-federal sources unless otherwise allowed by law. (See 2 CFR 200.306 and 2 CFR 910.130 for the applicable cost sharing requirements.)

AOI Number	Area of Interest	Cost Share for Universities and Non-Profits as Prime Applicant	Cost Share for FFRDCs and National Labs as Prime Applicant	Cost Share for all Other Applicants as Prime Applicant
1a	Lithium Ion Batteries using Silicon-based Anodes Research	*0%	N/A	N/A
1b	Lithium Ion Batteries using Silicon-based Anodes Research, Development, and Validation	20%	N/A	20%
2	Low Cost Electric Traction Drive Systems Using No Heavy Rare Earth Materials	20%	N/A	20%
3	Utility Managed Smart Charging Research and Demonstration	Phase 1 - 20% Phase 2 - 50%	N/A	Phase 1 - 20% Phase 2 - 50%
4	Platinum Group Metals (PGM) Content Reduction to Enable Cost-Effective Aftertreatment for Gasoline and Diesel Engines	*0%	N/A	20%
5	Improved Efficiency of Medium- and Heavy-Duty Natural Gas and Propane (LPG) Engines	*0%	**0-20%	20%
6a	Research to Transform the Efficiency of Off-Road Vehicles	*0%	**0-20%	20%
6b	Efficient Agricultural Vehicle Research, Development, and Validation	20%	N/A	20%
7	Two-Stroke, Opposed-Piston Engine Research and Development	N/A	N/A	20%
8	Lightweight and High-Performance Fiber-Reinforced Polymer Composites for Vehicle Applications	20%	N/A	20%
9	Improving Transportation System Efficiency Through Better Utilization	20%	N/A	20%

10	Enabling Vehicle and Infrastructure Connectivity	20%	N/A	20%
11	Improving Mobility, Affordability, and Energy Efficiency through Transit	20%	N/A	20%
12	Gaseous Fuels Technology Demonstration Projects	50%	N/A	50%
13	Alternative Fuel Proof-of-Concept in New Communities and Fleets	50%	N/A	50%
14	Electric Vehicle and Charging Community Partner Projects	50%	N/A	50%
15	Technology Integration Open Topic	50%	N/A	50%
16	Transportation and Energy Analysis	10%	N/A	20%

* For waived or reduced cost share, the prime recipient must perform at least 50% of the project work as measured by total project costs.

**FFRDCs and/or National Labs must provide 20% cost share. Those who can provide verification of their non-profit status are eligible for the reduced cost share.

To assist applicants in calculating proper cost share amounts, EERE has included a cost share information sheet and sample cost share calculation as Appendices A and B to this FOA.

i. Legal Responsibility

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the prime recipient, the prime recipient is legally responsible for paying the entire cost share. If the funding agreement is terminated prior to the end of the project period, the prime recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The prime recipient is solely responsible for managing cost share contributions by the project team and enforcing cost share obligation assumed by project team members in subawards or related agreements.

ii. Cost Share Allocation

Each project team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual project team members may vary, as long as the cost share requirement for the project as a whole is met.

iii. Cost Share Types and Allowability

Every cost share contribution must be allowable under the applicable federal cost principles, as described in Section IV.I.i of the FOA. In addition, cost share must be verifiable upon submission of the Full Application.

Project teams may provide cost share in the form of cash or in-kind contributions. Cost share may be provided by the prime recipient, subrecipients, or third parties (entities that do not have a role in performing the scope of work). Vendors/contractors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

Cash contributions include, but are not limited to: personnel costs, fringe costs, supply and equipment costs, indirect costs and other direct costs.

In-kind contributions are those where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. Allowable in-kind contributions include, but are not limited to: the donation of volunteer time or the donation of space or use of equipment.

It is very common for deployment/demonstration projects to include third-party equipment where the use of the equipment benefits both the DOE project as well as the third party when they are operating under normal business operations. As a result, when usage fees or usage rates in the form of in-kind contributions from a third party are proposed, DOE will review the benefit calculations and such project costs may be limited to a maximum of 45% of the usage rate. The intent of this restriction is to identify an appropriate percentage of the usage rates or usage fees that are allocable to the project. This applies only to vehicles or equipment that are donated to the project, provided as third-party cost share, and are still operating in some capacity under normal business operations. In rare cases, it is possible that the equipment will only benefit the project and exceptions may be considered.

DOE understands that projects selected under this FOA may require the use of existing data. For purposes of this FOA, DOE will consider data that is commercially available at an established price to be an allowable cost under the project (either as DOE share or non-federal cost share). However, DOE will not consider in-kind data (e.g., data that is owned by an entity, that is not routinely sold commercially but is instead donated to the project and assigned a value) to be an allowable cost under the project, including as Recipient cost share. Estimation methods used by the Recipient to assign a value to in-kind data cannot be objectively verified by DOE and therefore will not be accepted by DOE as an allowable cost under any project selected from this FOA. Consequently, DOE will not recognize in-kind data costs in any resulting approved DOE budget.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the funding was not provided to the state or local government by the federal government.

The prime recipient may not use the following sources to meet its cost share obligations including, but not limited to:

- Revenues or royalties from the prospective operation of an activity beyond the project period;
- Proceeds from the prospective sale of an asset of an activity;
- Federal funding or property (e.g., federal grants, equipment owned by the federal government); or
- Expenditures that were reimbursed under a separate federal program.

Project teams may not use the same cash or in-kind contributions to meet cost share requirements for more than one project or program.

Cost share contributions must be specified in the project budget, verifiable from the prime recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same federal regulations as federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants are encouraged to refer to 2 CFR 200.306 as amended by 2 CFR 910.130 for additional cost sharing requirements.

iv. Cost Share Contributions by FFRDCs

Because FFRDCs are funded by the federal government, costs incurred by FFRDCs generally may not be used to meet the cost share requirement. FFRDCs may contribute cost share only if the contributions are paid directly from the contractor's Management Fee or another non-federal source.

v. Cost Share Verification

Applicants are required to provide written assurance of their proposed cost share contributions in their Full Applications.

Upon selection for award negotiations, applicants are required to provide additional information and documentation regarding their cost share contributions. Please refer to Appendix A of the FOA.

vi. Cost Share Payment

EERE requires prime recipients to contribute the cost share amount incrementally over the life of the award. Specifically, the prime recipient's cost share for each billing period must always reflect the overall cost share ratio negotiated by the parties (i.e., the total amount of cost sharing on each invoice when considered cumulatively with previous invoices must reflect, at a minimum, the cost sharing percentage negotiated). As FFRDC funding will be provided directly to the FFRDC(s) by DOE, prime recipients will be required to provide project cost share at a

percentage commensurate with the FFRDC costs, on a budget period basis, resulting in a higher interim invoicing cost share ratio than the total award ratio.

In limited circumstances, and where it is in the government's interest, the EERE Contracting Officer may approve a request by the prime recipient to meet its cost share requirements on a less frequent basis, such as monthly or quarterly. Regardless of the interval requested, the prime recipient must be up-to-date on cost share at each interval. Such requests must be sent to the Contracting Officer during award negotiations and include the following information: (1) a detailed justification for the request; (2) a proposed schedule of payments, including amounts and dates; (3) a written commitment to meet that schedule; and (4) such evidence as necessary to demonstrate that the prime recipient has complied with its cost share obligations to date. The Contracting Officer must approve all such requests before they go into effect.

C. Compliance Criteria

Concept Papers and Full Applications must meet all compliance criteria listed below or they will be considered noncompliant. EERE will not review or consider noncompliant submissions, including Concept Papers and Full Applications that were: submitted through means other than EERE Exchange; submitted after the applicable deadline; and/or submitted incomplete. EERE will not extend the submission deadline for applicants that fail to submit required information by the applicable deadline due to server/connection congestion.

i. Compliance Criteria

1. Concept Papers

Concept Papers are deemed compliant if:

- The Concept Paper complies with the content and form requirements in Section IV.C of the FOA; and
- The applicant successfully uploaded all required documents and clicked the "Submit" button in EERE Exchange by the deadline stated in this FOA.

2. Full Applications

Full Applications are deemed compliant if:

- The applicant submitted a compliant Concept Paper;
- The applicant complied with the required teaming arrangements (if applicable);
- The Full Application complies with the content and form requirements in Section IV.D of the FOA; and
- The applicant successfully uploaded all required documents and clicked the "Submit" button in EERE Exchange by the deadline stated in the FOA.

D. Responsiveness Criteria

All “Applications Specifically Not of Interest,” as described in Section I.C of the FOA, are deemed nonresponsive and are not reviewed or considered for a technical merit review of the Full Application.

E. Other Eligibility Requirements

i. Requirements for DOE/NNSA and non-DOE/NNSA Federally Funded Research and Development Centers Included as a Subrecipient

DOE/NNSA and non-DOE/NNSA FFRDCs may be proposed as a subrecipient on another entity’s application subject to the following guidelines:

1. Authorization for non-DOE/NNSA FFRDCs

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

2. Authorization for DOE/NNSA FFRDCs

The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

“Authorization is granted for the Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory, and will not adversely impact execution of the DOE assigned programs at the laboratory.”

3. Value/Funding

The value of and funding for the FFRDC portion of the work will not normally be included in the award to a successful applicant. Usually, DOE will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal (WP) system and non-DOE/NNSA FFRDC through an interagency agreement with the sponsoring agency.

4. Cost Share

Although the FFRDC portion of the work is usually excluded from the award to a successful applicant, the applicant’s cost share requirement will be based on the total cost of the project, including the applicant’s, the subrecipient, and the FFRDC’s portions of the project.

5. Responsibility

The prime recipient will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues including, but not limited to disputes and claims arising out of any agreement between the prime recipient and the FFRDC contractor.

