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

Buildings Energy Efficiency Frontiers & Innovation Technologies (BENEFIT) – 2020

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Informational Webinar:	10/05/2020
Submission Deadline for Concept Papers:	11/05/2020 5:00pm ET
Submission Deadline for Full Applications:	01/20/2021 5:00pm ET
Anticipated Date for Distribution of Reviewer Comments:	03/24/2021
Expected Submission Deadline for Replies to Reviewer Comments:	03/29/2021 5:00pm ET
Expected Date for EERE Selection Notifications:	June 2021
Expected Timeframe for Award Negotiations:	September 2021

- 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.

Funding Opportunity Announcement Registration/Submission Requirements

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 EERE eXCHANGE.gov, register with the System for Award Management (SAM), register with Grants.gov, and, if selected for award, be registered in FedConnect). Applicants who are not registered with SAM and Grants.gov, should allow at least 44 days to complete these requirements. It is suggested that the process be started as soon as possible.

Applicants must obtain a DUNS number (including the plus 4 extension, if applicable) from Dun and Bradstreet (D&B).
DUNS website: http://fedgov.dnb.com/webform

Applicants must register through the EERE eXCHANGE.
EERE eXCHANGE website: https://eere-exchange.energy.gov/

Applicants must register with the SAM.
SAM website: http://www.sam.gov/ NOTE: Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in SAM registration. More information about SAM registration for applicants is found at: https://www.sam.gov/SAM/transcript/Quick_Guide_for_Grants_Registrations.pdf**.**

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. More information about the registration steps for Grants.gov is provided at**: https://www.grants.gov/web/grants/applicants/registration.html**

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 an 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-0002196@netl.doe.gov* and shall be submitted not later than three (3) business days prior to the application due date and time. 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

i. Objectives

The objective of this Funding Opportunity Announcement (FOA) is to research and develop next-generation building technologies that have the potential for significant energy savings and improved demand flexibility, affordability, and occupant comfort. An additional goal is to advance building construction, remodeling, and retrofit practices, and associated workforces.

ii. Background and Purpose

This FOA is being issued by the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Building Technologies Office (BTO). This section describes the overall goals of BTO and the type of projects that are being solicited for funding support through this FOA.

The DOE mission is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. As explained in the Energy Policy Act (EPAct 2005; 42 U.S.C. §16191), "The Secretary shall conduct programs of energy efficiency research, development, demonstration, and commercial application." Such activities include "increasing the energy efficiency of buildings" and developing "cost-effective technologies, for new construction and retrofit, to improve the energy efficiency and environmental performance of buildings, using a whole-buildings approach, including onsite renewable energy generation."

Powering our homes, offices, schools, hospitals, restaurants, and stores consumes a lot of energy. Residential and commercial buildings account for approximately 40% of the nation's total energy demand – greater than that for either industry (32%) or transportation (29%) – and about 75% of all electricity use (and even more of peak power demand). The resulting annual national energy bill for buildings totals over $410 billion.[1]

Improving the energy efficiency of buildings reduces energy costs in homes and commercial buildings. More than half of the nation's more than 119 million homes and 5.6 million commercial buildings were constructed before 1980—prior to the existence of today's efficient products and practices[2]. By saving

[1] EIA April 2020 Monthly Energy Review, Table 2-1 https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf
[2] BTO calculations based on EIA 2012 Commercial Buildings Energy Consumption Survey (CBECS) and 2015 Residential Energy Consumption Survey (RECS)

money on energy costs there is more money available to flow into other sectors of the economy. Unlocking the energy savings of these buildings through efficiency improvements, while maintaining or improving occupant comfort, represents a significant economic opportunity.

Improving the energy efficiency and flexibility of buildings alleviates pressure on our electric grid and extends our energy resources as we diversify to greater use of an all-of-the-above energy supply strategy. This helps to ensure a reliable energy system well into the future.

BTO leads a network of national laboratory, university, small business, and industry partners to develop innovative, cost-effective solutions—better products, better new homes, better ways to improve older homes, and better buildings in which we live and work. The United States has made significant progress in improving building energy efficiency over the last 30 to 40 years, due in part to the successful efforts of BTO.

The Office's high-impact research has contributed to significant improvement in building energy efficiency including whole building-as-a-system solutions as well as new technologies such as solid-state lighting (SSL), energy saving windows, heat pump water heaters, and high-efficiency furnaces and air conditioners.

iii. Technology Space and Strategic Goals

BTO's overall goal is to improve the energy productivity of buildings without sacrificing occupant comfort or product performance. Progress towards achieving this goal will make building energy costs more affordable to the benefit of American families and businesses.

Building energy performance and the efficiency and affordability of consumer products have improved across the design, construction and product development industries due in large part to DOE research and development, leveraging an array of technologies supported by BTO. This has helped result in increased adoption of energy efficient technologies. For example, today, light emitting diodes (LEDs) account for over 30% of all general lighting applications, up from less than 1% in 2010. DOE projects that by 2030, LEDs will reach 80% of all lighting sales, saving Americans $26 billion per year in electricity costs[3].

Other examples include refrigerators and windows. Today, more than 100 million refrigerators in homes across the country use an advanced compressor that can trace its roots to DOE's Research and Development (R&D) activities in

[3] LED Adoption report (https://www.energy.gov/eere/ssl/led-adoption-report)

the late 1970s[4]. In fact, today's average refrigerator is 20% larger, has more features, costs half the price, and uses one-quarter the energy than it did four decades ago[4]. Similarly, modern windows have over three times the insulation value compared to windows before the 1970s[5,6]. The core technology driving these advances was sponsored by DOE.

BTO research focuses on the highest-impact approaches, targeting the most promising opportunities, to reduce the energy intensity of new and existing, commercial and residential buildings, while balancing the need to maintain occupant comfort and productivity, and ensure product performance. BTO's R&D of next-generation building technologies includes heating, ventilation and air conditioning (HVAC), lighting, refrigeration, appliances, windows, opaque envelope, storage, sensors & controls, modeling, and data analytics, as well as other building integration technologies; all of which are addressed in this FOA.

As a complement to the integration research already being conducted for design and operations, BTO's recently launched Advanced Building Construction Initiative (ABC)[7] seeks to further innovation in construction and renovation processes; ABC aims to help the U.S. construction industry achieve affordable, high-performance, resilient, energy efficient buildings, including by investing in new technologies that can be mass produced cost competitively. As parts of the construction industry seek to improve their overall productivity, ABC is working to ensure that energy efficiency solutions are integrated into all parts of any industry transformation, from design and manufacturing through construction and installation. Furthermore, ABC is working with industry, researchers, and other stakeholders to ensure that technological and process improvements not only result in highly performing and efficient buildings, but also can be deployed quickly with minimal onsite construction time, are affordable and appealing to building owners, investors, and occupants, and have lower lifecycle impacts.

Improving the demand flexibility of buildings can provide significant energy savings. Just in energy efficiency alone, building technologies have the potential to provide significant energy savings on an annual basis compared to business as usual (such as described by the Annual Energy Outlook (AEO) reference case), and additional savings can be achieved from short term reduction or shifting of energy use. There are over 18 billion devices connected to the Internet

[4] https://www.energy.gov/articles/proof-pudding-how-refrigerator-standards-have-saved-consumers-billions
[5] https://arpa-e.energy.gov/sites/default/files/02%20-%20Schiff%20-%20Single%20Pane%20Window%20Opportunity%20v2%20-%20FINAL.pdf
[6] https://www.efficientwindows.org/standards_codeoverview.php
[7] https://www.energy.gov/eere/buildings/advanced-building-construction-initiative

globally[8], 9.5 billion of which are internet-of-things (IOT) devices[9] and the market for these devices is accelerating rapidly. In 2015 this market was expected to grow by about 20% annually, it is now projected to grow by 39% annually. BTO's grid-interactive efficient buildings (GEB) research will take advantage of the potential energy savings associated with these devices across the entire building sector, commercial and residential alike.

The GEB vision will allow American businesses and families to save energy and reduce their utility bills automatically and without impacting comfort or productivity by allowing buildings to provide grid services through flexible building loads. BTO is an active participant in DOE's broader Grid Modernization Initiative (GMI), a comprehensive effort of different DOE offices and national laboratories with public and private partners to help shape the future of our nation's grid.

BTO has issued the BENEFIT FOA annually since 2014. The 2020 BENEFIT FOA will invest up to $80 million across 2 topic areas to allow all interested parties to research and develop high-impact technologies and practices that will improve energy productivity, improve flexibility, security and resilience, as well as lower energy costs.

Topic 1: Building Technology Research, Development and Field Validation: High-impact, affordable building technologies to improve energy productivity and demand flexibility without negatively impacting occupant comfort.
Topic 2: Advanced Building Construction: Building envelope R&D and field validation as well as integration of technological and other advances into mass-produced building practices for manufactured homes and modular classrooms, including training issues such as improving quality installations and quality control.

The 2020 BENEFIT FOA permits a broader range of applications, which will help BTO to select the highest-impact awards and fulfill the most important needs for innovation. Applicants to this FOA may consider including field validation as part of their approach to verify technologies and integration practices. Field validation may be used to identify gaps in design and in-field performance. It can be used to support method development data verification, collection, management, and analysis. Applicants may consider third-party validation where beneficial.

[8] https://iot-analytics.com/iot-2018-in-review/
[9] https://iot-analytics.com/iot-2019-in-review/

B. Topic Areas

Detailed topic area descriptions are provided below. Applications will be selected based on evaluation factors such as technical merit and impact. Full evaluation criteria can be found in Section V: Application Review Information.

All applications are expected to identify the baseline technology or approach, describe the current technology or market deficiencies, and characterize/quantify current performance and cost parameters. Where applicable, the applicant should identify any relevant regulations, efficiency standards, building codes or other barriers which impact the proposed technology and/or approach. The applicant should identify any positive or negative impacts that the proposed technology and/or approach could have on technology integration, specifically related to the integration priorities associated with the Advanced Building Construction and Grid-interactive Efficient Buildings initiatives described above. To the extent possible, technology integration should be considered in energy savings, affordability, demand flexibility, and occupant comfort evaluations described below.

All applications should clearly detail a pathway for overcoming the identified technology and market deficiencies through their approach. This includes a thorough discussion of the proposed technical approach including quantified energy metrics, cost characteristics, and impact on occupant comfort and quality of life[10]. Applicants should clearly state all technical assumptions and provide appropriate data, data analysis, and/or modeling/simulation results to support the proposed approach. Key project risks and mitigation strategies should also be detailed.

Applications are expected to address the specific metrics or goals identified in the subtopic area descriptions below. In most subtopic areas, applicants are expected to address energy savings (technical energy savings potential), affordability (cost of conserved energy), demand flexibility, and occupant comfort. Guidance on energy savings and affordability calculations and addressing demand flexibility and occupant comfort considerations are provided below.

Energy Savings Calculations: Where required, applicants must provide the Primary Energy Savings Technical Potential (TBtu). The Primary Energy Savings Technical Potential is calculated from Eq. (1):

$$\begin{bmatrix}\text{Primary Energy Savings}\\ \text{Technical Potential}\\ \text{(TBtu)}\end{bmatrix} = \begin{bmatrix}\text{\% Energy Savings}\\ \text{Over Typical New}\\ \text{Technology}\end{bmatrix} \times \begin{bmatrix}\text{2040 Energy}\\ \text{Market Size}\\ \text{(TBtu)}\end{bmatrix} \qquad (1)$$

[10] BTO recognizes that topics that focus on early-stage R&D will not necessarily be able at this time to quantify all future cost, cost-effectiveness, comfort, and other product-specific characteristics.

