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

Advanced Building Construction with Energy Efficient Technologies & Practices (ABC)

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Submission Deadline for Concept Papers:	6/10/2019 5:00 pm ET
Submission Deadline for Full Applications:	8/12/2019 5:00 pm ET
Expected Submission Deadline for Replies to Reviewer Comments:	9/17/2019 5:00 pm ET
Expected Date for EERE Selection Notifications:	In first quarter FY20
Expected Timeframe for Award Negotiations:	In first quarter FY20

- Applicants must submit a Concept Paper by 5:00 pm ET the due date listed above to be eligible to submit a Full Application.

- To apply for 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.

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I. Funding Opportunity Description

A. Background and Context

This Funding Opportunity Announcement (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.

DOE's mission is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.[1] Powering and heating our homes, offices, schools, hospitals, restaurants, and stores consumes enormous amounts of energy. Residential and commercial buildings account for approximately 40% of the nation's total energy demand–greater than that for either industry or transportation—about 75% of all electricity use, and even more of peak power demand, resulting in an annual national energy bill totaling more than $380 billion. There is tremendous opportunity for savings given that 55% of the nation's more than 118 million homes and 50% of the nation's 5.6 million commercial buildings were built before 1980—prior to the existence of today's more efficient products and building construction practices.[2]

Unlocking the potential energy savings of these buildings through more affordable energy efficiency technologies represents significant economic opportunities for the United States. Implementation of more affordable efficiency technologies would yield such corollary benefits as alleviating stress on the electric grid and improving its reliability, resilience, and environmental performance. For American households and businesses, improving the energy efficiency of buildings translates to lower energy bills in homes and commercial buildings. Cutting energy waste in U.S. buildings by 20% would save our nation some $80 billion annually on energy bills,[3] about $235 a year for each person in the United States. Furthermore, saving money on energy costs allows more money to flow into other sectors of the economy, leading to the creation of new jobs.

[1] https://www.energy.gov/mission

[2] EIA, *Residential Energy Consumption Survey 2015* (RECS) and *Commercial Building Energy Consumption Survey 2012* (CBECS).

[3] DOE, "Quadrennial Technology Review 2015," "Chapter 5: Increasing Efficiency of Building Systems and Technologies," https://www.energy.gov/quadrennial-technology-review-2015

Remaining Challenges and Opportunities

The United States has made significant progress in improving building energy efficiency over the last 30 to 40 years[4] due in part to the breakthrough research supported by BTO.[5] BTO has improved the affordability and performance of a wide range of new energy technologies, including many advances in solid-state lighting, highly efficient windows, heat pump water heaters, and high efficiency furnaces and air conditioners, among other areas. These technologies have in turn enabled major advancements in energy efficiency for both new and existing buildings.

Nevertheless, energy use in U.S. residential and commercial buildings remains the largest end-use sector, and Americans spend a significant portion of income powering the buildings in which they live and work. Still, demand for energy efficiency in buildings—beyond simple equipment upgrades like light-emitting diode (LED) lights—remains low for a number of reasons, including the following challenges:

- Whole building efficiency (new or retrofits) cannot be implemented by deploying a single product or action.
  Unlike most products that consumers purchase and enjoy, a building's energy efficiency depends on many different components sold by different entities and installed by different contractors. Whole building energy efficiency retrofits also require multiple systems to be taken into account. For example, replacing a building's windows and adding appropriate window attachments may improve the lighting of a space (i.e. improved use of daylight), but the same window retrofit likely also impacts the HVAC system – for the retrofit to optimize energy savings the interaction between the windows upgrade and the HVAC system performance need to be taken into account, all while maintaining or improving occupants comfort and productivity.

  With multiple products, technologies, and systems in buildings, the market for whole building energy efficiency is both horizontally and vertically fragmented.

- Whole building energy efficiency retrofits are typically more expensive than single technology upgrades.

[4] https://www.eia.gov/energyexplained/index.php?page=us_energy_homes#tab2

[5] Industrial Economics, Incorporated. *Evaluation of Building America and Selected Building Energy Codes Program Activities*. 21 Feb. 2018, www.energy.gov/sites/prod/files/2018/03/f49/BTO-ResidentialEE-Evaluation_Final%20Report_2-21-2018.pdf.