F. Limitation on Number of Concept Papers and Full Applications Eligible for Review

An entity may submit more than one Full Concept Paper and one Full Application to this FOA, provided that each concept paper/application describes a unique, scientifically distinct project, and provided that an eligible Concept Paper was submitted for each Full Application. All concept papers and applications must be for a stand-alone project that is not dependent or contingent upon another application submitted to this or any other FOA.

G. Questions Regarding Eligibility

EERE will not make eligibility determinations for potential applicants prior to the date on which applications to this FOA must be submitted. The decision whether to submit an application in response to this FOA lies solely with the applicant.

IV. Application and Submission Information

A. Application Process

The application process will include two phases: a Concept Paper phase and a Full Application phase. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application.** At each phase, EERE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III of the FOA. EERE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths (described below) and must be submitted via EERE Exchange at <https://eere-exchange.energy.gov/>, unless specifically stated otherwise. **EERE will not review or consider submissions submitted through means other than EERE Exchange, submissions submitted after the applicable deadline, or incomplete submissions.** EERE will not extend deadlines for applicants who fail to submit required information and documents due to server/connection congestion.

A Control Number will be issued when an applicant begins the EERE Exchange application process. This control number must be included with all application documents, as described below.

The Concept Paper and Full Application must conform to the following requirements:

- Each must be submitted in Adobe PDF format unless stated otherwise.
- Each must be written in English;
- All pages must be formatted to fit on 8.5 x 11 inch paper with margins not less than one inch on every side. Use Times New Roman typeface, a black font color, and a font size of 12 point or larger (except in figures or tables, which may be 10 point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies. References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement;
- Page numbers must be included in the footer of every page; and
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages.

Applicants are responsible for meeting each submission deadline. **Applicants are strongly encouraged to submit their Concept Papers and Full Applications at least 48 hours in advance of the submission deadline.** Under normal conditions (i.e., at least 48 hours in advance of the submission deadline), applicants should allow at least 1 hour to submit a Concept Paper and Full Application. Once the Concept Paper and Full Application is submitted in EERE Exchange, applicants may revise or update that submission until the expiration of the applicable deadline. If changes are made to any of these documents, the applicant must resubmit the Concept Paper and Full Application before the applicable deadline.

EERE urges applicants to carefully review their Concept Papers and Full Applications and to allow sufficient time for the submission of required information and documents. All Full Applications that pass the initial eligibility review will undergo comprehensive technical merit review according to the criteria identified in Section V.A of the FOA.

i. Additional Information on EERE Exchange

EERE Exchange is designed to enforce the deadlines specified in this FOA. The “Apply” and “Submit” buttons will automatically disable at the defined submission deadlines. Should applicants experience problems with EERE Exchange, the following information may be helpful.

Applicants that experience issues with submission PRIOR to the FOA deadline: In the event that an applicant experiences technical difficulties with a submission, the applicant should contact the EERE Exchange helpdesk for assistance (EERE-ExchangeSupport@hq.doe.gov). The EERE Exchange helpdesk and/or the EERE Exchange system administrators will assist applicants in resolving issues.

B. Application Forms

The application forms and instructions are available on EERE Exchange. To access these materials, go to <https://eere-Exchange.energy.gov> and select the appropriate funding opportunity number.

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA, it must be broken into parts and denoted to that effect. For example:

ControlNumber_LeadOrganization_Project_Part_1

ControlNumber_LeadOrganization_Project_Part_2

C. Content and Form of the Concept Paper

To be eligible to submit a Full Application, applicants must submit a Concept Paper by the specified due date and time. Applicants may not change the applying entity between the Concept Paper and Full Application stages of the process.

i. Concept Paper Content Requirements

EERE will not review or consider ineligible Concept Papers (see Section III of the FOA).

Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.

The Concept Paper must conform to the following content requirements:

Section	Page Limit	Description
Cover Page	1 page maximum	The cover page should include the project title, the specific FOA Area of Interest being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Technical Description and Impacts	3 pages maximum	<p>Applicants are required to describe succinctly:</p> <ul style="list-style-type: none"> • The proposed technology, including its basic operating principles and how it is unique and innovative; • The proposed technology's target level of performance (applicants should provide technical data or other support to show how the proposed target could be met); • The current state-of-the-art in the relevant field and application, including key shortcomings, limitations, and challenges; • How the proposed technology will overcome the shortcomings, limitations, and challenges in the relevant field and application; • The potential impact that the proposed project would have on the relevant field and application; • The key technical risks/issues associated with the proposed technology development plan; • The impact that EERE funding would have on the proposed project; • Whether the Principal Investigator (PI) and Project Team have the skill and expertise needed to successfully execute the project plan; • Whether the applicant has prior experience which demonstrates an ability to perform tasks of similar risk and complexity; and • Whether the applicant has adequate access to equipment and facilities necessary to accomplish the effort. <p>The three pages for the technical description may include graphs, charts, photos or other data.</p>

EERE makes an independent assessment of each Concept Paper based on the criteria in Section V.A.i and V.A.ii of the FOA. EERE will encourage a subset of applicants to submit Full Applications. Other applicants will be discouraged from submitting a Full Application. An applicant who receives a "discouraged" notification may still submit a Full Application. EERE will review all eligible Full Applications. However, by discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project in an effort to save

the applicant the time and expense of preparing an application that is unlikely to be selected for award negotiations.

EERE may include general comments provided from reviewers on an applicant's Concept Paper in the encourage/discourage notification.

While the content and form of the Concept Paper does not require proposing a cost share amount during this concept paper submission phase, the EERE Exchange system will require entering a proposed cost share as a step in the submission process. Any proposed cost share at the Concept Paper stage of the application process can be updated or amended at the time of full application submission.

D. Content and Form of the Full Application

Applicants must submit a Full Application by the specified due date and time to be considered for funding under this FOA. applicants must complete the following application forms found on the EERE Exchange website at <https://eere-Exchange.energy.gov/>, in accordance with the instructions.

Applicants will have approximately 30 days from receipt of the Concept Paper Encourage/Discourage notification to prepare and submit a Full Application. Regardless of the date the applicant receives the Encourage/Discourage notification, the submission deadline for the Full Application remains the date and time stated on the FOA cover page.

All Full Application documents must be marked with the Control Number issued to the applicant. Applicants will receive a control number upon clicking the "Create Concept Paper" button in EERE Exchange. **The applicant is no longer required to follow any specific file naming convention other than to insure the file format and extension of the uploaded file is consistent with the requirements below. The EERE Exchange system will automatically rename the file once it has been successfully uploaded.**

i. Full Application Content Requirements

EERE will not review or consider ineligible Full Applications (see Section III of the FOA).

Each Full Application shall be limited to a single concept or technology. Unrelated concepts and technologies shall not be consolidated in a single Full Application.

Full Applications must conform to the following requirements:

Components	Required/ Optional	Required Format	Page Limit	Required Template
Technical Volume (See Chart in Section IV.D.ii)	Required	Adobe PDF	30	No
Statement of Project Objectives	Required	MS Word	10	https://eere-exchange.energy.gov/FileContent.aspx?FileID=4bb6ed87-0b4d-44ca-b097-0ce2c9ad8e60
SF-424 Applicant	Required	Adobe PDF	N/A	https://eere-exchange.energy.gov/FileContent.aspx?FileID=7250a874-b1e4-4ce9-b8cc-496dd4de5e27
Budget Justification (EERE 335) (See instructions below)	Required	MS Excel	N/A	https://eere-exchange.energy.gov/FileContent.aspx?FileID=2e7d66e9-85e0-4612-8d33-10616665be0c
Summary/Abstract for Public Release	Required	Adobe PDF	1	No
Summary Slide	Required	MS PowerPoint	1	https://eere-exchange.energy.gov/FileContent.aspx?FileID=21ae5af7-37a9-4231-b570-39cc2a974ea8
Subrecipient Budget Justification, if applicable (See instructions below)	Optional	MS Excel	N/A	https://eere-exchange.energy.gov/FileContent.aspx?FileID=2e7d66e9-85e0-4612-8d33-10616665be0c
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	Optional	Adobe PDF	N/A	https://eere-exchange.energy.gov/FileContent.aspx?FileID=8f22fc0b-6e47-47a7-aca8-336653e68eac
Authorization from cognizant Contracting Officer for FFRDC, if applicable	Optional	Adobe PDF	N/A	No
SF-LLL Disclosure of Lobbying Activities	Required	Adobe PDF	N/A	https://eere-exchange.energy.gov/FileContent.aspx?FileID=6baf9e0c-1884-4c92-83a8-9127529d09c4
Performance of Work in the United States waiver requests, if applicable	Optional	Adobe PDF	N/A	No

Cost Share Commitment Letters, if applicable	Optional	Adobe PDF	N/A	No
Resumes	Required	Adobe PDF	N/A	No
U.S. Manufacturing Plan	Required	Adobe PDF	N/A	No
Environmental Questionnaire	Required	Adobe PDF	N/A	https://eere-exchange.energy.gov/FileContent.aspx?FileID=bdfd9edf-43c2-4f1a-b272-69ef31453fce

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA it must be broken into parts and denoted to that effect. For example:

ControlNumber_LeadOrganization_TechnicalVolume_Part_1
ControlNumber_LeadOrganization_TechnicalVolume_Part_2

EERE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 10MB.

EERE provides detailed guidance on the content and form of each component below.

ii. Technical Volume

The Technical Volume must be submitted in Adobe PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages. This volume must address the Merit Review Criteria as discussed in Section V.A.iii – V.A.v of the FOA.

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

The Technical Volume to the Full Application may not be more than 30 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The page limitation does not include the Statement of Project Objectives, which is a separate document and not included as part of the Technical Volume. The applicant should consider the weighting of each of the evaluation criteria (see Section V.A.iii – V.A.v of the FOA) when preparing the Technical Volume.