Where applicable, applicants are encouraged to develop an energy conservation measure (ECM) for their proposed approach using BTO's free calculation tool: Scout (https://scout.energy.gov/). Applicants can calculate energy savings using Scout by defining a custom ECM for their technology. Scout installation instructions (https://scout-bto.readthedocs.io/en/latest/installation_guide.html) and tutorials (https://scout-bto.readthedocs.io/en/latest/tutorials.html) document how to set up and use Scout to calculate energy savings from custom ECMs. Calculations of the energy savings technical potential should be conducted for the year 2040.

Applicants may use other tools or methodologies to calculate their technical energy savings potential, such as BTO's free calculation tool: Baseline Energy Calculator (https://scout.energy.gov/baseline-energy-calculator.html). Applicants are required to fully detail the baselines, methodology, and assumptions in determining the energy savings potential such that their calculations can be critiqued for proper validation by BTO.

Affordability Calculations: Where required, applicants must calculate affordability. Applicants are encouraged to use Scout to calculate the estimated cost of conserved energy (CCE) based on the analysis of their energy savings calculation.

Applicants may use other tools or methodologies to calculate affordability. For example, applicants proposing technology innovations might calculate the cost effectiveness of a technology, as measured by the Simple Payback. This is applicable only to technology innovations, and not to other innovations such as design tools or enabling technologies for which primary energy savings and/or payback are difficult to describe. Applicants should compute the Simple Payback for their proposed technology innovation per Eq. 2:

$$\left[\begin{array}{c}\text{Simple}\\ \text{Payback}\\ (\text{Yr})\end{array}\right] = \frac{\left[\begin{array}{c}\text{Incremental Initial}\\ \text{Cost of Proposed}\\ \text{Technology at Scale }(\$)\end{array}\right]}{\left[\begin{array}{c}\text{Cost}\\ \text{Savings}\left(\frac{\$}{\text{Yr}}\right)\end{array}\right]} \quad (2)$$

$$= \frac{\left[\begin{array}{c}\text{Incremental Initial}\\ \text{Cost of Proposed}\\ \text{Technology at Scale }(\$)\end{array}\right]}{\left[\begin{array}{c}\text{Unit Energy Consumed by}\\ \text{Typical New Technology}\\ \text{Per Year }(\text{kWh/Yr})\end{array}\right]\left[\begin{array}{c}\text{Energy}\\ \text{Cost}\end{array}\left(\frac{\$}{\text{kWh}}\right)\right]\left[\begin{array}{c}\%\text{ Energy Savings}\\ \text{Over Typical New}\\ \text{Technology}\end{array}\right]}$$

where the Incremental Initial Cost of Proposed Technology at Scale ($) is computed from

$$\begin{bmatrix}\text{Incremental Initial}\\ \text{Cost of Proposed}\\ \text{Technology at Scale }(\$)\end{bmatrix}=\begin{bmatrix}\text{Unit Cost of}\\ \text{Proposed Technology}\\ \text{at Scale }(\$)\end{bmatrix}-\begin{bmatrix}\text{Unit Cost of}\\ \text{Typical New}\\ \text{Technology }(\$)\end{bmatrix} \quad (3)$$

Applicants should describe and provide supporting documentation for what they consider to be an acceptable maximum payback (in years which can vary significantly depending on the end use).

In all cases, applicants are expected to fully describe the "next best alternative" technology or practice (e.g. the baseline or state of the art) against which this solution's affordability is being compared, and any assumptions regarding economies of scale or learning curves that are determinative in the cost of their proposed solution such that their calculations can be properly validated by BTO.

When considering affordability, applicants are encouraged to include costs that are related to the entire scope "cradle-to-grave" impacts of their approach. For example, when considering the construction process, applicants could consider the costs associated with the acquisition and transportation of materials and equipment, design costs, and labor.

Demand Flexibility: Where required, applicants are expected to detail the ability of the proposed approach to provide one or more demand-side management strategies. Priority demand-side management strategies and related grid services, definitions, and key characteristics are provided in Appendix A – Demand Side Management and Grid Services. Applicants should fully detail how demand flexibility will be addressed and quantify the extent that their solution will improve demand flexibility through one or more of the grid services identified in Appendix A. Additional demand side management strategies and technology specific considerations are included in the Overview of Research Challenges and Gap GEB Technical Report[11].

In detailing the demand flexibility potential of their approach, applicants should fully describe the baseline, the load change characteristics of the proposed approach (i.e., duration of energy change, ramp time to provide energy change, and magnitude of energy change), the market size, and the adoption assumptions such that their calculations can be critiqued for proper validation by BTO.

[11] https://www1.eere.energy.gov/buildings/pdfs/75470.pdf

Occupant Comfort: One of the more difficult aspects of developing technologies for an occupied building space is the direct and often substantial outcomes for the occupant(s) of the space. For the purposes of this funding opportunity, occupant comfort can be defined as all aspects of the human interacting with the building space. It includes, but is not limited to, aspects of the conditioned space such as air quality, temperature, and humidity. It includes visual aspects such as glare, spectrum, and flicker. In addition, aspects of safety and productivity need to be considered. Occupant comfort goes beyond the tangible benefits of impact on technology acceptance and realized energy savings.

Where required, applicants to this funding opportunity are expected to discuss any potential effects, both positive and negative, to occupant comfort affected by their proposed approach.

Topic 1: Building Technology Research, Development and Field Validation

The objective of this topic area is to develop and validate high-impact, affordable technologies that will improve energy productivity, flexibility, security and resilience, without negatively impacting occupant comfort. The applicant should also identify positive or negative impacts that the proposed technology and/or approach could have on technology integration. To the extent possible, technology integration should be considered in the energy savings, affordability, demand flexibility, and occupant comfort evaluations described above.

Subtopic 1.1: Advancing Innovative Manufacturing and End-of-Life Processing of Efficient Building Energy Technologies

The objective of this subtopic is to more efficiently and effectively manufacture equipment and products related to energy use in buildings. This subtopic focuses on innovations in the value chain of building energy technologies, particularly in the value-add before and after consumer use (i.e., in the manufacturing and post-consumer activity through reuse and/or upcycling). While approaches for manufacturing technologies which are primarily applicable to the new construction sector are acceptable, priority will be given to those approaches which have potential applicability to large segments of the existing building stock.

Applicants should propose innovations in the manufacturing of building energy-related products capable of achieving significant (>25%) energy and cost reductions versus baseline manufacturing. Applicants are expected both to identify any estimating tools used and to support their assumptions and calculations.

At a minimum, applications are expected to address and quantify the following:

- Energy savings and greater affordability achieved through process improvements in the manufacturing of relevant building energy equipment and products, including any impacts to the operating energy of the building equipment and products, if relevant
- Estimated impacts on the cost of the anticipated final product
- Estimated impacts, if any, over the life of the product, including at end of life (i.e., energy, cost, carbon dioxide, performance, durability, longevity, embodied energy of resource extraction, manufacturing, transportation, demolition, and other life cycle impacts)
- Increased U.S. manufactured content or value added[12]

Applications should also consider addressing and quantifying the following:

- Maintaining or increasing product performance such as occupant comfort after the manufacturing process improvement
- Energy savings and cost efficiencies gained for laborers due to the manufacturing process improvements

Manufacturing improvements of construction processes that occur in a factory are acceptable under this subtopic. Proposed approaches should not include on-site building construction and/or on-site assembly.

Subtopic 1.2: Thermal Storage Research, Development and Field Validation

The objective of this subtopic is to develop improved thermal energy storage technologies (including materials, equipment, and systems) for building applications. Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable. Acceptable applications under this subtopic include:

- Low-cost, high-performance thermal storage materials, such as salt hydrate or other low-cost phase change materials (PCMs), novel thermochemical materials (TCMs), or combinations thereof, able to meet relevant Targets for Next Generation Thermal Storage Materials. The materials should meet safety and compatibility requirements for building applications and be non-toxic, non-flammable, non-explosive, non-reactive, and non-corrosive within designed environment.
- Dynamically tunable thermal energy storage materials that allow rapid, on-demand adjusting of transition temperature and/or other performance metrics

[12] Responses to this criteria should be in line with the Federal Trade Commission's guidance on determining U.S. content (https://www.ftc.gov/tips-advice/business-center/guidance/complying-made-usa-standard)

for optimized utilization of the storage capacity, energy savings, and flexibility for shedding and shifting building loads.

- Novel active approaches of utilizing thermal mass (i.e., sensible thermal energy storage) in building structures for on-demand charging and discharging to substantially reduce heating and cooling loads and provide on-demand load shifting and shedding capabilities.
- System innovations to enhance the performance and capability and reduce the effective cost of thermal storage in buildings. This includes, but is not limited to, thermal energy storage technologies or systems that when integrated with HVAC, water heating, and appliances provide significantly added energy savings and building load flexibility, as well as active, dynamic thermal envelope materials, or engineered solutions that have intentionally variable heat and mass transfer properties.

Applications are expected to address and quantify the following:

- Energy savings, affordability (including capital cost, end user's cost savings, and lifetime), demand flexibility, and occupant comfort

Subtopic 1.3: Heating, Ventilation and Air Conditioning Research, Development and Field Validation

The objective of this subtopic is to develop and validate energy efficient non-vapor compression[13] or fuel-driven equipment[14] that:

- Are capable of flexible operation to provide demand flexibility services
- Use readily available materials
- Minimize water consumption
- Have reduced size and/or weight relative to today's high efficiency units

For technology development applications, applicants should address relevant R&D targets for non-vapor compression air conditioning systems and fuel-driven equipment. Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable. For cooling technologies, there is particular interest in Sensible and Latent Cooling (SSLC) systems, specifically technologies that have high performance under extreme conditions.

Applications are expected to address and quantify the following:

- Energy savings, affordability, demand flexibility, and occupant comfort

[13] https://www.energy.gov/eere/buildings/downloads/non-vapor-compression-hvac-technologies-report
[14] https://www.osti.gov/biblio/1468386-opportunities-natural-gas-technologies-building-applications

Subtopic 1.4: Refrigeration, Water Heating Research, Development and Field Validation

The objectives of this subtopic are to 1) develop refrigeration technologies that reduce the energy consumption and cost of refrigeration equipment while improving demand flexibility and resilience to power interruptions, and 2) develop heat pumping solutions, including electric and fuel-driven solutions, that focus on new technologies or major first cost reductions (≥30%).

Applications are expected to address and quantify the following:

- Energy savings, affordability, demand flexibility, and occupant comfort

Subtopic 1.5: Integrated HVAC, Refrigeration and Water Heating Research, Development and Field Validation

The objective of this subtopic is to develop innovative heating, ventilation, air-conditioning, and refrigeration (HVAC&R) technologies that push the state of the art for energy cascading; the process of using the waste heat from one process as the energy source for another (system to system, or potentially building to building). Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable[15].