In order for whole building energy efficiency retrofits to be technically and economically successful (i.e. to significantly reduce energy consumption and provide a return on investment to the building owner) several aspects of the building must be evaluated for energy savings potential and upgraded to cost-effectively improve the building's overall energy efficiency. This holistic approach provides deeper savings but it typically costs more and has longer payback periods than single technology/product upgrades.[6]

- The benefits of whole building energy efficiency retrofits are often spread among more than one beneficiary.
  The primary beneficiary of energy efficiency upgrades in owner-occupied buildings is the building owner/occupant. But about one-third of homes and even a larger share of commercial space is renter-occupied, with the tenant often paying the utility bills. Thus the benefits that come from even cost-effective energy efficiency are spread among both owner and tenant, while the cost is typically borne just by the owner. Even when a building is owner-occupied, there are many corollary benefits of energy efficiency (e.g., enhanced grid reliability) which are not sold as part of the "product". These external benefits generally do not enter into the investment decision, in part because beneficiaries such as utilities are outside the purview of the building owner who is footing the bill for the upgrade.

- The value proposition for whole building efficiency and/or retrofits is not always clear to the parties that need to take action.
  Energy-efficiency measures are frequently invisible to consumers (e.g., insulation) and in some cases are not even in their vernacular (e.g., air sealing). Savings predictions and performance are not sufficiently reliable, in part due to an insufficient workforce with expertise in energy assessments, installation, and operations and maintenance. In new construction, investors and builders need to know that buyers will pay for efficiency upgrades before they will include them. With existing buildings, the owner must similarly see that their efficiency investment will pay off through reduced energy costs, improved comfort and/or enhanced property value.

- Available building efficiency products and processes can be disruptive which, understandably, often leads to a reluctance to adopt them.
  Whole building energy efficiency measures require multiple steps and invasive, messy installations. These can be particularly disruptive when implemented in existing, occupied buildings, leading to inconvenience and/or loss of commercial activity.

[6] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20761.pdf

Newly constructed buildings meeting today's energy codes and standards are 30% more efficient than those of 10 years ago.[7] The vast majority of new buildings in the U.S. are constructed onsite, and thus are influenced by many design decisions, technologies, and materials sold by different entities and installed by an array of specialized contractors, a model that is more often susceptible to delays and cost overruns.[8] Shortcomings in products and installation can compromise performance, including reduced thermal resistance of insulation, increased air leakage, and poorly functioning heating and cooling equipment. And although off-site construction methods such as panelized walls and modular building systems were introduced into the U.S. market in the 1950s, this segment of the industry has not yet achieved significant cost reductions, market growth, or energy savings.[9]

Energy efficiency improvements are a tougher sell for existing buildings. Although available technologies could cut building energy use in half[10], only a small portion of existing buildings undergo efficiency retrofits, let alone retrofits for deep energy savings. For example, the states with the highest retrofit rates in the country, e.g. in Massachusetts, Wisconsin and Oregon, have historically reached between 0.5 and 1.75 percent of homes per year and achieved between 20 and 35 percent savings[11]; the rest of the country has even lower rates of retrofits. An estimated 2.2 percent of commercial floor space undergoes some type of energy retrofit each year, resulting in median energy savings of roughly 11 percent for these buildings relative to average building energy use intensity (EUI).[12] While there has been significant progress on simpler upgrades like equipment and lighting (e.g., LEDs), more advanced and whole-building upgrades are less common.

Unlike energy-using equipment that is replaced periodically due to failure or obsolescence, building envelopes are much less frequently altered; and, more common changes, such as reroofing, rarely result in improved energy performance. To tap into the potential that buildings hold in terms of deep energy savings and grid

[7] https://www.energy.gov/sites/prod/files/2016/08/f33/Codes%20Fact%20Sheet%208-25-16.pdf

[8] McKinsey Global Institute. *Reinventing Construction: A Route to Higher Productivity*, February 2017, https://www.mckinsey.com/~/media/McKinsey/Industries/Capital%20Projects%20and%20Infrastructure/Our%20Insights/Reinventing%20construction%20through%20a%20productivity%20revolution/MGI-Reinventing-construction-A-route-to-higher-productivity-Full-report.ashx

[9] https://www.modulartoday.com/modular-history.html; HIRL Builder Survey

[10] https://www.energy.gov/sites/prod/files/2017/03/f34/qtr-2015-chapter5.pdf

[11] Neme, Chris, et al. *Residential Efficiency Retrofits: A Roadmap for the Future*. Regulatory Assistance Project, 2011, www.raponline.org/wp-content/uploads/2016/05/rap-neme-residentialefficiencyretrofits-2011-05.pdf

[12] Amann, Jennifer Thorne. *Unlocking Ultra-Low Energy Performance in Existing Buildings*. ACEEE, 2017, www.aceee.org/white-paper/unlocking-ule-0717.

responsiveness, home and building owners need new alternatives for changing building envelopes—options that are affordable, appealing, and much less disruptive, as well as those that help modernize the overall performance, such as integrated sensors and controls.