The Technical Volume should clearly describe and expand upon information provided in the Concept Paper. The Technical Volume must conform to the following content requirements:

SECTION/PAGE LIMIT	DESCRIPTION
Cover Page (1 Page)	The cover page should include the project title, the specific FOA Area of Interest being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Project Overview (Approximately 10% of the Technical Volume)	The Project Overview should contain the following information: <ul style="list-style-type: none">• Background: The applicant should discuss the background of their organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application.• Project Goal: The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal.• DOE Impact: The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the project objectives.
Technical Description, Innovation, and Impact (Approximately 30% of the Technical Volume)	The Technical Description should contain the following information: <ul style="list-style-type: none">• Relevance and Outcomes: The applicant should provide a detailed description of the technology, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project.• Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology and capability of achieving the anticipated performance targets, including a description of previous work done and prior results.• Innovation and Impacts: The applicant should describe the current state of the art in the applicable field, the specific innovation of the proposed technology, the advantages of proposed technology over current and emerging technologies, and the overall impact on advancing the state of the art/technical baseline if the project is successful.
Workplan and Market Transformation Plan	The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go Decision Points, and Project Schedule. A detailed SOPO is

(Approximately 40% of the Technical Volume)	<p>separately requested. The Workplan should contain the following information:</p> <ul style="list-style-type: none">• Project Objectives: The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes.• Technical Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period.• WBS and Task Description Summary: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a WBS for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as “we will then complete a proprietary process” is unacceptable). It is the applicant’s responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more limited description of the WBS and tasks.• Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a SMART technical milestone. SMART milestones should be Specific, Measurable, Achievable, Relevant, and Timely, and must demonstrate a technical achievement rather than simply completing a task. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one milestone per quarter for the duration of the project with at least one SMART technical milestone per year (depending on the project, more milestones may be necessary to comprehensively demonstrate progress). The applicant should also provide the means by which the milestone will be verified. The summary provided should be consistent with the Milestone Summary Table in the SOPO.• Go/No-Go Decision Points: The applicant should provide a summary of project-wide Go/No-Go decision points at
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	<p>appropriate points in the Workplan. A Go/No-Go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one project-wide Go/No-Go decision point for each budget period (12 to 15-month period) of the project. The Applicant should also provide the specific technical criteria to be used to make the Go/No-Go decision. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered “SMART” and can fulfill the requirement for an annual SMART milestone.</p> <ul style="list-style-type: none">• End of Project Goal: The applicant should provide a summary of the end of project goal(s). Unless otherwise specified in the FOA, the minimum requirement is that each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO.• Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and Go/No-Go decision points.• Project Management: The applicant should discuss the team’s proposed management plan, including the following:<ul style="list-style-type: none">○ The overall approach to and organization for managing the work○ The roles of each Project Team member○ Any critical handoffs/interdependencies among Project Team members○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices○ The approach to project risk management○ A description of how project changes will be handled○ If applicable, the approach to Quality Assurance/Control○ How communications will be maintained among Project Team members• Technology Transfer Plan: The applicant should provide a technology transfer plan, including the following:<ul style="list-style-type: none">○ Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including a mitigation plan
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	<ul style="list-style-type: none"> ○ Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. manufacturing plan and product distribution.
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	<p>The Technical Qualifications and Resources should contain the following information:</p> <ul style="list-style-type: none"> • Describe the Project Team’s unique qualifications and expertise, including those of key subrecipients. • Describe the Project Team’s existing equipment and facilities that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project. • This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives. • Describe the time commitment of the key team members to support the project. • Attach <u>one-page</u> resumes for key participating team members as an appendix. Resumes do not count towards the page limit. Multi-page resumes are discouraged. <p>Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable. For multi-organizational or multi-investigator projects, describe succinctly:</p> <ul style="list-style-type: none"> • The roles and the work to be performed by each PI and Key Participant; • Business agreements between the applicant and each PI and Key Participant; • How the various efforts will be integrated and managed; • Process for making decisions on scientific/technical direction; • Publication arrangements; • Intellectual Property issues; and • Communication plans

iii. Statement of Project Objectives (SOPO)

Applicants are required to complete a SOPO. A SOPO template is available on EERE Exchange at <https://eere-Exchange.energy.gov/>. The SOPO must not exceed 10 pages when printed using standard 8.5 x 11 paper with 1” margins (top, bottom, left, and right) with font not smaller than 12 point. **SOPOs must not include confidential, proprietary, business sensitive, or privileged information.**

iv. SF-424: Application for Federal Assistance

Complete all required fields in accordance with the instructions on the form. The list of certifications and assurances in Field 21 can be found at <http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms>, under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase or other subset of the project period.

v. Budget Justification Workbook

- Applicants are required to complete the Budget Justification Workbook. This form is available on EERE Exchange at <https://eere-Exchange.energy.gov/>.
- Prime Recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the prime recipient and its subrecipients and contractors.
- Applicants should include costs associated with required annual audits and incurred cost proposals in their proposed budget documents. The “Instructions and Summary” included with the Budget Justification Workbook will auto-populate as the applicant enters information into the Workbook.
- Applicants must carefully read the “Instructions and Summary” tab provided within the Budget Justification Workbook.

vi. Summary/Abstract for Public Release

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

vii. Summary Slide

Applicants are required to provide a single PowerPoint slide summarizing the proposed project. The slide must be submitted in Microsoft PowerPoint format using the supplied template. This slide is used during the evaluation process.

The Summary Slide template requires the following information:

- Proposed objectives;

- A description of the technology's impact and key takeaways;
- Key deliverables and anticipated accomplishments;
- Project title, prime recipient, Principal Investigator, and Key Participant information; and
- Requested EERE funds and proposed applicant cost share(s) for the prime applicant and subrecipients.

viii. Subrecipient Budget Justification (if applicable)

Applicants must provide a separate budget for each subrecipient that is expected to perform work estimated to be more than \$250,000 or 25% of the total work effort (whichever is less). The budget justification must include the same justification information described in the "Budget Justification Workbook" section above.

ix. Budget for DOE/NNSA FFRDC (if applicable)

If a DOE/NNSA FFRDC contractor is to perform a portion of the work, the applicant must provide a DOE WP in accordance with the requirements in DOE Order 412.1A, Work Authorization System, Attachment 3, available at: <https://www.directives.doe.gov/directives-documents/400-series/0412.1-BOrder-a-admchg1/@@images/file>. Save the WP in a single PDF file.

x. Authorization for non-DOE/NNSA or DOE/NNSA FFRDCs (if applicable)

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with the contractor's authority under its award.

xi. SF-LLL: Disclosure of Lobbying Activities (required)

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

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

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

- An employee of a Member of Congress.

xii. Waiver Request: Foreign Work (if applicable)

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

As set forth in Section IV.I.iii, all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. Appendix C lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

Save the Waiver(s) in a single PDF file.

xiii. Cost Share Commitment Letters

Applicants must have a letter from each third party contributing cost share (i.e., a party other than the organization submitting the application) stating that the third party is committed to providing a specific minimum dollar amount of cost share. Identify the following information for each third party contributing cost share: (1) the name of the organization; (2) the proposed dollar amount to be provided; (3) the amount as a percentage of the total project cost; and (4) the proposed type of cost share – cash, services, or property.

Please combine each individual Cost Share Commitment Letter into a single PDF file.

xiv. Resumes

Applicants are required to submit one-page resumes for key participating team members. Multi-page resumes are not allowed. Save the resumes in a single PDF file.

xv. U.S. Manufacturing Commitments

Each applicant to AOIs 1-11 is required to submit a U.S. Manufacturing Plan as part of its application. The U.S. Manufacturing Plan represents the applicant's measurable commitment to support U.S. manufacturing as a result of its award. Applicants to AOIs 12 – 16 may submit a placeholder document that states a Manufacturing Plan is not required for this topic.

Each U.S. Manufacturing Plan must include a commitment that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States, unless the applicant can show to the satisfaction of DOE that it is not commercially feasible to do so (referred to hereinafter as “the U.S. Competitiveness Provision”). The applicant further agrees to make the U.S. Competitiveness Provision binding on

any subawardee and any assignee or licensee or any entity otherwise acquiring rights to any subject invention, including subsequent assignees or licensees. A subject invention is any invention conceived of or first actually reduced to practice under an award.

Due to the lower technology readiness levels of this FOA, DOE does not expect the U.S. Manufacturing Plans to be tied to a specific product or technology. However, in lieu of the U.S. Competitiveness Provision, an applicant may propose a U.S. Manufacturing Plan with more specific commitments that would be beneficial to the U.S. economy and competitiveness. For example, an applicant may commit specific products to be manufactured in the U.S., commit to a specific investment in a new or existing U.S. manufacturing facility, keep certain activities based in the U.S. or support a certain number of jobs in the U.S. related to the technology. An applicant which is likely to license the technology to others, especially universities for which licensing may be the exclusive means of commercialization the technology, the U.S. Manufacturing Plan may indicate the applicant's plan and commitment to use a specific licensing strategy that would likely support U.S. manufacturing.

If DOE determines, at its sole discretion, that the more specific commitments would provide a sufficient benefit to the U.S. economy and industrial competitiveness, the specific commitments will be part of the terms and conditions of the award. For all other awards, the U.S. Competitiveness Provision shall be incorporated as part of the terms and conditions of the award as the U.S. Manufacturing Plan for that award.

The U.S. Competitiveness Provision is also a requirement for the Class Patent Waiver that applies to domestic large business under this FOA (see Section VIII.J. Title to Subject Inventions).

Save the U.S. Manufacturing Plan in a single PDF file.

xvi. Environmental Questionnaire

Applicants must complete the Environmental Questionnaire using the supplied template.

E. Post Selection Information Requests

If selected for award, EERE reserves the right to request additional or clarifying information regarding the following (non-exhaustive list):

- Indirect cost information;
- Other budget information;
- Updated Commitment Letters from Third Parties Contributing to Cost Share, if applicable;

- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5);
- Representation of Limited Rights Data and Restricted Software, if applicable;
- Foreign National Involvement;
- Updated Environmental Questionnaire; and
- Data Management Plan.