Applications to this subtopic are expected to address and quantify the following:

- Energy savings, affordability, demand flexibility, and occupant comfort

Subtopic 1.6: Appliances Research and Development and Field Validation

The objective of this subtopic is to develop innovative technologies that will reduce the energy consumption of appliances used in residential and commercial buildings, including fuel-driven equipment. Acceptable applications under this subtopic include:

- Advanced compressor designs, including non-vapor compression cycles, for refrigeration applications
- Advanced cooking appliances, general kitchen appliances, dishwashers and laundry equipment
- High-efficiency cooktop exhaust hoods with high capture efficiency (e.g., 0.8 or higher)
- Cross-Cutting Technologies: Integrated energy and water recovery & transfer between appliances

[15] Applicants may consider reviewing BTO's *Advanced Building Construction* Initiative at www.energy.gov/eere/buildings/advanced-building-construction-initiative

Applications to this subtopic are expected to address and quantify the following:

- Energy savings, affordability, and occupant comfort

Subtopic 1.7: Lighting Technology Research, Development and Field Validation
Recognizing that advances in LED lighting technology have already driven significant energy savings that would have been consumed in the absence of LEDs, this subtopic looks beyond incremental improvements in LED technology to address the future of advanced lighting. The objective of this subtopic is to improve energy efficiency, reduce costs, and improve performance, while also focusing on manufacturing R&D challenges associated with advanced lighting technologies. This subtopic is supported by the 2019 DOE Lighting Research and Development Opportunities (RDO)[16].

Acceptable applications under this subtopic include:

- **Platform Technology Development** – Applied R&D that advances understanding of materials and devices and improves performance at the package/module/panel level including, but not limited to addressing green gap, droop, light extraction, and optical distribution of LEDs. Responsive applications include novel approaches to known limitations arising from LED structure and carrier dynamics, non-radiative recombination in otherwise efficient emitting materials, development of low-glare, flexible source designs including organic light emitting diodes (OLEDs), quantum dots, and related technologies. Applicants are expected to address energy efficiency at an extended range of luminance/current density, extended color qualities, and/or full color tunability. New platform technologies should be scalable from a manufacturing standpoint and minimize the use of critical materials. Furthermore, applicants should describe clearly how their approach advances the state of the art.

- **Lighting-Building Integration** – Improved integration of the lighting system into buildings including:
  - Improved electrical integration of lighting into buildings through the novel use of DC power, microgrids, and energy storage;
  - Novel architectural integration of electric lighting into building structures to minimize cost, complexity, maintenance, barriers to interaction with other technologies, and/or improve lighting application efficiency;
  - Manufacturing innovations that improve the energy productivity of lighting products and processes and/or enable circular economies of lighting—without sacrificing lighting performance; and

[16] https://www.energy.gov/eere/ssl/technology-roadmaps

- Development of novel lighting controls, sensors, and/or communications technologies with broad interoperability that reduce lighting energy use, manage or otherwise optimize lighting energy use, increase productivity, or otherwise save energy (kWh and/or kW) through improved lighting management.

Applicants to Lighting-Building Integration are expected to address affordability, lighting application efficiency, grid energy reduction, demand flexibility, and occupant comfort and well-being. Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable.

- **Novel Lighting Applications** – Innovations in efficient lighting that improve optical delivery efficiency, spectral efficiency, intensity efficacy, and/or overall productivity for specific applications, including but not limited to hospitals and other care settings, agricultural applications, schools, commercial and industrial buildings. Applicants are expected to leverage and extend recent technology advances and to address both near- and long-term potential for widespread energy productivity improvements. Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable.

- **Lighting Science** – Applied research that advances understanding of the proper application and use of light including:
  - Understanding human responses to light to improve health, wellness, and productivity through non-visual and visual responses including but not limited to color discernment, glare and temporal light artifacts; and
  - Understanding and optimizing lighting application efficiency, including defining optimum lighting conditions for different functions of lighting.

  Applicants to Lighting Science are expected to address energy savings and occupant comfort and well-being.

In addition to those items identified above, applications are expected to address and quantify the following:

- Description of the manner and extent by which their approach advances the state of the art
- Relevant metrics as identified for technology gaps from the 2019 SSL RDO document

Subtopic 1.8: Energy and Demand Data, Modeling, and Analytics

The objective of this subtopic is to develop new or enhanced approaches to modeling and analyzing energy use in buildings, building portfolios, and communities. This subtopic covers traditional physics-based "white-box" modeling of the kind addressed by BTO's Building Energy Modeling (BEM) sub-program and its recent BEM Research and Development Opportunities[17] (RDO) document. It also covers data-driven "black box" modeling, so called "grey-box" modeling and hybrid approaches. This subtopic also covers data collection, curation, management, and analysis of the kind addressed by BTO's Building Energy Data sub-program.

Target applications include both energy efficiency and demand flexibility, in either new or existing buildings, residential or commercial, and at any phase of the building life cycle (e.g., design, construction, operation).

For physics-based BEM, proposed approaches should address at least one of the barriers identified in the BEM RDO or any other demonstrable barrier, including:

- Education, training, and support for BEM professionals
- Interoperability (e.g., tools to support existing standards or, if necessary, development of new standards), workflow integration, and BEM process automation (e.g., automation of standard "rulesets", calibration methods, or other BEM tasks)
- Quality control and assurance and improvements in BEM processes, both manual and automated
- Core BEM capabilities (e.g., models for new equipment, enhanced models for physical phenomena) and multi-domain analyses that combine BEM with other analyses at either the simulation timestep level (e.g., electrical distribution, outdoor environmental impacts) or the larger workflow level (e.g., life cycle cost, construction cost)
- Data sets that support BEM and BEM processes (e.g., weather data, equipment performance data, detailed measured data that can be used to develop and validate BEM) and/or demonstrate the value of BEM (e.g., project data that isolates the cost of BEM and its impact on building first cost and operational costs)
- New BEM-based and/or BEM-supporting applications and services

For other forms of modeling, data management, and analytics that are not currently covered by a BTO RDO document, applications should target a demonstrable barrier. Applications should also include measurable metrics (e.g., American Institute of Architects (AIA) 2030 Design Data Exchange (DDx) percentage of commercial square footage modeled, AIA 2030 DDx percent energy use intensity

[17] https://www.energy.gov/sites/prod/files/2019/04/f61/bto-bem-rdo-041719.pdf

(EUI) reduction of modeled buildings over non-modeled buildings), benchmarks, and targets.

Subtopic 1.9: Comprehensive Electric Load Optimization

The objective of this subtopic is to address research, development, and field validation for reducing electric loads associated with end-uses outside of heating, ventilation, air condition, lighting, water heating, and refrigeration. These loads, which include plug loads from power electronics and electronic components such as office equipment, televisions, and battery chargers as well as hard-wired loads such as security systems and escalators, make up 46% of forecasted delivered electricity consumption in residential and commercial buildings between now and 2050[18].

Applications are expected to address one or more of the following:

- Real-world field validation to demonstrate demand flexibility and interactivity through control of electric loads to reduce peak load or shift loads outside of peak grid demand times without sacrificing occupant comfort
- Substantial improvements in energy performance for high-impact power electronics as defined by DOE[19]
- Demonstrate software data layer protocol, leveraging industry standards for interacting with a variety of power electronics and electronic components
- Integration of whole-building systems to identify, control, and reduce waste for electronics plug-loads application

Applications to this subtopic are expected to present a thorough technical case based on significant energy savings, improved performance and/or occupant comfort, significant cost reductions, and/or improved demand flexibility.

Topic 2: Advanced Building Construction

The Advanced Building Construction Initiative integrates energy efficiency solutions into highly productive U.S. construction practices for new buildings and retrofits. The ABC Initiative aims to help the U.S. construction industry achieve affordable, high-performance, resilient, energy efficient buildings by investing in new technologies that can be produced, and/or practices that can be adopted, cost competitively. The objective of this topic area is to develop and validate high impact technologies, specifically the building envelope, and approaches for manufactured homes and portable classrooms. The applicant should also identify positive or negative impacts that the proposed technology and/or approach could

[18] Energy Information Administration. 2019 Annual Energy Outlook. https://www.eia.gov/outlooks/aeo/

[19] Lighting and Electronics GEB Technical Report. https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings

have on technology integration. To the extent possible, technology integration should be considered in energy savings, affordability and occupant comfort evaluations described above.

Subtopic 2.1: Mass Produced Highly Efficient Manufactured Homes and Portable Classrooms

This specific subtopic focuses on two important building sub-sectors — manufactured homes and portable classrooms — both of which have significant potential for greater efficiency and other improvements.

Manufactured homes, according to the EIA's 2015 Residential Energy Consumption Survey, use 38% more energy and spend nearly double on energy costs per square foot than the average single-family home[20]. The average household in a manufactured home spends $1,700 each year on energy; this comes to 5.8% of average yearly income, compared to the 3.3% of household income[21] spent by the average U.S. household. Furthermore, 30% of occupied manufactured housing was built prior to the establishment of the first federal standard in 1976. With ENERGY STAR manufactured homes already available in the market, integrating high levels of efficiency is certainly feasible. However, these homes are currently cost prohibitive to much of the targeted market segment. To address this challenge, BTO is seeking innovations that dramatically reduce the cost of manufacturing homes while simultaneously integrating solutions that address energy efficiency, comfort, and occupant health. Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable.

Portable classrooms are used by roughly one-third of our nation's 99,000 public schools[22]. These structures typically serve as temporary classrooms to alleviate over-crowded school conditions. Among schools with portable buildings, more than one-third rated their overall condition as "fair" or "poor". Approximately one-third of the schools rated their portable buildings as having "fair" or "poor" building envelopes, ventilation and filtration, emergency management systems, and electrical systems and lighting – resulting in not only unnecessary spending on utility costs but most likely a poorer educational environment. Energy efficiency measures applied to modified portable classrooms have been found to generate

[20] U.S. Energy Information Administration (EIA), Residential Energy Consumption Survey (2015). Table CE1.1 Summary annual household site consumption and expenditures in the U.S.—totals and intensities, 2015. https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce1.1.pdf. Accessed on 10/29/2019

[21] ACEEE. "Rural households spend much more of their income on energy bills than others." https://aceee.org/press/2018/07/rural-households-spend-much-more. Accessed on 10/29/2019

[22] U.S. Department of Education, National Center for Education Statistics. (2014). Condition of America's Public School Facilities (NCES 2014-022). URL: https://nces.ed.gov/fastfacts/display.asp?id=94. Accessed on 10/28/2019

energy savings in the 30%-80% range, depending upon climate zone[23]. BTO is seeking novel solutions that leverage manufacturing efficiencies to reduce production costs, while creating high-performing portable structures that can improve occupant health and learning conditions, and reduce energy use and utility bills.

Applicants are encouraged to propose innovations that can help reduce the business risk of modifying conventional factories in this industry segment (or others) to mass produce highly efficient manufactured homes and/or portable classrooms. Innovations may include use of automation, robotics, and other mechanisms for enhancing manufacturing productivity to incorporate highly efficient technologies and deliver high-performing structures at a competitive cost. Applicants are encouraged to develop solutions that meet the needs for both highly efficient portable classrooms and highly efficient manufactured homes, to take advantage of manufacturing innovation and economies of scale, and to broaden the potential consumer base.

Applications are expected to include a financial commitment (e.g. potential purchase order or investor prioritization) that establishes sufficient demand to mass produce highly efficient structures. Applications are expected to describe how DOE funds will be used to leverage non-DOE investments for long-term modification of manufacturing capabilities that improve both factory productivity and the energy performance of the manufactured homes and portable classrooms. Applications are expected to exclude or limit the use of DOE funding to buy down the cost of the product. Applicants are expected to include a discussion of this commitment in the technical narrative and upload an Investor Commitment Letter (see section IV.C.xvii) as part of the application.