Compounding these obstacles to scaling efficiency in new and existing buildings, the construction industry lags significantly behind other industries in terms of productivity and innovation. According to a 2017 McKinsey Global Institute report, the construction sector has fallen significantly behind in adopting the advanced technologies (e.g., robotics, vertically integrated IT solutions) that have propelled other industries forward.[13]

Given this underinvestment in research and development (R&D) and a high degree of fragmentation,[14] the construction industry is ripe for the introduction of automation, robotics, and digitization. The U.S. has a compelling opportunity to innovate solutions that not only improve the industry's productivity and competitiveness, but simultaneously tackle other building-related challenges, including energy efficiency, grid reliability, resiliency, and environmental performance.

This FOA represents an integrated strategy across BTO activities to capitalize on this opportunity and develop innovative and advanced technologies that can maximize energy efficiency while being economical, practicable, and appealing; leverage opportunities for buildings to be more responsive to the grid; and encourage productive partnerships that can help overcome technical and other challenges.

Specifically, the FOA will fund research aimed at developing transformative technology solutions that—

- deliver cost-effective and scalable[15] deep energy savings in both new and existing buildings;
- incorporate methods to modernize construction, reduce costs, and improve quality;
- address aforementioned barriers to rapid and broad-scale adoption of energy efficiency technologies and approaches; and,

[13] McKinsey Global Institute. *Reinventing Construction: A Route to Higher Productivity*, February, 2017: www.mckinsey.com/~/media/mckinsey/industries/capital%20projects%20and%20infrastructure/our%20insights/reinventing%20construction%20through%20a%20productivity%20revolution/mgi-reinventing-construction-executive-summary.ashx

[14] McKinsey, p. 102

[15] For the purposes of this FOA, "scalable" is defined as being readily applied to at least one common building type in one or more climate zones with significant appeal to building owners, investors, and contractors.

- where possible, serve complementary interests such as grid reliability, productivity, comfort, etc. to help drive uptake.

Strategic Goals & FOA Objectives

BTO research aimed at rapid development and integration of next-generation building technologies—including advanced materials, components, equipment, and whole-building technologies—is critical to improving the nation's productive use of energy, as well as enhancing the affordability of building ownership and residency, and maintaining our nation's energy independence.

To that end, BTO is issuing this Advanced Building Construction with Energy-Efficient Technologies & Practices (ABC) FOA to invest in research and development of solutions that can be applied to many segments of the building sector, including existing and new buildings, residential and commercial, and across multiple climate zones. BTO seeks applications aimed at developing deep energy retrofit and new construction technologies that holistically tackle a combination of envelope, heating, cooling, water heating, and ventilation issues, and hold appeal for both building owners and occupants. BTO and successful applicants must also take steps in their research and development to ensure that the energy-efficiency solutions do not sacrifice the comfort or productivity of building occupants or the performance of labor-saving household appliances, products, devices and equipment. BTO does not anticipate that one solution will meet the needs of all building sectors, therefore applicants are strongly encouraged to consider how their proposed innovations can be modified to address different building types and climate regions, and thereby have the potential to achieve greater benefits.

The figures shown below illustrate some of the factors that will affect the ability of different technical solutions to have impacts on energy use nationwide, particularly for retrofit applications. Figure 1 demonstrates that the four focus areas of Advanced Building Construction (i.e., heating, cooling, water heating, and ventilation) make up 72% of national residential site energy consumption and 52% of national commercial site energy consumption.