Applicants will be required to submit a Data Management Plan within 90 days of award. The Data Management Plan is a document that outlines the proposed plan for data sharing or preservation. Information regarding the content of the Data Management Plan is shown in Appendix D and will also be provided in the Federal Assistance Requirements Reporting Checklist upon receipt of award.

F. Dun and Bradstreet Universal Numbering System (DUNS) Number and System for Award Management (SAM)

Each applicant (unless the applicant is an individual or federal awarding agency that is excepted from those requirements under 2 CFR §25.110(b) or (c), or has an exception approved by the federal awarding agency under 2 CFR §25.110(d)) is required to: (1) Be registered in the (SAM) at <https://www.sam.gov> before submitting its application; (2) provide a valid Dun and Bradstreet Universal Numbering System (DUNS) number in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by a federal awarding agency.

DOE may not make a federal award to an applicant until the applicant has complied with all applicable DUNS and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, the DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

G. Submission Dates and Times

Concept Papers and Full Applications must be submitted in EERE Exchange no later than 5 p.m. Eastern Time on the dates provided on the cover page of this FOA.

H. Intergovernmental Review

This FOA is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

I. Funding Restrictions

i. Allowable Costs

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable federal cost principles.

Refer to the following applicable federal cost principles for more information:

- Federal Acquisition Regulation (FAR) Part 31 for For-Profit entities; and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

ii. Pre-Award Costs

Selectees must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the federal award directly pursuant to the negotiation and in anticipation of the federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that they would have been allowable if incurred after the date of the federal award and **only** with the written approval of the federal awarding agency, through the Contracting Officer assigned to the award.

Pre-award costs cannot be incurred prior to the Selection Official signing the Selection Statement and Analysis. Pre-award costs can only be incurred if such costs would be reimbursable under the agreement if incurred after award.

Pre-award expenditures are made at the Selectee's risk; EERE is not obligated to reimburse costs: (1) in the absence of appropriations; (2) if an award is not made; or (3) if an award is made for a lesser amount than the Selectee anticipated.

1. National Environmental Policy Act (NEPA) Requirements Related to Pre-Award Costs

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

EERE does not guarantee or assume any obligation to reimburse pre-award costs incurred prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that DOE determines may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the applicant is doing so at risk of not receiving federal funding for their project and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer override these NEPA requirements to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives. Likewise, if an application is

selected for negotiation of award, and the prime recipient elects to undertake activities that are not authorized for federal funding by the Contracting Officer in advance of EERE completing a NEPA review, the prime recipient is doing so at risk of not receiving federal funding and such costs may not be recognized as allowable cost share.

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

1. Requirement

All work performed under EERE awards must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment; however, the prime recipient should make every effort to purchase supplies and equipment within the United States. The prime recipient must flow down this requirement to its subrecipients.

2. Failure to Comply

If the prime recipient fails to comply with the Performance of Work in the United States requirement, EERE may deny reimbursement for the work conducted outside the United States and such costs may not be recognized as allowable recipient cost share. The prime recipient is responsible should any work under this Award be performed outside the United States, absent a waiver, regardless of whether the work is performed by the prime recipient, subrecipients, contractors or other project partners.

3. Waiver

There may be limited circumstances where it is in the interest of the Project to perform a portion of the work outside the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit a written waiver request to EERE. Appendix C lists the necessary information that must be included in a for a foreign work waiver.

The applicant must demonstrate to the satisfaction of EERE that a waiver would further the purposes of the FOA and is in the economic interests of the United States. EERE may require additional information before considering a waiver request. Save the waiver request(s) in a single PDF file. The applicant does not have the right to appeal EERE's decision concerning a waiver request.

iv. Construction

Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs.

v. Foreign Travel

Foreign travel costs may be necessary to conduct the research and may be allowable (case-by-case basis) only with the written prior approval of the Contracting Officer assigned to the award.

If international travel is proposed for your project, please note that your organization must comply with the International Air Transportation Fair Competitive Practices Act of 1974 (49 USC 40118), commonly referred to as the “Fly America Act,” and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a U.S. flag carrier, if service is available.

vi. Equipment and Supplies

To the greatest extent practicable, all equipment and products purchased with funds made available under this FOA should be American-made. This requirement does not apply to used or leased equipment.

Property disposition will be required at the end of a project if the current fair market value of property exceeds \$5,000

For-profit entity disposition requirements are set forth at 2 CFR 910.360. Property disposition requirements for other non-Federal entities are set forth in 2 CFR 200.310 – 200.316.

vii. Lobbying

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

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

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

viii. Risk Assessment

Prior to making a federal award, the DOE is required by 31 U.S.C. 3321 and 41 U.S.C. 2313 to review information available through any Office of Management and

Budget (OMB) designated repositories of government-wide eligibility qualification or financial integrity information, such as SAM Exclusions and “Do Not Pay.”

In addition, DOE evaluates the risk(s) posed by applicants before they receive federal awards. This evaluation may consider: results of the evaluation of the applicant's eligibility; the quality of the application; financial stability; quality of management systems and ability to meet the management standards prescribed in this part; history of performance; reports and findings from audits; and the applicant's ability to effectively implement statutory, regulatory, or other requirements imposed on non-federal entities.

In addition to this review, DOE must comply with the guidelines on government-wide suspension and debarment in 2 CFR 180, and must require non-federal entities to comply with these provisions. These provisions restrict federal awards, subawards and contracts with certain parties that are debarred, suspended or otherwise excluded from or ineligible for participation in federal programs or activities.

ix. Invoice Review and Approval

DOE employs a risk-based approach to determine the level of supporting documentation required for approving invoice payments. Recipients may be required to provide some or all of the following items with their requests for reimbursement:

- Summary of costs by cost categories;
- Timesheets or personnel hours report;
- Invoices/receipts for all travel, equipment, supplies, contractual, and other costs;
- UCC filing proof for equipment acquired with project funds by for-profit recipients and subrecipients;
- Explanation of cost share for invoicing period;
- Analogous information for some subrecipients;
- Other items as required by DOE.

V. Application Review Information

A. Technical Review Criteria

i. Concept Papers (For AOs 1-11)

Concept Papers will be evaluated against the criteria shown below. All sub-criteria are of equal weight.

Concept Paper Criterion: Overall FOA Responsiveness and Viability of the Project (Weight: 100%)

This criterion involves consideration of the following factors:

- Extent to which the concept paper describes the proposed technology, how the technology is unique and innovative, and how the technology will overcome barriers to advance the current state-of-the-art or baseline technology;
- Extent to which the concept paper identifies risks, technical barriers, challenges, and possible mitigation strategies, and demonstrates the impact that the proposed project would have on the relevant field and application;
- Extent to which the proposed project team has the qualifications, relevant experience, capabilities, equipment, and facilities to successfully complete the proposed project; and
- Extent to which the proposed project, if successfully accomplished, would meet the objectives as stated in the FOA.

ii. Concept Papers (For AOIs 12-16)

Concept Papers are evaluated based on consideration of the following factors. All sub-criteria are of equal weight.

Concept Paper Criterion: Overall FOA Responsiveness and Viability of the Project (Weight: 100%)

This criterion involves consideration of the following factors:

- The proposed project is responsive to the objectives as stated in the FOA/AOI;
- The proposed project is clearly described, unique, and innovative;
- The proposed approach/project will significantly accelerate the widespread use of the identified technologies or fuels;
- The probability that the proposed project will accomplish its objectives.
- The proposed partnerships are appropriate; and
- The applicant has the qualifications, experience, capabilities and other resources necessary to complete the proposed project.

iii. Full Applications (For AOIs 1-11)

Applications will be evaluated against the merit review criteria shown below. All sub-criteria are of equal weight.

Criterion 1: Technical Merit, Innovation, and Impact (Weight 45%)

This criterion involves consideration of the following factors:

- Extent to which the applicant demonstrates knowledge of the current state-of-the-art (SOA) or baseline technology and how the proposed project will move the state-of-the-art;
- Extent to which the proposed project will likely achieve prescribed goals, targets, or requirements as described in the area of interest; and

- Extent to which the proposed project is technically sound, viable, and is supported by relevant data, calculations, technical assumptions, design rationale, alternatives, discussion of prior work, and references to literature.

Criterion 2: Project Plan (Weight 40%)

This criterion involves consideration of the following factors:

- Extent to which the approach comprehensively and logically addresses research, development, validation, technology integration, risks, and risk mitigation strategies as well as provides appropriate tasks and detailed task descriptions;
- Extent to which the project schedule includes all required tasks, reasonable task durations, logical predecessor and successor task ordering, and a defined critical path;
- Extent to which the baseline performance is defined, performance metrics quantify interim performance progress, appropriately scheduled SMART milestones demonstrate project advancement based upon significant project outcomes, and appropriately scheduled SMART Go/No Go Decision Points represent decisions regarding project continuation; and
- Extent to which the Technology Transfer Plan/Manufacturing Plan demonstrates knowledge of the target market(s), distribution channels, required licensing, and competitors as well as the risks and risk mitigation strategies associated with each.

Criterion 3: Project Team and Resources (Weight 15%)

This criterion involves consideration of the following factors:

- Extent to which the qualifications, relevant experience, and time commitment of the individuals on the proposed project team are aligned and integrated for successful completion of the proposed project;
- Extent to which existing equipment and facilities, along with proposed acquisition of equipment, support successful completion of the proposed project; and
- Extent and appropriateness of resource commitment to the proposed project by project partners or other key participants validated by letters of commitment.

iv. Full Applications (For AOIs 12-15)

Applications will be evaluated against the merit review criteria shown below. All sub-criteria are of equal weight.