Applications are expected to meet the following requirements:

- Applicants should include a partnership between one or more manufacturers of manufactured homes or portable classrooms and one or more building investors (i.e., entities capable of making a commitment to purchase manufactured homes and/or portable classrooms).
    - The manufacturer(s) should have sufficient expertise and experience in the field with a demonstrated history of successful product delivery and product quality;
    - The building investor(s) are expected to demonstrate and quantify a commitment to purchase and install a combination of manufactured homes and/or portable classrooms (for example, a commitment to purchase 100 units for a school district or housing development)

[23] Stephanie Thomas-Rees, Danny Parker, and John Sherwin. "Lessons Learned in Portable Classrooms." ASHRAE Journal, May 2009.

once the manufacturer meets acceptable specifications and installed cost requirements as outlined in the proposed approach.

- Within its team, the applicant is expected to have expertise in building science to ensure that a prototype can be field validated and final structures will meet energy performance and other agreed upon specifications.
- The application should include:
  - a description of the proposed technological solution(s) and how the final structure will meet an energy efficiency specification at least equivalent to current model energy codes (i.e., 2018 International Energy Conservation Code and ANSI/ASHRAE/IES Standard 90.1-2016);
  - a preliminary set of targeted energy, cost, and other relevant specifications (e.g., meeting EPA Indoor airPLUS specifications for indoor air quality, resilience metrics such as passive survivability) for the proposed manufactured buildings[24];
  - a rationale for how this approach will lead to scaling highly efficient manufactured homes and/or portable classrooms at a price point competitive with average units sold in the market today (i.e., median sales price of manufactured homes or portable classrooms in 2018);
  - a description[25] of how the applicant will produce and field test a prototype building to measure performance and provide a baseline cost; and,
  - a description of how the applicant will develop a business plan for manufacturing the proposed quantity of buildings identified in the Investor Commitment Letter within five years of testing the prototype building should it meet specified performance targets and installed cost.

Subtopic 2.2: Building Envelope Research, Development and Field Validation

The objective of this subtopic is to develop and validate high-performance building technologies that reduce building energy use attributed to the opaque portions of the building envelope (walls, roofs, foundation, and infiltration) as well as high-performance windows[26]. Opaque envelope components provide all four critical building science control layers (i.e., air, bulk moisture, moisture vapor, and thermal) to protect building occupants from undesirable external environmental conditions. In addition, the envelope can be designed to take advantage of desirable external conditions to provide natural comfort (e.g., solar heating and night cooling). These

[24] If the applicant intends to produce both manufactured homes AND modular classrooms, separate specifications for the two different building types may be required.

[25] Applicants are also encouraged to provide supporting documentation reflecting their qualifications to fulfill these requirements.

[26] https://www.energy.gov/sites/prod/files/2014/02/f8/BTO_windows_and_envelope_report_3.pdf

strategies may reduce the use of energy associated with heating, cooling, and ventilation equipment.

Field validation of advanced envelope technologies, installation methods and tools that result in major reductions in the installed costs of envelope retrofits are encouraged. Field validation applications should identify any positive or negative impacts on technology integration and performance as well as proposed mitigation strategies, if applicable.

This subtopic is supported by the Research and Development Opportunities (RDO) Report for Windows and the Research and Development Opportunities (RDO) Report for Opaque Building Envelopes.

Acceptable applications under this subtopic include:

- **Windows**
  - Lower cost, affordable, high-efficient (>R6) whole windows.[27]
  - Lower cost, affordable automated shading attachments that are integrated with electric lighting systems and controls (including Building Energy Management Systems and Building Automation Systems).
  - Lower cost, affordable integrated dynamic glass that can pass ASTM 2141 and have dynamic solar heat gain coefficients (SHGC) with market-acceptable colors.

- **Low Thermal Conductivity Insulation**
  - Development of low thermal conductivity (≥R10/inch), durable, opaque insulation materials at a comparable installed cost per square foot to conventional insulation materials such as aged polyisocyanurate with scalable fabrication processes.
  - Development of low cost (≤$1 per square foot per inch) vacuum insulation panels (VIPs). In addition to cost improvements, innovations are needed to make VIPs much more inherently robust and durable, allowing VIPs to be cut to size onsite or punctured without significant loss of thermal performance, and to maximize overall, long-term panel performance by reducing edge losses and effects of aging.

- **Advanced Robotics, Tools, and Methods for Retrofits**
  - Novel hardware and software tools and approaches for significantly improving onsite installation speed, installation quality, worker safety, and performance of onsite- or prefab-enabled building envelope retrofits that

[27] National Fenestration Rating Council (NFRC) certified U values of 0.17 to 0.08 BTU/hr ft^2 F

can adapt or conform to varying conditions of existing buildings, including types of cladding, foundations, roof overhangs, attic ventilation strategies, etc. This includes novel approaches for incorporating energy performance improvements in typical home maintenance and remodeling work, such as upon reroofing or siding replacement.

- Ultra-low cost (prefer at least 50% below current state of the art) retrofit approaches using robotics and other advanced remediation methods in existing buildings for effectively integrating control layers (i.e., thermal insulation, air infiltration control, bulk moisture control and vapor control), particularly in areas unattainable or unaffordable with today's approaches. This includes developing and validating nondestructive or minimally invasive air sealing and methods for adding insulation, as well as building science research to improve moisture management of air-tight high-performance envelope assemblies. All retrofit approaches are expected to reduce or eliminate the risk of existing and future condensation inside the construction assembly and be as fast and non-invasive as possible to occupants and the building envelope, preferably without requiring occupants to leave the premises during the retrofit process.

All applications to Advanced Robotics, Tools, and Methods for Retrofits should define the "next best alternative" technology or practice (e.g. the baseline or state of the art) and describe how their solution significantly improves over this baseline in terms of cost reductions, invasiveness, installation time, and installation safety.

Applications must address and quantify the following:

- Energy savings, affordability, demand flexibility, and occupant comfort
- Description of the manner and extent by which their approach advances the state of the art
- Relevant metrics as identified in the Research and Development Opportunities (RDO) Report for Windows and the Research and Development Opportunities (RDO) Report for Opaque Building Envelopes

When determining affordability, applicants may also address indirect cost savings that may be realized through technology integration, specifically through reduced HVAC system requirements resulting from envelope improvements. For example, the applicant may address smaller HVAC system installation, less complex space conditioning distribution systems, improved comfort avoiding energy intensive set point temperatures fluctuation, reduced peak thermal loads, and possibly increased thermal resilience.

Subtopic 2.3: Advanced Workforce for Advanced Technology

The objective of this subtopic is to support the energy-related construction, renovation, equipment installation, design and related workforce in adapting to new and advanced energy-related technologies, thereby enhancing industry competitiveness, improving and optimizing the energy efficiency, affordability, comfort and productivity of American homes and businesses. Recent surveys indicate that employers experience consistent difficulty hiring skilled personnel, particularly engineers, construction technicians and other skilled professionals[28]. A White House factsheet identifies education and training as a shortcoming in preparing American workers to thrive in the 21st century economy[29]. These issues are further exacerbated by the fact that much of the industry is turning over as workers near retirement[30].

This subtopic area focuses on developing curricula, tools, and other resources that can seamlessly integrate cutting-edge energy efficiency technologies into professional credentialing and continuing education pathways. Successful projects will leverage research findings and established best practices[31], and support the Administration's priority to support "initiatives that re-skill Americans for the jobs of today and the future"[32]. Applicants will validate that their new materials increase worker understanding of energy efficiency technologies through incorporation into educational programs that either recruit individuals to energy efficiency careers or provide continuing education to the existing workforce. Approaches should be scalable beyond the scope of the award to potentially impact building industry professionals nationwide. Applicants are encouraged to consider approaches which maximize accessibility via virtual and online formats, and are conducive to students and professionals with limited budgets for training, such as small businesses and those affected by economic slowdown.

To address the challenges facing America's energy efficiency workforce, applications should target one of the following critical industry segments:

[28] EFI & NASEO 2019 "US Energy Employment Report" https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5c7f5326b208fc58dbad974c/1551848231042/USEER_EE_Chapter.pdf

[29] White House factsheet on Workforce Training: https://www.whitehouse.gov/briefings-statements/president-trump-leads-workforce-development/

[30] National Center for Construction Education & Research. Inside the Industry Report. Page 30. https://www.nccer.org/docs/default-source/pdfs/nccer-cornerstone-fall-winter-2017-final.pdf

[31] Where possible, best practices documented in the Building America Solution Center should be used in education and training: https://basc.pnnl.gov/. Additionally, programs should address competencies outlined in the Guidelines for Building Science Education: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24143Rev2.pdf

[32] FY20 Administration R&D Priorities Memo. July 31, 2018.

- **Building Engineering Education Programs:** A variety of engineering professionals, including architectural engineers, mechanical engineers, software engineers, and electrical engineers, play key roles in creating high-performing, energy-efficient buildings. However, many traditional education programs lack a focus on energy-efficient technologies. Applicants are expected to partner with organizations such as academic institutions and credentialing organizations to leverage engineering student training and excitement for problem-solving and to increase competencies related to energy efficiency, flexibility and a variety of integrated building technologies. Key competency gaps for building engineers include using energy modeling and simulation software, optimizing advanced building systems, integrating smart technology, and ensuring cybersecurity. Awardees will develop and validate curricula that prepare engineering students with the technical skillsets required to design and operate high-performance buildings, and connect emerging professionals with relevant career opportunities.

- **Quality Installation Training and Certification Programs:** High-quality installations and well-trained construction technicians and installers, including those for HVAC, insulation, controls, and other key technologies, are critical to realizing the full performance benefits and capabilities of these technologies. BTO seeks training, certification and credentialing organizations with demonstrated ability to recruit and prepare building technicians for the range of advanced and integrated technologies, to assist in matching apprentice candidates into jobs with energy efficiency related employers, particularly regarding energy upgrades for existing buildings. Key competency gaps for installers and technicians include understanding of advanced building systems, integrating smart technologies, performing retro-commissioning, and understanding relevant regulations. Applicants will demonstrate how they will reach individuals pursuing construction training and/or underemployed construction workers, increase their competencies related to energy-efficient building technologies, and connect them to relevant career opportunities.

- **Continuing Education for Design and Construction Professionals**: Design and construction professionals also play key roles affecting the efficiency of homes and businesses and ensuring that buildings will deliver intended benefits to their eventual occupants. However, many industry professionals have limited access to educational opportunities specific to building energy efficiency, particularly strategies to optimize for variables such as performance, cost and comfort, as well as the range of applicable industry standards. BTO seeks applicants who will develop and deliver continuing education, training and technical assistance initiatives supporting industry professionals as they adapt to advanced energy technologies, as well as enabling design and construction practices. Key competency gaps for design professionals include understanding

of building energy modeling and simulation software, understanding advanced building systems, using measured performance data, selecting advanced equipment, and setting performance benchmarks. Applicants will cultivate partnerships among key stakeholders (e.g., state and local governments, professional and trade organizations, and the research community), complement established professional licensing and certification pathways, and cover a range of critical design and construction professionals (e.g., builders, architects, engineers, the trades, and local building department personnel, among others).