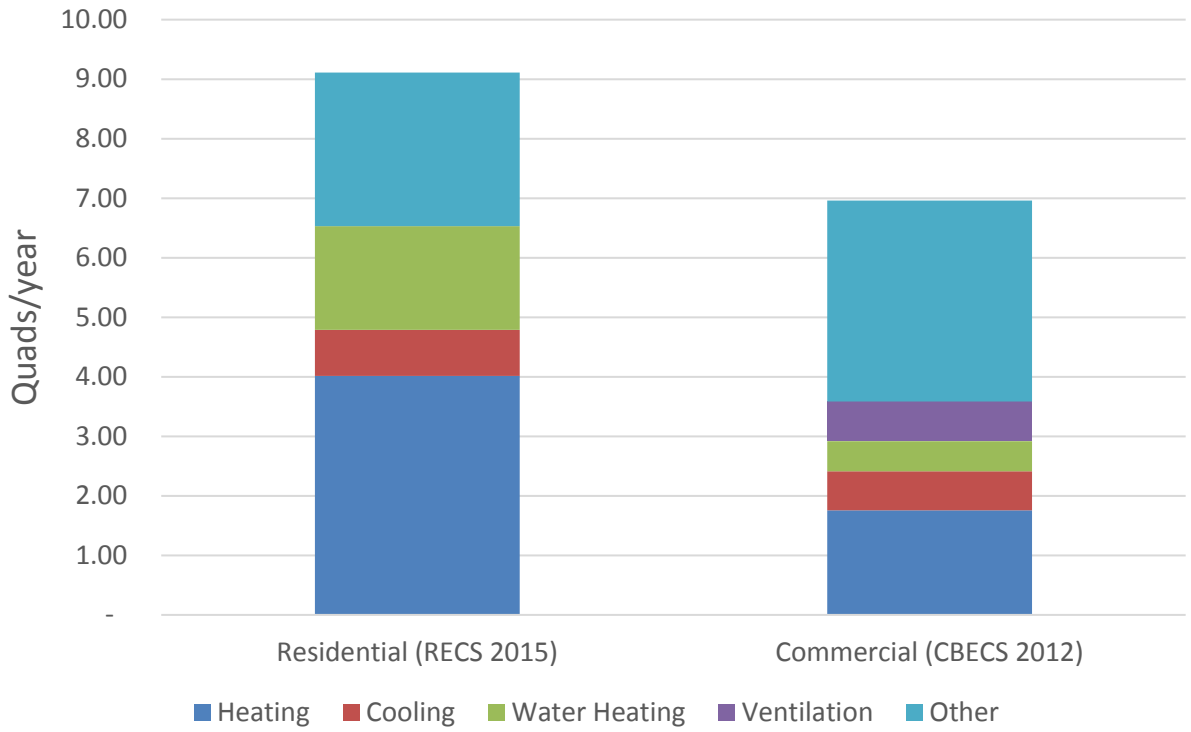

Figure 1: Residential[16] and commercial[17] site energy consumption by end use

Figure 2 illustrates how total site energy consumption varies across building type and climate region. The cold and mixed-humid climate regions account for most energy use, while the hot-dry/mixed-dry and marine climate zones account for relatively little energy use. While residential energy use exceeds that of commercial buildings, a solution for single family homes would need to be applied to a far greater number of buildings to have a significant energy impact compared to solutions intended for multifamily buildings or some higher energy-using commercial buildings.

[16] EIA 2015. 2015 Residential Energy Consumption Survey Micro Data. https://www.eia.gov/consumption/residential/data/2015/index.php?view=microdata. Washington, D.C. US Department of Energy.

[17] EIA 2012. Commercial Buildings Energy Consumption Survey Micro Data. https://www.eia.gov/consumption/commercial/data/2012/index.php?view=microdata Washington, D.C. US Department of Energy.