Criterion 1: Project Merit, Innovation, and Impact (40%)

This criterion involves consideration of the following factors:

- Extent to which the proposed approach has merit and responsiveness of the project goals to the area of interest objectives;

- Extent to which the application objectively describes, using quantifiable metrics, the problem that is being addressed by this project, and defines a baseline upon which progress can be measured; and
- Extent to which the application demonstrates, using measurable parameters, supporting data, and analysis, that the project outcomes will significantly advance the baseline.

Criterion 2: Project Plan (30%)

This criterion involves consideration of the following factors:

- Extent to which the workplan includes required tasks and the schedule includes reasonable task durations, logical task ordering, and a defined critical path;
- Appropriateness of the proposed technical and project metrics, including milestones and Go/No-Go decision points, and the extent to which they enable objective monitoring and control of technical and project progress, including decisions regarding project continuation;
- Reasonableness of the proposed plan for collecting, utilizing, analyzing, and publicly sharing project data; and
- Extent to which the project or its components are constructed to have ongoing impact and produce results and insights that are replicable across other organizations and geographies.

Criterion 3: Project Team and Resources (30%)

This criterion involves consideration of the following factors:

- Extent of team member qualifications, expertise, and experience, in relation to project and AOI objectives;
- Reasonableness of the allocation of project resources, including key personnel, to ensure the successful completion of the proposed work; and
- Extent and appropriateness of resource commitment to the proposed project by project partners or other key participants as validated by letters of commitment.

v. Full Applications (AOI 16)

Applications will be evaluated against the merit review criteria shown below. All sub-criteria are of equal weight.

Criterion 1: Project Merit, Innovation, and Impact (40%)

This criterion involves consideration of the following factors:

- Extent to which the proposed methods for collecting, transmitting, storing, validating and analyzing data are clearly described, feasible, and aligned with the area of interest objectives;

- Reasonableness of the approach to sharing models, tools, and analytical applications/insights and the extent to which summary reports and operational data sets will be made publicly available; and
- Comprehensiveness of the proposed models, tools, and analytical applications/insights and its consistency with the requirements of the AOI.

Criterion 2: Project Plan (30%)

This criterion involves consideration of the following factors:

- Extent to which the project plan and schedule include all required tasks, reasonable task durations, logical predecessor and successor task ordering, and a defined critical path;
- Extent to which the baseline performance is defined, performance metrics quantify interim performance progress, appropriately scheduled SMART milestones demonstrate project advancement based upon significant project outcomes, and appropriately scheduled SMART Go/No Go Decision Points represent decisions regarding project continuation; and
- Extent to which the project plan effectively addresses the management of Personally Identifiable Information (PII).

Criterion 3: Project Team and Resources (30%)

This criterion involves consideration of the following factors:

- Extent of team member qualifications, relevant expertise, resource commitment, and time commitment to address all aspects of the proposed work with a high probability of success;
- Reasonableness of the allocation of project resources to ensure the successful completion of the proposed work; and
- Extent and appropriateness of resource commitment to the proposed project by project partners or other key participants validated by letters of commitment.

B. Standards for Application Evaluation

Applications that are determined to be eligible will be evaluated in accordance with this FOA, by the standards set forth in EERE's Notice of Objective Merit Review Procedure (76 Fed. Reg. 17846, March 31, 2011) and the guidance provided in the "DOE Merit Review Guide for Financial Assistance," effective April 14, 2017, which is available at: <https://energy.gov/management/downloads/merit-review-guide-financial-assistance-and-unsolicited-proposals-current>.

C. Other Selection Factors**i. Program Policy Factors**

In addition to the above criteria, the Selection Official may consider the following program policy factors in determining which Full Applications to select for award negotiations:

- The proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from the subject FOA;
- The proposed project, including proposed cost share, optimizes the use of available EERE funding to achieve programmatic objectives;
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers;
- The proposed project is likely to lead to increased employment and manufacturing in the United States;
- The proposed project will accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty;
- The proposed project leads to diverse types and sizes of applicant organizations while not being detrimental to the overall objectives of the program;
- The proposed project provides diverse technology concepts and applications, as well as technical approaches, while not being detrimental to the overall objectives of the program;
- The proposed project enables new and expanding market segments; and
- The proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications).

D. Evaluation and Selection Process

i. Overview

The evaluation process consists of multiple phases; each includes an initial eligibility review and a thorough technical review. Rigorous technical reviews of eligible submissions are conducted by reviewers that are experts in the subject matter of the FOA. Ultimately, the Selection Official considers the recommendations of the reviewers, along with other considerations such as program policy factors, in determining which applications to select.

ii. Pre-Selection Clarification

EERE may determine that pre-selection clarifications are necessary from one or more applicants. Pre-selection clarifications are distinct from and less formal than pre-selection interviews. These pre-selection clarifications will solely be for the purposes of clarifying the application, and will be limited to information already provided in the application documentation. The pre-selection clarifications may occur before, during or after the merit review evaluation process. Information provided by an applicant that is not necessary to address the pre-selection clarification question will not be reviewed or considered. Typically, a pre-selection

clarification will be carried out through either written responses to EERE's written clarification questions or video or conference calls with EERE representatives.

The information provided by applicants to EERE through pre-selection clarifications is incorporated in their applications and contributes to the merit review evaluation and EERE's selection decisions. If EERE contacts an applicant for pre-selection clarification purposes, it does not signify that the applicant has been selected for negotiation of award or that the applicant is among the top ranked applications.

EERE will not reimburse applicants for expenses relating to the pre-selection clarifications, nor will these costs be eligible for reimbursement as pre-award costs.

iii. Recipient Integrity and Performance Matters

DOE, prior to making a federal award with a total amount of federal share greater than the simplified acquisition threshold, is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313).

The applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.

DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under federal awards when completing the review of risk posed by applicants as described in 2 C.F.R. § 200.205.

iv. Selection

The Selection Official may consider the technical merit, the Federal Consensus Board's recommendations, program policy factors, and the amount of funds available in arriving at selections for this FOA.

E. Anticipated Notice of Selection and Award Negotiation Dates

EERE anticipates notifying applicants selected for negotiation of award and making awards by the dates provided on the FOA cover page.

VI. Award Administration Information

A. Award Notices

i. Ineligible Submissions

Ineligible Concept Papers and Full Applications will not be further reviewed or considered for award. The Contracting Officer will send a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange. The notification letter will state the basis upon which the Concept Paper or the Full Application is ineligible and not considered for further review.

ii. Concept Paper Notifications

EERE will notify applicants of its determination to encourage or discourage the submission of a Full Application

Applicants may submit a Full Application even if they receive a notification discouraging them from doing so. By discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project. Such assessments do not necessarily reflect judgments on the merits of the proposed project. The purpose of the Concept Paper phase is to save applicants the considerable time and expense of preparing a Full Application that is unlikely to be selected for award negotiations.

A notification encouraging the submission of a Full Application does not authorize the applicant to commence performance of the project. Please refer to Section IV.I.ii of the FOA for guidance on pre-award costs.

iii. Full Application Notifications

EERE will notify applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, EERE may notify one or more applicants that a final selection determination on particular Full Applications will be made at a later date, subject to the availability of funds or other factors.

iv. Successful Applicants

Receipt of a notification letter selecting a Full Application for award negotiations does not authorize the applicant to commence performance of the project. If an application is selected for award negotiations, it is not a commitment by EERE to issue an award. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement, accessible by the prime recipient in FedConnect.

The award negotiation process will take approximately 60 days. Applicants must designate a primary and a backup point-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. The applicant must be responsive during award negotiations (i.e., provide requested documentation) and meet the negotiation deadlines. If the applicant fails to do so or if award

negotiations are otherwise unsuccessful, EERE will cancel the award negotiations and rescind the Selection. EERE reserves the right to terminate award negotiations at any time for any reason.

Please refer to Section IV.I.ii of the FOA for guidance on pre-award costs.

v. Alternate Selection Determinations

In some instances, an applicant may receive a notification that its application was not selected for award and EERE designated the application to be an alternate. As an alternate, EERE may consider the Full Application for federal funding in the future. A notification letter stating the Full Application is designated as an alternate does not authorize the applicant to commence performance of the project. EERE may ultimately determine to select or not select the Full Application for award negotiations.

vi. Unsuccessful Applicants

EERE shall promptly notify in writing each applicant whose application has not been selected for award or whose application cannot be funded because of the unavailability of appropriated funds.

B. Administrative and National Policy Requirements

i. Registration Requirements

There are several one-time actions before submitting an application in response to this FOA, and it is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA, or to meet the negotiation deadlines and receive an award if the application is selected. These requirements are as follows:

1. EERE Exchange

Register and create an account on EERE Exchange at <https://eere-exchange.energy.gov>.

This account will then allow the user to register for any open EERE FOAs that are currently in EERE Exchange. It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. Applicants should also designate backup points of contact so they may be easily contacted if deemed necessary.

This step is required to apply to this FOA.

The EERE Exchange registration does not have a delay; however, **the remaining registration requirements below could take several weeks to process and are necessary for a potential applicant to receive an award under this FOA.**

2. DUNS Number

Obtain a DUNS number (including the plus 4 extension, if applicable) at <http://fedgov.dnb.com/webform>.

3. System for Award Management (SAM)

Register with the SAM at <https://www.sam.gov>. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called an Marketing Partner ID (MPIN)IN are important steps in SAM registration. Please update your SAM registration annually.

4. FedConnect

Register in FedConnect at <https://www.fedconnect.net>. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

5. Grants.gov

Register in Grants.gov (<http://www.grants.gov>) to receive automatic updates when Amendments to this FOA are posted. However, please note that Concept Papers, and Full Applications will not be accepted through Grants.gov.