This topic seeks applications to develop educational or training materials that address key efficiency technology competency gaps and validate these products in actual programs to evaluate their ability to successfully recruit, train, and educate individuals in the workforces described above. Successful applications will do one or more of the following:

- Develop curricula on efficient building technologies.
  For clarity and illustrative purposes only, some examples are presented: Selection, installation, and maintenance of heat pump water heaters for relevant installers; Understanding and use of commercially available automated fault detection and diagnostic (AFDD) devices for HVAC installers; Challenge for engineering students to develop software that can improve operability and performance of building efficiency technologies, which can be incorporated into existing software engineering courses; Continuing education on connected technologies for building design professionals.
- Develop tools and other resources, such as:
  - Knowledge testing documentation to evaluate program effectiveness
  - Materials to attract new individuals toward the targeted workforce
  - Train-the-trainer guidance information
  - Web resources to showcase program participate success stories
  - Online videos describing the value of new or improved training programs.
- Conduct classes to validate and improve training program.
  For clarity and illustrative purposes only, some examples are presented: Online trainings providing continuing education for 500 construction managers, targeting regions with rapid growth; Collaboration between 10 engineering associate degree programs to host a smart home hack-a-thon; In-field trainings for 1,000 retrofit installers on efficient and durable envelope upgrades in hurricane-prone regions to integrate solutions into disaster relief.
- Collaborate with other education and training providers to integrate materials into existing degree and credentialing programs.

Applications to this subtopic should clearly specify the following:

- Project deliverables (e.g., new and updated educational materials, teaching curricula, credentialing program, train-the-trainer documentation, website(s), educational platform/software)
- Targeted industry sectors (e.g., residential and/or commercial buildings, new and/or existing buildings)
- Targeted program participants, including estimated number of individuals reached with program content throughout the award period. Applicants should indicate if the program is intended for underserved populations, exiting soldiers and new veterans, non-English-as-a-first-language speakers, or other particular groups.
- Description of workforce needs in the targeted location and population, including regional, state and/or local market characteristics
- Key programmatic elements, including proposed training venues, educational approaches (e.g., classroom-based training or virtual formats), instruction materials, instructor qualifications, method of assessment, number of credit hours
- Relevant industry standards (e.g., applicable building codes and standards)
- How the program complements existing educational programs (e.g., secondary or trade schools, community colleges, as well as professional licensing, certification and continuing education) and how the program will enhance the quality and accessibility of industry education and training programs
- Methodology for how program success will be measured in terms of increased participant understanding of energy technologies, potentially including but not limited to:
    - identification of appropriate metrics;
    - assessment of competencies achieved;
    - pre/post knowledge testing of program participants;
    - complementary research initiatives (e.g., data collection or field validation in support of specific training activities);
    - comparisons to control groups;
    - recruitment reach, retention, and job placement rates; and/or,
    - qualitative participant feedback.
- Testament of the program's ability to sustain itself beyond the award period, scale to other regions, and integrate with related educational programs

Applications with one or more of the following features are preferred:

- Programs which address a broad set of topics, with a focus on state-of-the-art building technologies, integration of technologies (e.g., energy-efficient

building design paired with distributed energy resources, energy storage, and/or grid-interactive systems), and supporting building science principles
- Programs which are adaptable between traditional and virtual approaches, such as combining classroom-based education with online and/or onsite approaches to enhance access to program content
- Collaboration/partnerships between training providers, relevant certification bodies, and potential employers
- Programs that support veterans and/or active duty military personnel who are transitioning to the energy-efficient workforce
- Programs which incorporate third-party program evaluation
- Geographic regions of significant impact potential or which complement economic stimulus or resilience efforts (e.g., post-disaster regions, regions where efficiency can be integrated into resilience planning and/or rebuilding efforts, and states or regions with high construction volume)
- Demonstrated extensive need (e.g., knowledge of skill gaps specific to the particular region, target population, and/or the building industry)

To maximize the impact of federal funding provided for workforce training and apprenticeships as a part of this FOA, the prime recipient and subrecipient(s) of projects funded are expected to license to the public all work related to training or education developed in the performance of the award under a Creative Commons Attribution License (CC BY)[33]. Awardees must confer with DOE on the appropriateness of including such materials in an open format and may decide, at both parties' discretion, to leave such materials out of the Creative Commons license[34]. For more information on this license, please visit https://creativecommons.org/licenses/by/4.0/.

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All work under EERE funding agreements must be performed in the United States. See Section IV.I.iii. and Appendix C.

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):

- Applications that fall outside the technical parameters specified in Section I.A. and I.B. of the FOA

[33] https://creativecommons.org/licenses/by/4.0/

[34] DOE, at its sole discretion, may choose not to require CC BY licensing at the time of project negotiation if there is a reasonable basis consistent with the objectives of this FOA not to require it.

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

D. Teaming Partner List

EERE is compiling a Teaming Partner List to facilitate the widest possible national participation for this FOA. The list allows organizations who may wish to participate in an application, but do not wish to apply as the Prime applicant, to express their interest to potential applicants and to explore potential partners.

The Teaming Partner List will be available on EERE Exchange at https://eere-Exchange.energy.gov under DE-FOA-0002196 beginning shortly after the FOA's release as Teaming Partners are identified. The Teaming Partner List will be updated at least weekly until the close of the Full Application period to reflect new Teaming Partners who have provided their information. Any organization that would like to be included on this list should submit the following information to DE-FOA-0002196@netl.doe.gov with the subject line "Teaming Partner Information":

Organization Name, Contact Name, Contact Address, Contact Email, Contact Phone, Organization Type, Topic/Subtopic Area(s) to which the organization would like to participate, Area of Technical Expertise, and Brief (approximately 200 words or less) Description of Capabilities.

By submitting a request to be included on the Teaming Partner List, the requesting organization consents to the publication of the above-referenced information. By facilitating this Teaming Partner List, EERE does not endorse or otherwise evaluate the qualifications of the entities that self-identify themselves for placement on the Teaming Partner List. EERE will not pay for the provision of any information, nor will it compensate any applicants or requesting organizations for the development of such information.

E. Authorizing Statutes

The programmatic authorizing statute is: Energy Policy Act (EPAct 2005; 42 U.S.C. §16191) §911(a)(1) and 42 U.S.C. §16191) §911(a)(2)(B).

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulation (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 $80 million of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE may issue one, multiple, or no awards under each topic/subtopic area. The federal share of individual awards for each subtopic is identified in table 1.

Topic	Subtopic	Award Duration	Federal $$ per award (estimated)	Total Federal Funding (estimated)	Cost Share Minimum
Topic 1	All Subtopics	up to 36 months	up to $3M	$61M	20%
Topic 2	Subtopics 2.1 – 2.2			$12M	
	Subtopic 2.3		up to $750,000	$7M	0%
TOTAL				**up to $80M**	

Table 1: Topic Area Award and Funding Summary

EERE may establish more than one budget period for each award and fund only the initial budget period(s). Funding for all budget periods, including the initial budget period, is not guaranteed. Before the expiration of the initial budget period(s), EERE may perform a down-select among different recipients and provide additional funding only to a subset of recipients.

ii. Period of Performance

EERE anticipates making awards that will run up to 36 months in length, comprised of one or more budget periods. Project continuation will be contingent upon several elements, including satisfactory performance and Go/No-Go decision review. For a complete list, see Section VI.B.xiv. At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, the extent milestone objectives are met, compliance with reporting requirements, and overall contribution to the program goals and objectives. As a result of this evaluation, EERE 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.

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, FFRDCs 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. Grants

Although EERE has the authority to provide financial support to prime recipients through grants, EERE generally does not fund projects through grants. EERE may fund a limited number of projects through grants, as appropriate.

iv. Technology Investment Agreements (TIAs)

In rare cases and if determined appropriate, EERE will consider awarding a TIA to a non-FFRDC applicant. TIAs, governed by 10 CFR Part 603, are assistance instruments used to increase the involvement of commercial entities in the Department's research, development, and demonstration programs. A TIA may be either a type of cooperative agreement or an assistance transaction other than a cooperative agreement, depending on the intellectual property provisions. In both cases, TIAs are not necessarily subject to all of the requirements of 2 CFR Part 200 as amended by 2 CFR Part 910.

In a TIA, EERE may modify the standard government terms and conditions, including but not limited to:

- Intellectual Property Provisions: EERE may negotiate special arrangements with recipients to avoid the encumbrance of existing intellectual property rights or to facilitate the commercial deployment of inventions conceived or first actually reduced to practice under the EERE funding agreement.
- Accounting Provisions: EERE may authorize the use of Generally Accepted Accounting Principles (GAAP) where recipients do not have accounting systems that comply with government recordkeeping and reporting requirements.

EERE will be more amenable to awarding a TIA in support of an application from a consortium or a team arrangement that includes cost sharing with the private sector, as opposed to an application from a single organization. Such a consortium or teaming arrangement could include a FFRDC. If a DOE/NNSA FFRDC is a part of the consortium or teaming arrangement, the value of, and funding for the DOE/NNSA FFRDC portion of the work will be authorized and funded under the DOE field work authorization system and performed under the laboratory's Management and Operating (M&O) contract. Funding for a non-DOE/NNSA FFRDC would be through an interagency agreement under the Economy Act or other statutory authority. Other appropriate contractual accommodations, such as those involving intellectual property, may be made through a "funds in" agreement to facilitate the FFRDCs' participation in the consortium or teaming arrangement. If a TIA is awarded, certain types of information described in 10 CFR 603.420(b) are exempt from disclosure under the Freedom of Information Act (FOIA) for five years after DOE receives the information.

An applicant may request a TIA if it believes that using a TIA could benefit the RD&D objectives of the program (see section 603.225) and can document these

benefits. If an applicant is seeking to negotiate a TIA, the applicant must include an explicit request in its Full Application. After an applicant is selected for award negotiation, the Contracting Officer will determine if awarding a TIA would benefit the RD&D objectives of the program in ways that likely would not happen if another type of assistance agreement (e.g., cooperative agreement subject to the requirements of 2 CFR Part 200 as amended by 2 CFR Part 910). The Contracting Officer will use the criteria in 10 CFR 603, Subpart B, to make this determination.

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. Individuals

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

ii. 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.

DOE/NNSA FFRDCs are eligible to apply for funding as a prime or subrecipient for subtopics 1.2, 1.7, and 2.2. For all other subtopics, DOE/NNSA FFRDCs are only eligible to apply as a subrecipient.

Non-DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

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.

NETL is not eligible for award under this announcement and may not be proposed as a subrecipient on another entity's application. An application that includes NETL as a prime recipient or subrecipient will be considered non-responsive.

iii. Foreign Entities

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA. 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.

Foreign entities may request a waiver of the requirement to designate a subsidiary in the United States as the prime recipient in the Full Application (i.e., a foreign entity may request that it remains the prime recipient on an award). To do so, the applicant must submit an explicit written waiver request in the Full Application. Appendix C lists the necessary information that must be included in a request to waive this requirement. The applicant does not have the right to appeal EERE's decision concerning a waiver request.

In the waiver request, the applicant 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 have a foreign entity serve as the prime recipient. EERE may require additional information before considering the waiver request.

A foreign entity may receive funding as a subrecipient.

iv. 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.

v. 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

Project cost share must be at least 20% of the total allowable costs for research and development projects (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). Applications submitted under all subtopics, except subtopic 2.3, must meet the 20% minimum requirement.

Subtopic 2.3 does not require cost share by statute.