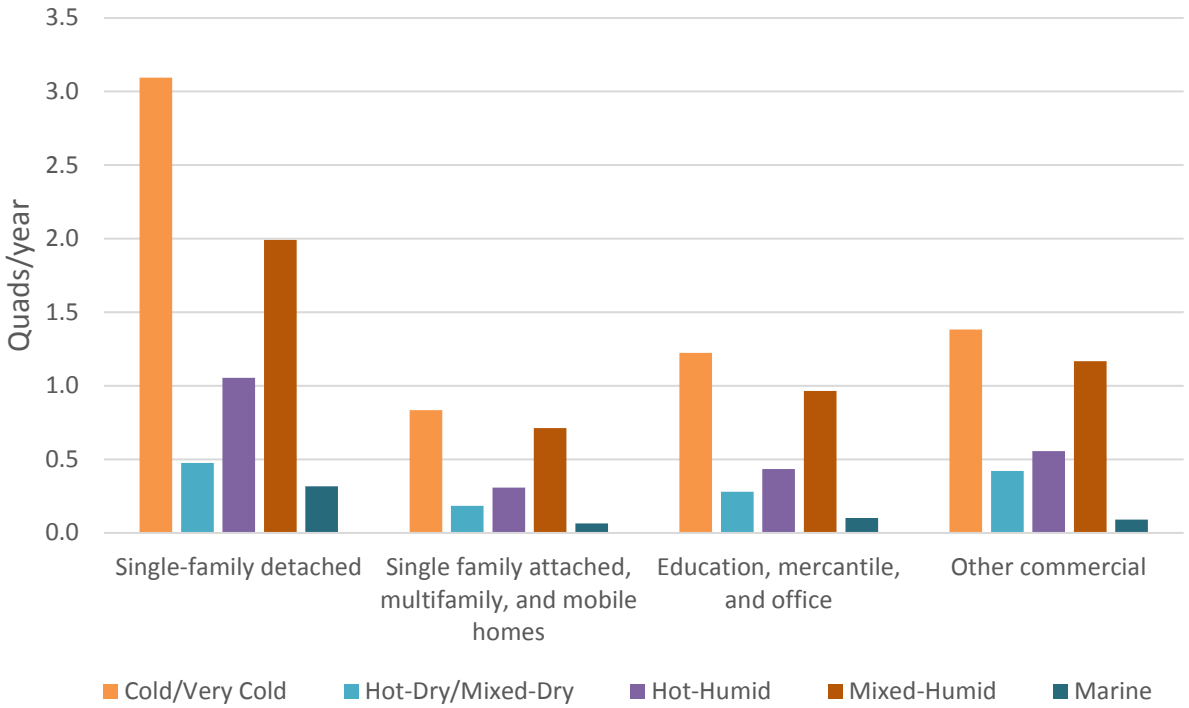

Figure 2: Energy use by climate zones[18]

Figure 3 highlights the end uses of energy in eight major building types and different climate zones. It also illustrates that the "other" category—lighting, electronics, and servers, among other end uses—is significant in many non-residential applications. Although this FOA is particularly focused on R&D of solutions geared toward reducing heating, cooling, water heating, and ventilation, applicants should also look for opportunities to reduce "other" loads where significant, particularly if such loads (e.g., lighting) have implications for heating, cooling, and ventilation.

[18] EIA 2015 and EIA 2012.