6. Electronic Authorization of Applications and Award Documents

Submission of an application and supplemental information under this FOA through electronic systems used by the DOE, including EERE Exchange and FedConnect.net, constitutes the authorized representative's approval and electronic signature.

ii. Award Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR Part 200 as amended by 2 CFR Part 910.

iii. Foreign National Access to DOE Sites

All applicants selected for an award under this FOA may be required to provide information to the Department of Energy (DOE) in order to satisfy requirements for foreign nationals' access to DOE sites, information, technologies, equipment, programs, and personnel. A foreign national is any person who was born outside the jurisdiction of the United States, is a citizen of a foreign government, and has not been naturalized under U.S. law. If a selected applicant (including any of its subrecipients or subcontractors) anticipates involving foreign nationals in the performance of its award, the selected applicant may be required to provide to DOE with specific information about each foreign national to ensure compliance with the requirements for access approval. Access approval for foreign nationals from countries identified on the U.S. Department of State's list of State Sponsors of Terrorism <https://www.state.gov/j/ct/list/c14151.htm> receive final

approval authority from the Secretary of Energy before they can commence any work under the award.

iv. Subaward and Executive Reporting

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR Part 170. Prime recipients must register with the new FFATA Subaward Reporting System database and report the required data on their first tier subrecipients. Prime recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

v. National Policy Requirements

The National Policy Assurances that are incorporated as a term and condition of award are located at: <http://www.nsf.gov/awards/managing/rtc.jsp>.

vi. Environmental Review in Accordance with National Environmental Policy Act (NEPA)

EERE's decision whether and how to distribute federal funds under this FOA is subject to the NEPA (42 USC 4321, *et seq.*). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at <http://nepa.energy.gov/>.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project. If DOE determines certain records must be prepared to complete the NEPA review process (e.g., biological evaluations or environmental assessments), the costs to prepare the necessary records may be included as part of the project costs.

Applicants selected for award negotiations will be required to enter their environmental questionnaire electronically at <https://www.eere-pmc.energy.gov/>

vii. Applicant Representations and Certifications

1. Lobbying Restrictions

By accepting funds under this award, the prime recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. §1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

2. Corporate Felony Conviction and Federal Tax Liability Representations

In submitting an application in response to this FOA, the applicant represents that:

- a. It is **not** a corporation that has been convicted of a felony criminal violation under any federal law within the preceding 24 months, and
- b. It is **not** a corporation that has any unpaid federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

For purposes of these representations the following definitions apply:

A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

3. Nondisclosure and Confidentiality Agreements Representations

In submitting an application in response to this FOA the applicant represents that:

- a. It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contractors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a federal department or agency authorized to receive such information.
- b. It **does not and will not** use any federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:
 - (1) *“These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.”*

- (2) The limitation above shall not contravene requirements applicable to Standard Form 312, Classified Information Nondisclosure Agreement (<https://fas.org/sgp/othergov/sf312.pdf>), Form 4414 Sensitive Compartmented Information Disclosure Agreement (<https://fas.org/sgp/othergov/intel/sf4414.pdf>), or any other form issued by a federal department or agency governing the nondisclosure of classified information.
- (3) Notwithstanding the provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

viii. Statement of Federal Stewardship

EERE will exercise normal federal stewardship in overseeing the project activities performed under EERE awards. Stewardship Activities include, but are not limited to, conducting site visits; reviewing performance and financial reports, providing assistance and/or temporary intervention in unusual circumstances to correct deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

ix. Statement of Substantial Involvement

EERE has substantial involvement in work performed under awards made as a result of this FOA. EERE does not limit its involvement to the administrative requirements of the award. Instead, EERE has substantial involvement in the direction and redirection of the technical aspects of the project as a whole. Substantial involvement includes, but is not limited to, the following:

1. EERE shares responsibility with the recipient for the management, control, direction, and performance of the project.
2. EERE may intervene in the conduct or performance of work under this award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.

3. EERE may redirect or discontinue funding the project based on the outcome of EERE's evaluation of the project at that the Go/No Go decision point(s).
4. EERE participates in major project decision-making processes.

x. Subject Invention Utilization Reporting

In order to ensure that prime recipients and subrecipients holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, EERE may require that each prime recipient holding title to a subject invention submit annual reports for 10 years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts made by prime recipient or their licensees or assignees to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the prime recipient, and such other data and information as EERE may specify.

xi. Intellectual Property Provisions

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at <http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards>.

xii. Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist, attached to the award agreement. This helpful EERE checklist can be accessed at <https://www.energy.gov/eere/funding/eere-funding-application-and-management-forms>. See Attachment 2 Federal Assistance Reporting Checklist, after clicking on "Model Cooperative Agreement" under the Award Package section.

xiii. Go/No-Go Review

Each project selected under this FOA will be subject to a periodic project evaluation referred to as a Go/No-Go Review. At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, and overall contribution to the EERE program goals and objectives. Federal funding beyond the Go/No-Go decision point (continuation funding) is contingent upon (1) availability of federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) recipient's technical progress; (4) recipient's submittal of required reports; (5) compliance with the terms and conditions of the award; (6) EERE's Go/No-Go decision; (7) the recipient's submission of a continuation application; and (8) written approval of the continuation application by the Contracting Officer.

As a result of the Go/No-Go Review, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the

availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the project because of insufficient progress, change in strategic direction, or lack of funding.

The Go/No-Go decision is distinct from a non-compliance determination. In the event a recipient fails to comply with the requirements of an award, EERE may take appropriate action, including but not limited to, redirecting, suspending or terminating the award.

xiv. Conference Spending

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States Government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States Government would otherwise exceed \$20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

xv. Uniform Commercial Code (UCC) Financing Statements

Per 2 CFR 910.360 (Real Property and Equipment) when a piece of equipment is purchased by a for-profit recipient or subrecipient with federal funds, and when the federal share of the financial assistance agreement is more than \$1,000,000, the recipient or subrecipient must:

Properly record, and consent to the Department's ability to properly record if the recipient fails to do so, UCC financing statement(s) for all equipment in excess of \$5,000 purchased with project funds. These financing statement(s) must be approved in writing by the Contracting Officer prior to the recording, and they shall provide notice that the Recipient's title to all equipment (not real property) purchased with federal funds under the financial assistance agreement is conditional pursuant to the terms of this section, and that the Government retains an undivided reversionary interest in the equipment. The UCC financing statement(s) must be filed before the Contracting Officer may reimburse the recipient for the federal share of the equipment unless otherwise provided for in the relevant financial assistance agreement. The recipient shall further make any amendments to the financing statements or additional recordings, including appropriate continuation statements, as necessary or as the Contracting Officer may direct.

VII. Questions/Agency Contacts

Upon the issuance of a FOA, EERE personnel are prohibited from communicating (in writing or otherwise) with applicants regarding the FOA except through the established question and answer process as described below.

Specifically, questions regarding the content of this FOA must be submitted to: DE-FOA-0002197@netl.doe.gov. Questions must be submitted not later than 5 business days prior to the application due date and time. Please note, feedback on individual concepts will not be provided through Q&A.

All questions and answers related to this FOA will be posted on EERE Exchange at: <https://eere-exchange.energy.gov>. **Please note that you must first select this specific FOA Number in order to view the questions and answers specific to this FOA.** EERE will attempt to respond to a question within 5 business days, unless a similar question and answer has already been posted on the website. All questions submitted must clearly identify the Area of Interest (AOI) to insure a timely and accurate response. Failure to identify the AOI, or not being as specific as possible with a question, may result in additional time to address the question or require further correspondence for further clarification regarding the submitted questions.

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

VIII. Other Information

A. FOA Modifications

Amendments to this FOA will be posted on the EERE Exchange website and the Grants.gov system. However, you will only receive an email when an amendment or a FOA is posted on these sites if you register for email notifications for this FOA in Grants.gov. **EERE recommends that you register as soon after the release of the FOA as possible to ensure you receive timely notice of any amendments or other FOAs.**

B. Government Right to Reject or Negotiate

EERE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. Commitment of Public Funds

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by anyone other than the Contracting Officer, either express or implied, is invalid.

D. Treatment of Application Information

Applicants should not include trade secrets or commercial or financial information that is privileged or confidential in their application unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in the FOA. Applicants are advised to not include any critically sensitive proprietary detail.

If an application includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, EERE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for merit review of the application or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Concept Papers, Full Applications, Replies to Reviewer Comments, and other submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

The cover sheet of the Concept Paper, Full Application, Reply to Reviewer Comments, or other submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

E. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation and Peer Review, the Government may seek the advice of qualified non-federal personnel as reviewers. The Government may also use non-federal personnel to conduct routine, nondiscretionary administrative

activities, including EERE contractors. The applicant, by submitting its application, consents to the use of non-federal reviewers/administrators. Non-federal reviewers must sign conflict of interest (COI) and non-disclosure acknowledgements (NDA) prior to reviewing an application. Non-federal personnel conducting administrative activities must sign an NDA.

F. Notice Regarding Eligible/Ineligible Activities

Eligible activities under this FOA include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

G. Notice of Right to Conduct a Review of Financial Capability

EERE reserves the right to conduct an independent third-party review of financial capability for applicants that are selected for negotiation of award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

H. Requirement for Full and Complete Disclosure

Applicants are required to make a full and complete disclosure of all information requested. Any failure to make a full and complete disclosure of the requested information may result in:

- The termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;
- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

I. Retention of Submissions

EERE expects to retain copies of all Concept Papers, Full Applications, and other submissions. No submissions will be returned. By applying to EERE for funding, applicants consent to EERE's retention of their submissions.

J. Title to Subject Inventions

Ownership of subject inventions is governed pursuant to the authorities listed below:

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions.