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 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 are 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 percentage as negotiated between DOE and the Applicant. 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, Full Applications and Replies to Reviewer Comments must meet all compliance criteria listed below or they will be considered noncompliant. EERE will not review or consider noncompliant submissions, including Concept Papers, Full Applications, and Replies to Reviewer Comments 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.B. 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 Full Application 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 the FOA.

3. *Replies to Reviewer Comments*
Replies to Reviewer Comments are deemed compliant if:

- The Reply to Reviewer Comments complies with the content and form requirements in Section IV.D. of the FOA; and

- The applicant successfully uploaded all required documents to 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.

E. Other Eligibility Requirements

i. Requirements for DOE/National Nuclear Security Agency (NNSA) Federally Funded Research and Development Centers (FFRDC) Listed as the applicant

For subtopics 1.2, 1.7, and 2.2 only: A DOE/NNSA FFRDC is eligible to apply for funding under this FOA if its cognizant Contracting Officer provides written authorization and this authorization is submitted with the application.

The following wording is acceptable for the 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.
> (end of acceptable authorization)

If a DOE/NNSA FFRDC is selected for award negotiation, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's Management and Operating (M&O) contract.

NETL is not eligible for award under this announcement and may not be proposed as a subrecipient on another entity's application. An application that includes NETL as a prime recipient or subrecipient will be considered non-responsive.

ii. 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's, 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.

   NETL is not eligible for award under this announcement and may not be proposed as a subrecipient on another entity's application. An application that includes NETL as a prime recipient or subrecipient will be considered non-responsive.

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

An entity may submit more than one 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

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, Full Application, and Reply to Reviewer Comments 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;

- The Control Number must be prominently displayed on the upper right corner of the header of every page. 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, Full Application, or Reply to Reviewer Comments. Once the Concept Paper, Full Application, or Reply to Reviewer Comments 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, Full Application, or Reply to Reviewer Comments 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.ii. 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.

A. 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

B. 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.

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 Topic/Subtopic Area being addressed, both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Technical Description and Impacts	2 pages maximum	Applicants are required to describe succinctly: • The proposed technology or approach, including basic operating principles, where applicable, and how it is unique and innovative; • The specific outcomes of the approach and/or 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 or approach 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; and • The impact that EERE funding would have on the proposed project.
Addendum	1 page maximum	Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed project team, including: • 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; • Whether the applicant has worked together with its teaming partners on prior projects or programs; and • Whether the applicant has adequate access to equipment and facilities necessary to accomplish the effort and/or clearly explain how it intends to obtain access to the necessary equipment and facilities. Applicants may also use the Addendum section to provide photographs, maps, references, graphs, charts, or other data to supplement their Technology Description. However, the Addendum section, inclusive of any supplemental photograph, maps, references, graphs, charts, or other data, may not exceed the maximum page limit for the section specified in the preceding column.

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 posted on EERE Exchange at the close of that phase.

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.

C. 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 on EERE Exchange 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, and should include that control number in the file name of their Full Application submission (i.e., *Control number_Applicant Name_Full Application*).

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.

NOTE: The applicant is no longer required to follow any specific file naming convention other than to ensure 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.

Full Applications must conform to the following requirements:

Submission	Components	File Name (Exchange generated)
Full Application (PDF, unless stated otherwise)	Technical Volume (PDF format. See Chart in Section IV.D.ii.)	ControlNumber_LeadOrganization_TechnicalVolume
	Resumes (PDF format. 1 page maximum per person)	ControlNumber_LeadOrganization_Resumes
	Letters of Commitment, if applicable (PDF format. 1 page maximum per letter)	ControlNumber_LeadOrganization_LOCs
	Statement of Project Objectives (SOPO) (Microsoft Word format. 5 page limit; template available in EERE Exchange)	ControlNumber_LeadOrganization_SOPO
	SF-424 Application for Federal Assistance (PDF format; template available in EERE Exchange)	ControlNumber_LeadOrganization_App424
	Budget Justification (Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Budget_Justification
	Summary for Public Release (PDF format. 1 page limit)	ControlNumber_LeadOrganization_Summary
	Summary Slide (Microsoft PowerPoint format. 1 page limit)	ControlNumber_LeadOrganization_Slide
	Subrecipient Budget Justification, if applicable (Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
	DOE Work Proposal for FFRDC, if applicable (PDF format. See DOE O 412.1A, Attachment 3)	ControlNumber_LeadOrganization_WP
	Authorization from cognizant Contracting Officer for FFRDC, if applicable (PDF format)	ControlNumber_LeadOrganization_FFRDCAuth
	SF-LLL Disclosure of Lobbying Activities (PDF format; template available in EERE Exchange)	ControlNumber_LeadOrganization_SF-LLL
	Foreign Entity Participation and Performance of Work in the United States (Foreign Work) waiver requests, if applicable (PDF format)	ControlNumber_LeadOrganization_Waiver
	U.S. Manufacturing Plan (PDF format) **[Not required for subtopic 2.3 – see description below]**	ControlNumber_LeadOrganization_USMP
	Data Management Plan (Microsoft Word format) **[Not required for subtopic 2.3 – see description below]**	ControlNumber_LeadOrganization_DMP
	Investor Commitment Letter (PDF format) **[Required only for subtopic 2.1]**	ControlNumber_LeadOrganization_ICL

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.ii. of the FOA. Save the Technical Volume in a single PDF file.

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

The Technical Volume to the Full Application may not be more than 20 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The applicant should consider the weighting of each of the evaluation criteria (see Section V.A.ii. 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	The cover page should include the project title, control number, the specific FOA Topic/Subtopic Area being addressed, both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Project Overview (This section should constitute approximately 10% of the Technical Volume)	The Project Overview should contain the following information: • 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/subtopic 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 (This section should constitute approximately 30% of the Technical Volume)	The Technical Description should contain the following information: • Relevance and Outcomes: The applicant should provide a detailed description of the technology or approach, 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 approach 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 and/or approach, the advantages of proposed technology and/or approach 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 Technology Transition Plan (This section should constitute approximately 40% of the Technical Volume)	The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go Decision Points, and Project Schedule. A detailed SOPO is separately requested. The Workplan should contain the following information:

	• 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 standard WBS for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as "we will then complete a proprietary process" is unacceptable). It is the applicant's responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a SMART technical milestone. SMART milestones should be **S**pecific, **M**easurable, **A**chievable, **R**elevant, and **T**imely, 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. • Go/No-Go Decision Points: The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. A Go/No-Go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of

	performance is evaluated, prior to actually beginning the execution of future phases. At a minimum, each project must have at least one project-wide Go/No-Go decision point for each budget period (approximate 12-month period) of the project. See Section VI.B.xiv. The applicant should also provide the specific technical criteria to be used to evaluate the project at the Go/No-Go decision point. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered "SMART".
	• End of Project Goal: The applicant should provide a summary of the end of project goal(s). At a minimum, each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO.
	• Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and Go/No-Go decision points.
	• Project Management: The applicant should discuss the team's proposed management plan, including the following:
	  ○ 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 Transition Plan: The applicant should describe the state of the technology and include a summary of the Value Proposition & Market Opportunity and Risk Mitigation Strategy. The applicant should define a reasonable path for the proposed technology toward commercial viability and success. The Technology Transition Plan should include the following information:
	  ○ Value Proposition & Market Opportunity: Quantify the market opportunity and describe the value proposition and competitive differentiation. Include an explanation of why the proposed solution would be commercially relevant (e.g., what needs are you trying to address? How have previous solutions fallen short?) and how you plan to test and qualify your product concept in the market.
	  ○ Risk Mitigation Strategy: Identify techno-economic challenges to be overcome for the proposed

	technology to be commercially relevant and discuss any scalability, regulatory, cost, intellectual property (IP) or integration risks and considerations associated with the technology. Describe your strategy to address and/or mitigate these challenges. Discuss any other factors key to the successful realization of energy savings potential, cost reduction targets, installation time targets, as well as any known or perceived barriers to market adoption/dissemination and your plans for enhancing or mitigating these.
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	The Technical Qualifications and Resources should contain the following information: • Describe the project team's unique qualifications and expertise, including those of key subrecipients. • Describe the project team's existing equipment and facilities that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project. • This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives. • Describe the time commitment of the key team members to support the project. • Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable. • For multi-organizational or multi-investigator projects, describe succinctly: ○ 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 ○ Communication plans

iii. 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.

iv. Letters of Commitment

Submit letters of commitment from all subrecipient and third party cost share providers. If applicable, also include any letters of commitment from

partners/end users (1 page maximum per letter). Save the letters of commitment in a single PDF file.

v. 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, including the Milestone Table, must not exceed 5 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. Save the SOPO in a single Microsoft Word file.

Note: SOPOs must not include confidential, proprietary, business sensitive, or privileged information.
Note: Past FOAs have included milestones in the SOPO. Applicants whose full applications are selected for award negotiations will be required to submit a Project Management Plan (PMP)(see section IV.C.xix). For this FOA, milestones will be incorporated into the PMP rather than the SOPO. However, all applications must fully detail their proposed milestones in the technical volume of the Full Application (see section IV.C.ii).

vi. SF-424: Application for Federal Assistance

Complete all required fields in accordance with the instructions on the form that is provided in EERE Exchange. 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. Save the SF-424 in a single PDF file.

vii. 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. Save the Budget Justification Workbook in a single Microsoft Excel file.

viii. 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 application control number, 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. Save the Summary for Public Release in a single PDF file.

ix. Summary Slide

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

The Summary Slide template requires the following information:

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

x. Subrecipient Budget Justification (if applicable)

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

xi. 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/@@images/file. Save the WP in a single PDF file.

xii. 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. Save the Authorization in a single PDF file.

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

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

Prime recipients and subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (document is available in EERE Exchange) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

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

Save the SF-LLL in a single PDF file.

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

1. **Foreign Entity Participation:**
   As set forth in Section III.A.iii., 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. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application. Appendix C lists the necessary information that must be included in a request to waive this requirement.

2. **Performance of Work in the United States (Foreign Work Waiver)**
   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 foreign work waiver request.

Save the Waivers in a single PDF file.

xv. U.S. Manufacturing Commitments

Applicants to all subtopics except subtopic 2.3 are required to submit a U.S. Manufacturing Plan with the Full Application. Applicants to subtopic 2.3 are not required to submit a U.S. Manufacturing Plan. Applicants to subtopic 2.3 may submit a "placeholder" document that states, "A Manufacturing Plan is not required for this subtopic".

Pursuant to the DOE Determination of Exceptional Circumstances (DEC) dated September 9, 2013, each applicant 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.

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. Data Management Plan (DMP)

Applicants to all subtopics except subtopic 2.3 are required to submit a Data Management Plan with the Full Application. Applicants to subtopic 2.3 are not required to submit a Data Management Plan. Applicants to subtopic 2.3 may submit a "placeholder" document that states, "A Data Management Plan is not required for this subtopic".

An applicant may select one of the template Data Management Plans (DMP) listed below. Alternatively, instead of selecting one of the template DMPs below, an applicant may submit another DMP provided that the DMP, at a minimum, (1) describes how data sharing and preservation will enable validation of the results from the proposed work, how the results could be validated if data are not shared or preserved and (2) has a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publications. DOE Public Access Plan dated July 24, 2014 provides additional guidance and information on DMPs.