- All other parties: The federal Non-Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the Government obtains title to new inventions unless a waiver is granted (see below).
- Class Patent Waiver: DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient.
- Advance and Identified Waivers: Applicants may request a patent waiver that will cover subject inventions that may be invented under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to EERE within the timeframes set forth in the award's intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- Each applicant for AOIs 1-11 is required to submit a U.S. Manufacturing Plan as part of its application. DOE has determined that exceptional circumstances exist that warrants the modification of the standard patent rights clause for small businesses and non-profit awardees under Bayh-Dole to the extent necessary to implement and enforce the U.S. Manufacturing Plan. If selected, the U.S. Manufacturing Plan shall be incorporated into the award terms and conditions for domestic small businesses and nonprofit organizations. Any Bayh-Dole entity (domestic small business or nonprofit organization) affected by this determination has the right to appeal it.

K. Government Rights in Subject Inventions

Where prime recipients and subrecipients retain title to subject inventions, the U.S. Government retains certain rights.

i. Government Use License

The U.S. Government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world. This license extends to contractors doing work on behalf of the Government.

ii. March-In Rights

The U.S. Government retains march-in rights with respect to all subject inventions. Through "march-in rights," the Government may require a prime

recipient or subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention to a third party. In addition, the Government may grant licenses for use of the subject invention when a prime recipient, subrecipient, or their assignees and exclusive licensees refuse to do so.

DOE may exercise its march-in rights only if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by federal statutes in a reasonably satisfied manner; or
- The U.S. Manufacturing requirement has not been met.

Any determination that march-in rights are warranted must follow a fact-finding process in which the recipient has certain rights to present evidence and witnesses, confront witnesses and appear with counsel and appeal any adverse decision. To date, DOE has never exercised its march-in rights to any subject inventions.

L. Rights in Technical Data

Data rights differ based on whether data is first produced under an award or instead was developed at private expense outside the award.

“Limited Rights Data”: The U.S. Government will not normally require delivery of confidential or trade secret-type technical data developed solely at private expense prior to issuance of an award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.

Government Rights in Technical Data Produced Under Awards: The U.S. Government normally retains unlimited rights in technical data produced under Government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of data generated under EERE awards may be protected from public disclosure for up to five years after the data is generated (“Protected Data”). Data protection is available to all AOIs except AOIs 12 - 16. For awards permitting Protected Data, the protected data must be marked as set forth in the awards intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

M. Copyright

The prime recipient and subrecipients may assert copyright in copyrightable works, such as software, first produced under the award without EERE approval. When copyright is asserted, the Government retains a paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works, distribute copies to the public, and to perform publicly and display publicly the copyrighted work. This license extends to contractors and others doing work on behalf of the Government.

N. Export Control

The U.S. government regulates the transfer of information, commodities, technology, and software considered to be strategically important to the U.S. to protect national security, foreign policy, and economic interests without imposing undue regulatory burdens on legitimate international trade. There is a network of federal agencies and regulations that govern exports that are collectively referred to as “Export Controls”. To ensure compliance with Export Controls, it is the prime recipient’s responsibility to determine when its project activities trigger Export Controls and to ensure compliance.

Export Controls may apply to individual projects, depending on the nature of the tasks. When Export Controls apply, the recipient must take the appropriate steps to obtain any required governmental licenses, monitor and control access to restricted information, and safeguard all controlled materials. Under no circumstances may foreign entities (organizations, companies or persons) receive access to export controlled information unless proper export procedures have been satisfied and such access is authorized pursuant to law or regulation.

Applicants are advised that some of the results of the research conducted under this FOA are expected to be restricted for proprietary reasons and not published or shared broadly within the scientific community.

O. Personally Identifiable Information (PII)

All information provided by the applicant must to the greatest extent possible exclude PII. The term “PII” refers to information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, alone, or when combined with other personal or identifying information which is linked or linkable to a specific individual, such as date and place of birth, mother’s maiden name. (See OMB Memorandum M-07-16 dated May 22, 2007, found at: <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2007/m07-16.pdf>)

By way of example, applicants must screen resumes to ensure that they do not contain PII such as personal addresses, personal landline/cell phone numbers, and personal emails. **Under no circumstances should Social Security Numbers (SSNs) be included in the application.** Federal Agencies are prohibited from the collecting, using, and

displaying unnecessary SSNs. (See, the Federal Information Security Modernization Act of 2197 (Pub. L. No. 113-283, Dec 18, 2197; 44 U.S.C. §3551

P. Annual Independent Audits

If a for-profit entity is a prime recipient and has expended \$750,000 or more of DOE awards during the entity's fiscal year, an annual compliance audit performed by an independent auditor is required. For additional information, please refer to 2 C.F.R. § 910.501 and Subpart F.

If an educational institution, non-profit organization, or state/local government is a prime recipient or subrecipient and has expended \$750,000 or more of federal awards during the non-federal entity's fiscal year, then a Single or Program-Specific Audit is required. For additional information, please refer to 2 C.F.R. § 200.501 and Subpart F.

Applicants and subrecipients (if applicable) should propose sufficient costs in the project budget to cover the costs associated with the audit. EERE will share in the cost of the audit at its applicable cost share ratio.

Appendix A – Cost Share Information

Cost Sharing or Cost Matching

The terms “cost sharing” and “cost matching” are often used synonymously. Even the DOE Financial Assistance Regulations, 2 CFR 200.306, use both of the terms in the titles specific to regulations applicable to cost sharing. EERE almost always uses the term “cost sharing,” as it conveys the concept that non-federal share is calculated as a percentage of the Total Project Cost. An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here “cost matching” for the non-federal share is calculated as a percentage of the federal funds only, rather than the Total Project Cost.

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. FFRDC costs must be included in Total Project Costs. The following is an example of how to calculate cost sharing amounts for a project with \$1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

- Formula: federal share (\$) divided by federal share (%) = Total Project Cost
Example: \$1,000,000 divided by 80% = \$1,250,000
- Formula: Total Project Cost (\$) minus federal share (\$) = Non-federal share (\$)
Example: \$1,250,000 minus \$1,000,000 = \$250,000
- Formula: Non-federal share (\$) divided by Total Project Cost (\$) = Non-federal share (%)
Example: \$250,000 divided by \$1,250,000 = 20%

What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under an EERE grant or cooperative agreement, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the federal Government under another award unless authorized by federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though are generally the same for all types of entities. The specific rules applicable to:

- FAR Part 31 for For-Profit entities, (48 CFR Part 31); and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

In addition to the regulations referenced above, other factors may also come into play such as timing of donations and length of the project period. For example, the value of ten years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, EERE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, EERE generally does not allow pre-award costs prior to the signing of the Selection Statement by the EERE Selection Official.

General Cost Sharing Rules on a DOE Award

1. Cash Cost Share - encompasses all contributions to the project made by the recipient or subrecipient(s), for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project.
2. In Kind Cost Share - encompasses all contributions to the project made by the recipient or subrecipient(s) that do not involve a payment or reimbursement and represent donated items or services. In Kind cost share items include volunteer personnel hours, donated existing equipment, donated existing supplies. The cash value and calculations thereof for all In Kind cost share items must be justified and explained in the Cost Share section of the project Budget Justification. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out the In Kind cost share section of the Budget Justification.
3. Funds from other federal sources **MAY NOT** be counted as cost share. This prohibition includes FFRDC subrecipients. Non-federal sources include any source not originally derived from federal funds. Cost sharing commitment letters from subrecipients must be provided with the original application.
4. Fee or profit, including foregone fee or profit, are not allowable as project costs (including cost share) under any resulting award. The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

DOE Financial Assistance Rules 2 CFR Part 200 as amended by 2 CFR Part 910

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

- (A) Acceptable contributions. All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the prime recipient's cost sharing if such contributions meet all of the following criteria:
 - (1) They are verifiable from the recipient's records.
 - (2) They are not included as contributions for any other federally-assisted project or program.
 - (3) They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.
 - (4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:
 - a. For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A-122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the FAR, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations; and
 - b. Other types of organizations. For all other non-federal entities, allowability of costs is determined in accordance with 2 CFR Part 200 Subpart E.
 - (5) They are not paid by the federal government under another award unless authorized by federal statute to be used for cost sharing or matching.
 - (6) They are provided for in the approved budget.
- (B) Valuing and documenting contributions
 - (1) Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated

capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

- a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or
 - b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.
- (2) Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.
- (3) Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.
- (4) Valuing property donated by third parties.
- a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.
 - b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:
 - i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.
 - ii. The value of loaned equipment must not exceed its fair rental value.

- (5) Documentation. The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:
- a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.
 - b. The basis for determining the valuation for personal services and property must be documented.

Appendix B – Sample Cost Share Calculation for Blended Cost Share Percentage

The following example shows the math for calculating required cost share for a project with \$2,000,000 in federal funds with four tasks requiring different non-federal cost share percentages:

Task	Proposed Federal Share	Federal Share %	Recipient Share %
Task 1 (R&D)	\$1,000,000	80%	20%
Task 2 (R&D)	\$500,000	80%	20%
Task 3 (Demonstration)	\$400,000	50%	50%
Task 4 (Outreach)	\$100,000	100%	0%

Federal share (\$) divided by federal share (%) = Task Cost

Each task must be calculated individually as follows:

Task 1

\$1,000,000 divided by 80% = \$1,250,000 (Task 1 Cost)

Task 1 Cost minus federal share = Non-federal share

\$1,250,000 - \$1,000,000 = \$250,000 (Non-federal share)

Task 2

\$500,000 divided by 80% = \$625,000 (Task 2 Cost)

Task 2 Cost minus federal share = Non-federal share

\$625,000 - \$500,000 = \$125,000 (Non-federal share)

Task 3

\$400,000 divided by 50% = \$800,000 (Task 3 Cost)

Task 3 Cost minus federal share = Non-federal share

\$800,000 - \$400,000 = \$400,000 (Non-federal share)

Task 4

Federal share = \$100,000

Non-federal cost share is not mandated for outreach = \$0 (Non-federal share)

The calculation may then be completed as follows:

Tasks	\$ Federal Share	% Federal Share	\$ Non-Federal Share	% Non-Federal Share	Total Project Cost
Task 1	\$1,000,000	80%	\$250,000	20%	\$1,250,000
Task 2	\$500,000	80%	\$125,000	20%	\$625,000
Task 3	\$400,000	50%	\$400,000	50%	\$800,000
Task 4	\$100,000	100%	\$0	0%	\$100,000
Totals	\$2,000,000		\$775,000		\$2,775,000

Blended Cost Share %

Non-federal share (\$775,000) divided by Total Project Cost (\$2,775,000) = 27.9% (non-federal)

Federal share (\$2,000,000) divided by Total Project Cost (\$2,775,000) = 72.1% (federal)

Appendix C – Waiver Request: Performance of Work in the United States (Foreign Work Waiver)

As set forth in Section IV.I.iii, all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. There may be limited circumstances where it is in the interest of the project to perform a portion of the work outside the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit an explicit waiver request in the Full Application. A separate waiver request must be submitted for each entity proposing performance of work outside of the United States.

Overall, a waiver request must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to perform work outside of the United States. A request to waive the *Performance of Work in the United States* requirement must include the following:

- The rationale for performing the work outside the U.S. (“foreign work”);
- A description of the work proposed to be performed outside the U.S.;
- An explanation as to how the foreign work is essential to the project;
- A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the U.S. economy;
- The associated benefits to be realized and the contribution to the project from the foreign work;
- How the foreign work will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the foreign work will promote domestic American manufacturing of products and/or services;
- A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP; and
- The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
- The countries in which the foreign work is proposed to be performed; and
- The name of the entity that would perform the foreign work.

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE’s decision concerning a waiver request.

Appendix D - Data Management Plan

A data management plan (“DMP”) explains how data generated in the course of the work performed under an EERE award will be shared and preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate.

DMP Requirements

In order for a DMP to be considered acceptable, the DMP must address the following:

At a minimum, the DMP must describe how data sharing and preservation will enable validation of the results from the proposed work, or how results could be validated if data are not shared or preserved.

The DMP must provide a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

The DMP should consult and reference available information about data management resources to be used in the course of the proposed work. In particular, a DMP that explicitly or implicitly commits data management resources at a facility beyond what is conventionally made available to approved users should be accompanied by written approval from that facility. In determining the resources available for data management at DOE User Facilities, researchers should consult the published description of data management resources and practices at that facility and reference it in the DMP. Information about other DOE facilities can be found in the additional guidance from the sponsoring program.

The DMP must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all laws (i.e., export control laws), and DOE regulations, orders, and policies.

Data Determination for a DMP

The Principal Investigator should determine which data should be the subject of the DMP and, in the DMP, propose which data should be shared and/or preserved in accordance with the DMP Requirements noted above.

For data that will be generated through the course of the proposed work, the Principal Investigator should indicate what types of data should be protected from immediate public disclosure by DOE (referred to as “protected data”) and what types of data that DOE should be able to release immediately. Similarly, for data developed outside of the proposed work at private expense that will be used in the course of the proposed work, the Principal Investigator should indicate whether that type of data will be subject to public release or kept confidential (referred to as “limited rights data”). Any use of limited rights data or labeling of data as “protected data” must be consistent with the DMP Requirements noted above.

Suggested Elements for a DMP

The following list of elements for a DMP provides suggestions regarding the data management planning process and the structure of the DMP:

Data Types and Sources: A brief, high-level description of the data to be generated or used through the course of the proposed work and which of these are considered digital research data necessary to validate the research findings or results.

Content and Format: A statement of plans for data and metadata content and format including, where applicable, a description of documentation plans, annotation of relevant software, and the rationale for the selection of appropriate standards. Existing, accepted community standards should be used where possible. Where community standards are missing or inadequate, the DMP could propose alternate strategies for facilitating sharing, and should advise the sponsoring program of any need to develop or generalize standards.

Sharing and Preservation: A description of the plans for data sharing and preservation. This should include, when appropriate: the anticipated means for sharing and the rationale for any restrictions on who may access the data and under what conditions; a timeline for sharing and preservation that addresses both the minimum length of time the data will be available and any anticipated delay to data access after research findings are published; any special requirements for data sharing, for example, proprietary software needed to access or interpret data, applicable policies, provisions, and licenses for re-use and re-distribution, and for the production of derivatives, including guidance for how data and data products should be cited; any resources and capabilities (equipment, connections,

systems, software, expertise, etc.) requested in the research proposal that are needed to meet the stated goals for sharing and preservation (this could reference the relevant section of the associated research proposal and budget request); and whether/where the data will be preserved after direct project funding ends and any plans for the transfer of responsibilities for sharing and preservation.

Protection: A statement of plans, where appropriate and necessary, to protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; and avoid significant negative impact on innovation, and U.S. competitiveness.

Rationale: A discussion of the rationale or justification for the proposed data management plan including, for example, the potential impact of the data within the immediate field and in other fields, and any broader societal impact.

Additional Guidance

In determining which data should be shared and preserved, researchers must consider the data needed to validate research findings as described in the Requirements, and are encouraged to consider the potential benefits of their data to their own fields of research, fields other than their own, and society at large.

DMPs should reflect relevant standards and community best practices and make use of community accepted repositories whenever practicable.

Costs associated with the scope of work and resources articulated in a DMP may be included in the proposed research budget as permitted by the applicable cost principles.

To improve the discoverability of and attribution for datasets created and used in the course of research, EERE encourages the citation of publicly available datasets within the reference section of publications, and the identification of datasets with persistent identifiers such as Digital Object Identifiers (DOIs). In most cases, EERE can provide DOIs free of charge for data resulting from DOE-funded research through its Office of Scientific and Technical Information (OSTI) DataID Service.

EERE's Digital Data Management principles can be found at: [EERE Digital Data Management | Department of Energy](#)

Definitions

Data Preservation: Data preservation means providing for the usability of data beyond the lifetime of the research activity that generated them.

Data Sharing: Data sharing means making data available to people other than those who have generated them. Examples of data sharing range from bilateral communications with colleagues, to providing free, unrestricted access to anyone through, for example, a web-based platform.

Digital Research Data: The term digital data encompasses a wide variety of information stored in digital form including: experimental, observational, and simulation data; codes, software and algorithms; text; numeric information; images; video; audio; and associated metadata. It also encompasses information in a variety of different forms including raw, processed, and analyzed data, published and archived data.

Research Data: The recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, or communications with colleagues. This 'recorded' material excludes physical objects (e.g., laboratory samples). Research data also do not include:

(A) Trade secrets, commercial information, materials necessary to be held confidential by a researcher until they are published, or similar information which is protected under law; and

(B) Personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study.”

Validate: In the context of DMPs, validate means to support, corroborate, verify, or otherwise determine the legitimacy of the research findings. Validation of research findings could be accomplished by reproducing the original experiment or analyses; comparing and contrasting the results against those of a new experiment or analyses; or by some other means.

Appendix E – Glossary

Applicant – The lead organization submitting an application under the FOA.

Continuation application – A non-competitive application for an additional budget period within a previously approved project period. At least ninety (90) days before the end of each budget period, the Recipient must submit to EERE its continuation application, which includes the following information:

- i. A report on the Recipient’s progress towards meeting the objectives of the project, including any significant findings, conclusions, or developments, and an estimate of any unobligated balances remaining at the end of the budget period. If the remaining unobligated balance is estimated to exceed 20 percent of the funds available for the budget period, explain why the excess funds have not been obligated and how they will be used in the next budget period.
- ii. A detailed budget and supporting justification if there are changes to the negotiated budget, or a budget for the upcoming budget period was not approved at the time of award.
- iii. A description of any planned changes from the negotiated Statement of Project Objectives and/or Milestone Summary Table.

Cooperative Research and Development Agreement (CRADA) – a contractual agreement between a national laboratory contractor and a private company or university to work together on research and development. For more information, see <https://www.energy.gov/gc/downloads/doe-cooperative-research-and-development-agreements>

Federally Funded Research and Development Centers (FFRDC) - FFRDCs are public-private partnerships which conduct research for the United States Government. A listing of FFRDCs can be found at <http://www.nsf.gov/statistics/ffrdclist/>.

Go/No-Go Decision Points: – A decision point at the end of a budget period that defines the overall objectives, milestones and deliverables to be achieved by the recipient in that budget period. As of a result of EERE’s review, EERE may take one of the following actions: 1) authorize federal funding for the next budget period; 2) recommend redirection of work; 3) discontinue providing federal funding beyond the current budget period; or 4) place a hold on federal funding pending further supporting data.

Project – The entire scope of the cooperative agreement which is contained in the recipient’s Statement of Project Objectives.

Recipient or “Prime Recipient”— A non-Federal entity that receives a Federal award directly from a Federal awarding agency to carry out an activity under a Federal program. The term recipient does not include subrecipients.

Subrecipient – A non-Federal entity that receives a subaward from a pass-through entity to carry out part of a Federal program; but does not include an individual that is a beneficiary of such program. A subrecipient may also be a recipient of other Federal awards directly from a Federal awarding agency. Also, a DOE/NNSA and non-DOE/NNSA FFRDC may be proposed as a subrecipient on another entity’s application. See section III.

Appendix F – Definition of Technology Readiness Levels

TRL 1:	Basic principles observed and reported
TRL 2:	Technology concept and/or application formulated
TRL 3:	Analytical and experimental critical function and/or characteristic proof of concept
TRL 4:	Component and/or breadboard validation in a laboratory environment
TRL 5:	Component and/or breadboard validation in a relevant environment
TRL 6:	System/subsystem model or prototype demonstration in a relevant environment
TRL 7:	System prototype demonstration in an operational environment
TRL 8:	Actual system completed and qualified through test and demonstrated
TRL 9:	Actual system proven through successful mission operations

Questions about this FOA? Email DE-FOA-0002197@netl.doe.gov.

Problems with EERE Exchange? Email EERE- EERE-ExchangeSupport@hq.doe.gov Include FOA name and number in subject line.