Option 1 (when protected data is allowed): For the deliverables under the award, the recipient does not plan on making the underlying research data supporting the findings in the deliverables publicly-available for up to five (5) years after the data were first produced because such data will be considered

protected under the award. The results from the DOE deliverables can be validated by DOE who will have access, upon request, to the research data. Other than providing deliverables as specified in the award, the recipient does not intend to publish the results from the project. However, in an instance where a publication includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Option 2: For any publication that includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Save the DMP in a single Microsoft Word file.

xvii. Investor Commitment Letter

As described under Section I.B of this FOA, only applicants to subtopic 2.1 are required to provide one or more letters of commitment from potential building investor(s) to purchase and install any combination of manufactured homes and/or portable classrooms once the manufacturer meets acceptable specifications and installed cost requirements as outlined in the proposed approach. Applicants are expected to quantify a purchase commitment to the extent possible.

xviii. Software Commercialization or Open-Source Distribution Plan

Applicants whose full applications are selected for award negotiations, and whose technical approach includes development of software, will have the option to either commercialize that software or distribute it as open-source. Awardees will be required to submit a Software Commercialization Plan or an Open Source Software Distribution Plan during the first year of the project, at a time determined during award negotiation.

xix. Project Management Plan

Applicants whose full applications are selected for award negotiations must submit a Project Management Plan. The initial PMP is due as a first quarter deliverable. At a minimum, the PMP will be updated and submitted as part of

the continuation application prior to the initiation of each budget period. The Recipient will manage and implement the project in accordance with the PMP. The PMP template is available on EERE Exchange at https://eere-Exchange.energy.gov/.

D. Content and Form of Replies to Reviewer Comments

EERE will provide applicants with reviewer comments following the evaluation of all eligible Full Applications. Applicants will have a brief opportunity to review the comments and to prepare a short Reply to Reviewer Comments responding to the comments however they desire or supplementing their Full Application. The Reply to Reviewer Comments is an optional submission; applicants are not required to submit a Reply to Reviewer Comments. EERE will post the Reviewer Comments in EERE Exchange. The expected submission deadline is on the cover page of the FOA; however, it is the applicant's responsibility to monitor EERE Exchange in the event that the expected date changes. The deadline will not be extended for applicants who are unable to timely submit their reply due to failure to check EERE Exchange or relying on the expected date alone. Applicants should anticipate having approximately three (3) business days to submit Replies to Reviewer Comments.

EERE will not review or consider ineligible Replies to Reviewer Comments (see Section III of the FOA). EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

Replies to Reviewer Comments must conform to the following content and form requirements, including maximum page lengths, described below. If a Reply to Reviewer Comments is more than three (3) pages in length, EERE will review only the first three (3) pages and disregard any additional pages.

Section	Page Limit	Description
Text	2 pages max	Applicants may respond to one or more reviewer comments or supplement their Full Application.
Optional	1 page max	Applicants may use this page however they wish; text, graphs, charts, or other data to respond to reviewer comments or supplement their Full Application are acceptable.

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;
- 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;
- Environmental Questionnaire;
- Software Commercialization or Open-Source Distribution Plan;
- Intellectual Property Management Plan (See Section VI.B.x);
- Project Management Plan

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 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, Full Applications, and Replies to Reviewer Comments 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 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 foreign work waiver, the applicant must submit a written waiver request to EERE. Appendix C lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

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 titled "ControlNumber_LeadOrganization_Waiver". 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 and allowable in limited circumstances with the prior written 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. Domestic Preference – Infrastructure Projects

As appropriate and to the extent consistent with law, Applicants shall ensure that, to the greatest extent practicable, iron and aluminum as well as steel, cement, and other manufactured products (items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber) used in the proposed project

shall be produced in the United States. This requirement shall flow down to all sub-awards including all contracts, subcontracts and purchase orders for work performed under the proposed project.

viii. 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.

ix. 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.

x. 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; and
- Other items as required by DOE.

V. Application Review Information

A. Technical Review Criteria

i. Concept Papers

Concept Papers are evaluated based on consideration 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 sub-criteria:

- The applicant clearly describes the proposed technology and/or approach, describes how the technology and/or approach is unique and innovative, and how the technology and/or approach will advance the current state-of-the-art;
- The applicant has identified risks and challenges, including possible mitigation strategies, and has shown the impact that EERE funding and the proposed project would have on the relevant field and application;
- The applicant has the qualifications, experience, capabilities and other resources necessary to complete the proposed project; and
- The proposed work, if successfully accomplished, would clearly meet the objectives as stated in the FOA.

ii. Full Applications

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 (50%)
This criterion involves consideration of the following sub-criteria:

Technical Merit and Innovation

- Extent to which the proposed technology or approach is innovative;
- Degree to which the current problem, current state of the technology, and the proposed advancement are clearly described;
- Extent to which the application specifically and convincingly demonstrates how the applicant will move the state-of-the-art to the proposed advancement; and
- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious and revolutionary, including relevant data, calculations and discussion of prior work in the literature with analyses that support the viability of the proposed work.

Impact of Technology Advancement

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

Criterion 2: Project Research and Market Transformation Plan (30%)
This criterion involves consideration of the following factors:

Research Approach, Workplan and SOPO

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

Identification of Technical Risks

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

Baseline, Metrics, and Deliverables

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

Technology Transition Plan

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

Criterion 3: Team and Resources (20%)
This criterion involves consideration of the following factors:

- The capability of the Principal Investigator(s) and the proposed team to address all aspects of the proposed work with a high probability of success. The qualifications, relevant expertise, and time commitment of the individuals on the team;
- The sufficiency of the facilities to support the work;
- The degree to which the proposed team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed technologies;
- The level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan; and
- The reasonableness of the budget and spend plan for the proposed project and objectives.

iii. Criteria for Replies to Reviewer Comments

EERE has not established separate criteria to evaluate Replies to Reviewer Comments. Instead, Replies to Reviewer Comments are attached to the original applications and evaluated as an extension of the Full Application.

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 degree to which the proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from the subject FOA;
- The degree to which the proposed project, including proposed cost share above the minimum requirement, 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 degree to which the proposed project is likely to lead to increased employment and manufacturing in the United States;
- The degree to which 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; and
- The degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications).
- The degree to which the proposed project collectively represents diverse types and sizes of applicant organizations.
- Whether the proposed project will occur in a Qualified Opportunity Zone or otherwise advance the goals of Qualified Opportunity Zones[35]. The goals include spurring economic development and job creation in distressed communities throughout the United States.

[35] Opportunity zones were added to the Internal Revenue Code by section 13823 of the Tax Cuts and Jobs Act of 2017, codified at 26 U.S.C. 1400Z-1. The list of designated Qualified Opportunity Zones can be found in IRS Notices 2018-48 (PDF) and 2019-42 (PDF). Further, a visual map of the census tracts designated as Qualified Opportunity Zones may also be found at Opportunity Zones Resources. Also see, frequently asked questions about Qualified Opportunity Zones.

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 Interviews

As part of the evaluation and selection process, EERE may invite one or more applicants to participate in Pre-Selection Interviews. Pre-Selection Interviews are distinct from and more formal than pre-selection clarifications (See Section V.D.iii of the FOA). The invited applicant(s) will meet with EERE representatives to provide clarification on the contents of the Full Applications and to provide EERE an opportunity to ask questions regarding the proposed project. The information provided by applicants to EERE through Pre-Selection Interviews contributes to EERE's selection decisions.

EERE will arrange to meet with the invited applicants in person at EERE's offices or a mutually agreed upon location. EERE may also arrange site visits at certain applicants' facilities. In the alternative, EERE may invite certain applicants to participate in a one-on-one conference with EERE via webinar, videoconference, or conference call.

EERE will not reimburse applicants for travel and other expenses relating to the Pre-Selection Interviews, nor will these costs be eligible for reimbursement as pre-award costs.

EERE may obtain additional information through Pre-Selection Interviews that will be used to make a final selection determination. EERE may select applications for funding and make awards without Pre-Selection Interviews. Participation in Pre-Selection Interviews with EERE does not signify that applicants have been selected for award negotiations.

iii. 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.

iv. 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.

v. 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 negotiating awards by the dates provided on the cover page of this FOA.

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. EERE will post these notifications to EERE Exchange.

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.II.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**
   Register with the SAM at https://www.sam.gov. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called a Marketing Partner ID Number (MPIN) 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 – Unclassified Foreign Visits and Assignments Program

All applicants selected for an award under this FOA are required to provide information to the DOE in order to satisfy requirements for foreign nationals' access to DOE sites, information, technologies, equipment, programs, or personnel. A "foreign national" is defined as any person who is not a U.S. citizen by birth or naturalization.

If a selected applicant anticipates involving foreign nationals in the performance of its Award, the selected applicant must provide specific information about each foreign national to DOE for review and consideration. The selected applicant must provide this information for any foreign national who will participate in the performance of the Award for the selected applicant or any subrecipient. The information must also be provided for any foreign national who will provide a service under a contract and who will be exposed to Official Use Only (OUO) or business sensitive information, or information or technology developed under the Award that may be included under any category of national or state security.

The Secretary of Energy or the Secretary's assigned approval authority must approve foreign national participation before any foreign national may gain access to DOE sites, information, technologies, equipment, programs, or personnel or begin performance of 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 NEPA (42 U.S.C. 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 https://www.energy.gov/nepa.

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 recipient may be required to prepare the records and 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 contactors 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 the Go/No-Go decision point(s).

4. EERE participates in major project decision-making processes.

5. EERE promotes and facilitates technology transfer activities, including disseminating Technology Office results through presentations and publications.

6. EERE participates in project management planning activities, including risk analysis, to ensure EERE Technology Office requirements or limitations are considered in performance of the work elements.

x. Intellectual Property Management Plan (IPMP)

Within the first quarter of award execution, applicants may be required to submit an executed IPMP between the members of the consortia or team. The award will set forth the treatment of and obligations related to intellectual property rights between EERE and the individual members. The IPMP should describe how the members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies (see Sections VIII.K.-VIII.N. of this FOA for more details on applicable federal intellectual property laws and regulations). Guidance regarding the contents of IPMP is available from EERE upon request.

The following is a non-exhaustive list of examples of items that the IPMP may cover:

- The treatment of confidential information between members (e.g., the use of NDAs);
- The treatment of background intellectual property (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the award (e.g., any requirements for disclosing to the other members on an application, filing patent applications, paying for patent prosecution, and cross-licensing or other licensing arrangements between the members);
- The treatment of data produced, including software, under the award (e.g., any publication process or other dissemination strategies, copyrighting strategy or arrangement between members);

- Any technology transfer and commercialization requirements or arrangements between the members;
- The treatment of any intellectual property issues that may arise due to a change in membership of the consortia or team; and
- The handling of disputes related to intellectual property between the members.

xi. 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 ten (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.

xii. 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.

xiii. 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.

xiv. 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 compared to the milestones in the Project Management Plan; (4) recipient’s submittal of required reports; (5) recipient’s 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.

xv. 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.

xvi. 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-0002196@netl.doe.gov. Questions must be submitted not later than three (3) 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 three (3) business days, unless a similar question and answer has already been posted on the website.

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

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, the Go/No-Go Reviews and Peer Reviews, 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, Replies to Reviewer Comments, 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; and

- Determination of Exceptional Circumstances (DEC): Each applicant, for all subtopics **except subtopic 2.3**, is required to submit a U.S. Manufacturing Plan as part of its application. If selected, the U.S. Manufacturing Plan shall be incorporated into the award terms and conditions for domestic small businesses and nonprofit organizations. 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. Any Bayh-Dole entity (domestic small business or nonprofit organization) affected by this DEC 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.

1. 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.

2. 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 for all subtopic areas except subtopic 2.3.*** For awards permitting Protected Data, the protected data must be marked as set forth in the award's 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. In addition, for those awards requiring distribution of software as Open-Source Software (OSS), see Section IV.C.xviii.

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 2014 (Pub. L. No. 113-283, Dec 18, 2014; 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.

Q. Informational Webinar

EERE will conduct one informational webinar during the FOA process. It will be held after the initial FOA release but before the due date for Concept Papers.

Attendance is not mandatory and will not positively or negatively impact the overall review of any applicant submissions. As the webinar will be open to all applicants who wish to participate, applicants should refrain from asking questions or communicating information that would reveal confidential and/or proprietary information specific to their project. Specific dates for the webinar can be found on the cover page of the FOA.

APPENDIX A – DEMAND SIDE MANAGEMENT AND GRID SERVICES

Demand-Side Management Strategies	Grid Services	Definition	Key Characteristics	
Efficiency	Generation: Energy Generation: Capacity Transmission and Distribution (T&D): Non-Wires Solutions	Persistent reduction in load. Interval data are needed for measurement and verification purposes, but this is not a dispatchable service.	Typical duration	Continuous
			Load change	Long-term decrease
			Response time	N/A
			Event frequency	Lifetime of equipment
Load Shed	Contingency Reserves	Load reduction for a short time to make up for a shortfall in generation.	Typical duration	Up to 1 hr
			Load change	Short-term decrease
			Response time	<15 min
			Event frequency	20 times per year
	Generation: Energy Generation: Capacity T&D: Non-Wires Solutions	Load reduction during peak periods in response to grid constraints or based on time-of-use pricing structures[36].	Typical duration	30 mins to 4 hrs
			Load change	Short-term decrease
			Response time	30 min to 2 hrs
			Event frequency	<100 hrs per year/seasonal
Load Shift	Generation: Capacity T&D: Non-Wires Solutions	Load shifting from peak to off-peak periods in response to grid constraints or based on time-of-use pricing structures.	Typical duration	30 mins to 4 hrs
			Load change	Short-term shift
			Response time	<1 hour
			Event frequency	<100 hrs per year/seasonal
	Avoid Renewable Curtailment	Load shifting to increase energy consumption at times of excess renewable generation output. This type of load shifting is not a dispatchable service but can be indicated through time-of-use pricing structures.	Typical duration	2 to 4 hrs
			Load change	Short-term shift
			Response time	N/A
			Event frequency	Daily
Modulate	Frequency Regulation	Load modulation in real time to closely follow grid signals. Advanced telemetry is required for output signal transmission to grid operator; also expected to be able to receive automatic control signal.	Typical duration	Seconds to minutes
			Load change	Rapid increase/decrease
			Response time	<1 min
			Event frequency	Continuous
			Typical duration	Seconds to minutes

[36] Time-of-use pricing that specifically incentivizes energy use at times when renewable generation output is high and electricity prices are low.

	Ramping	Load modulation to offset short term variable renewable generation output changes.[37]	Load change	Rapid increase/decrease
			Response time	Seconds to minutes
			Event frequency	Continuous

Mapping Demand-Side Management Strategies to Grid Services[38]

Grid Services	Potential Avoided Cost	Potential Market Size Addressable by Demand-Side Management in Buildings
Generation Services		
Generation: Energy	Power plant fuel, operation, maintenance, and startup and shutdown costs	**Large.** The market potential for reducing generation operations is large because it is a service in every regional transmission organization (RTO) and independent system operator (ISO). Reducing generation operations involves optimizing operation conditions and utilizing lowest-cost generation. For buildings, energy efficiency has the greatest potential to reduce generation operations. Demand response also has moderate potential, though the market size is limited by peak/off-peak price spread and hourly marginal costs, which vary by RTO/ISO (and some utilities) and change over time.
Generation: Capacity	Capital costs for new generating facilities and associated fixed operation and maintenance costs	**Large.** Deferred generation capacity investment results primarily from peak demand reduction. The size of the market varies by region based on the marginal generation costs and system load profiles. Buildings can play a large role in reducing the peak demand because they are the primary driver of peak electricity demand. Buildings can contribute to this service by both lowering the overall need for generation through energy efficiency as well as providing short-term load reduction to address system peaks. For buildings, demand response has the greatest potential to address capacity needs.
Ancillary Services		
Contingency Reserves[39]	Power plant fuel, operation, maintenance, and associated opportunity costs	**Moderate.** The market for contingency reserves is significantly smaller than those for generation capacity or generation operations, making up less than 3% of U.S. peak demand (Ela et al. 2011; Denholm et al. 2015). Despite the small market, buildings are well positioned to provide contingency reserve products by reducing demand for short periods of time.
Frequency Regulation	Power plant fuel, operation, maintenance, and opportunity costs[40] associated with providing frequency regulation	**Small.** Each RTO/ISO requires less than 1,000 megawatts (MW) of frequency regulation—less than 1% of total U.S. generation capacity (Denholm et al. 2015; Tacka 2016)**.** In addition to the small market, demand-side resources are expected to compete against cost-effective distributed supply-side resources that provide frequency regulation. In some RTO/ISOs, generators are required to provide frequency regulation, but rules are changing to allow distributed resources to participate. Multiple technologies (variable

[37] This is not currently offered as a grid service by any RTOs/ISOs.
[38] Grid-interactive Efficient Buildings Technical Report Series Overview of Research Challenges and Gaps (https://www1.eere.energy.gov/buildings/pdfs/75470.pdf)
[39] Including reserves products with various timescales, including spinning/nonspinning reserves and other reserves products that exist in some regions.
[40] E.g., not selling power in order to be ready for up-regulation.

Grid Services	Potential Avoided Cost	Potential Market Size Addressable by Demand-Side Management in Buildings
		frequency drives, water heaters, batteries, solar inverters) can provide frequency regulation.
Ramping	Power plant fuel, operation, maintenance, and startup and shutdown costs	**Small.** Ramping services are an emerging market that is currently not offered in most RTO/ISOs. Ramping services include resources that offset rapid changes in generation output. It is expected to grow as more variable renewable generation is added to the grid. Buildings can provide quick response ramping services from technologies that can dispatch/store electricity (batteries) and can be cycled to offset generation shortfalls (HVAC).
Delivery Services		
Non-Wires Solutions[41]	Capital costs for T&D equipment upgrades	**Moderate.** Opportunities to defer or avoid the need for investments in T&D infrastructure are highly location dependent. Further, the resource is expected to be located electrically downstream from the transmission or distribution equipment to provide this service. Buildings can provide non-wires solutions in a variety of ways, including energy efficiency, demand response, distributed generation, voltage support, and energy storage.
Voltage Support	Capital costs for voltage control equipment (e.g., capacitor banks, transformers, smart inverters)	**Small.** Payments available for voltage support (or reactive power compensation) from demand-side resources vary significantly depending on the utility context and the size. Multiple building technologies can provide limited voltage support, including rooftop solar inverters and battery inverters, though they are expected to compete against cost-effective supply-side resources, including transformers, fixed capacitor banks, and line regulators.

Potential Grid Services Provided by Demand-Side Management in Buildings[42]

[41] Also referred to as deferred T&D upgrades or non-wires alternatives.

[42] https://www1.eere.energy.gov/buildings/pdfs/75470.pdf

APPENDIX B – 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.

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 C – 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 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 / 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 D – WAIVER REQUESTS AND APPROVAL PROCESSES: 1. FOREIGN ENTITY PARTICIPATION AS THE PRIME RECIPIENT; AND 2. PERFORMANCE OF WORK IN THE UNITED STATES (FOREIGN WORK WAIVER)

1. Waiver for Foreign Entity Participation as the Prime Recipient

As set forth in Section III.A.iii., 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. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Overall, the applicant 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 have a foreign entity serve as the prime recipient. A request to waive the *Foreign Entity Participation as the prime recipient* requirement must include the following:

- Entity name;
- The rationale for proposing a foreign entity to serve as the prime recipient;
- Country of incorporation and the extent, if any, the entity is state owned or controlled;
- A description of the project's anticipated contributions to the US economy;
- How the project 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 project will promote domestic American manufacturing of products and/or services;
- A description of how the foreign entity's participation as the prime recipient is essential to the project;
- A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP; and
- Countries where the work will be performed (Note: if any work is proposed to be conducted outside the U.S., the applicant must also complete a separate request for waiver of the Performance of Work in the United States requirement).

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.

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

As set forth in Section IV.J.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 US 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;
- 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 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 Project Management Plan.

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.E.ii.

APPENDIX F – LIST OF ACRONYMS

ABC	Advanced Building Construction
AEO	Annual Energy Outlook
AIA	American Institute of Architects
ANSI	American National Standards Institute
BEM	Building Energy Modeling
BENEFIT	Buildings Energy Efficiency Frontiers & Innovation Technologies
BTO	Building Technologies Office
CC BY	Creative Commons Attribution License
CCE	Cost of Conserved Energy
COI	Conflict of Interest
COP	Coefficient of Performance
D&B	Dun and Bradstreet
DDx	Design Data Exchange
DEC	Determination of Exceptional Circumstances
DMP	Data Management Plan
DOE	Department of Energy
DUNS	Data Universal Numbering System
EBiz POC	Electronic Business Point of Contact
ECM	Energy Conservation Measure
EERE	Energy Efficiency and Renewable Energy
EFI	Energy Federation Incorporated
EH&S	Environmental Health & Safety
EIA	Energy Information Administration
EUI	Energy Use Intensity
FAR	Federal Acquisition Regulation
FFATA	Federal Funding and Transparency Act of 2006
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FFRDC	Federally Funded Research and Development Center
GAAP	Generally Accepted Accounting Principles
GEB	Grid-Interactive Efficient Buildings
GMI	Grid Modernization Initiative
HVAC	Heating, Ventilation and Air Conditioning
HVAC&R	Heating, Ventilation, Air Conditioning and Refrigeration
IoT	Internet-of-Things
IP	Intellectual Property
IPMP	Intellectual Property Management Plan
ISO	Independent System Operator
LED	Light Emitting Diode
M&O	Management and Operating
MPIN	Marketing Partner ID Number
MELs	Miscellaneous Electric Loads

MW	Megawatt
NASEO	National Association of State Energy Officials
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NFRC	National Fenestration Rating Council
NNSA	National Nuclear Security Agency
OLED	Organic Light Emitting Diode
OMB	Office of Management and Budget
OUO	Official Use Only
PCM	Phase Change Material
PI	Principal Investigator
PII	Personal Identifiable Information
PMP	Project Management Plan
R&D	Research and Development
RDO	Research and Development Opportunities
RFI	Request for Information
RTO	Regional Transmission Organization
SAM	System for Award Management
SSL	Solid-State Lighting
SSLC	Separate Sensible and Latent Cooling
SOPO	Statement of Project Objectives
T&D	Transmission and Distribution
TCM	Thermochemical Material
TIA	Technology Investment Agreement
UCC	Uniform Commercial Code
VIP	Vacuum Insulation Panels
WBS	Work Breakdown Structure
WP	DOE Field Work Proposal