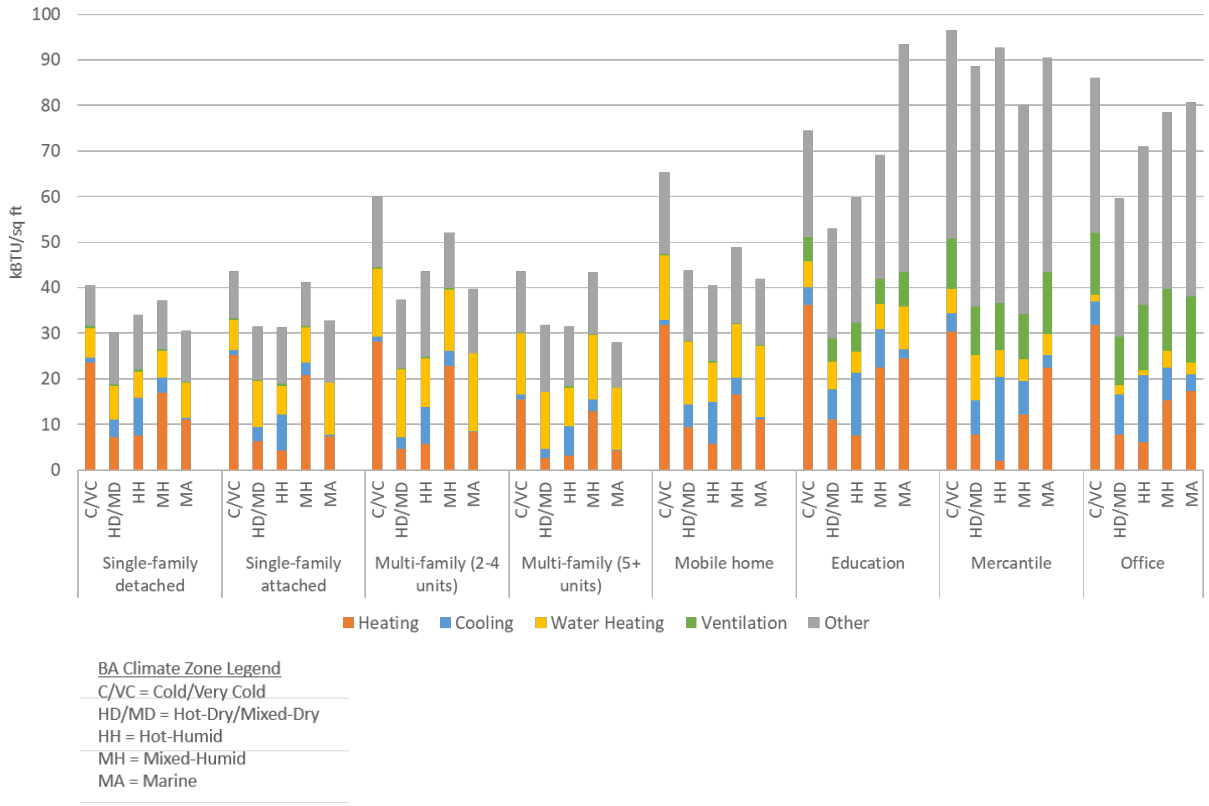

Figure 3: Average site Energy Use Intensity (EUI) by ABC end use for multiple building types and climate zones[19]

This FOA encourages innovation in—

- creating and integrating technologies that achieve more affordable, deep energy savings in existing buildings and new construction (e.g., light and durable highly insulated panels; combined heating, cooling and hot water systems);

- building design, construction, remodeling, and installation (e.g., off-site manufacturing, digitization, automation, improved modeling) to improve affordability, scalability and performance of energy efficient building systems and methods; and,

- workforce training, quality assurance, and service delivery methods suited to regional and/or local needs, including those related to weather, building stock, and grid characteristics.

In all of these areas, DOE seeks transformative innovation that can dramatically increase the energy efficiency of buildings, while offering more affordability and benefits to enhance their appeal and likelihood of successful commercialization (e.g., faster

[19] Ibid.

production, consistent performance, improved reliability, lower lifecycle impacts, and greater resiliency). This FOA also encourages collaboration and includes one topic specifically aimed at facilitating the exchange of information among industry, building owners, and research communities, including cross-scientific disciplines to spur new approaches and cross-fertilization of ideas.

We invite applicants to submit proposed projects that address any of the following three topics.

Topic 1: Integrated Building Retrofits

This topic will support R&D of next generation retrofit solutions that achieve significant energy savings, while making retrofits faster to complete (maximum one week), more convenient, more affordable, and more desirable. The ultimate goal is to produce scalable retrofit packages for common U.S. buildings that result in buildings with an EUI for space heating, space cooling, water heating, and ventilation less than or equal to 75% (stretch goal) below the current median EUI for those loads in the targeted building type and location, without sacrificing comfort, affordability, or performance.

Topic 2: New Construction Technologies

This topic will focus on R&D of innovative construction technologies and practices that improve the quality and affordability of highly efficient buildings and homes, increase competitiveness of U.S. construction businesses, and support a skilled building construction and retrofit workforce. The stretch goal of this topic is to advance technologies that lead to construction of homes and buildings that are 50% more efficient compared to current code (i.e., 2018 International Energy Conservation Code and ANSI/ASHRAE/IES Standard 90.1-2016) at no additional first cost, with a subtopic focusing specifically on highly efficient manufactured housing.

Topic 3: Advanced Technology Integration

This topic will support work aimed at identifying, de-risking and solving a range of field integration problems that impede large-scale uptake of energy efficiency in new and existing buildings. It will facilitate technology transfer from the "laboratory" to the field. Collaboration at multiple levels (national, regional, state, and local) is critical to ensuring that energy efficiency solutions not only deliver energy savings, but also address various building owner and occupant needs, take into account local or regional grid differences, and suitably train the local workforce with skills needed to implement these solutions effectively.

Figure 4 provides a timeline for all of the FOA topics. While some projects will cover a shorter duration, the work under this FOA is meant to serve as a coordinated, integrated approach to addressing the broad challenges outlined above.

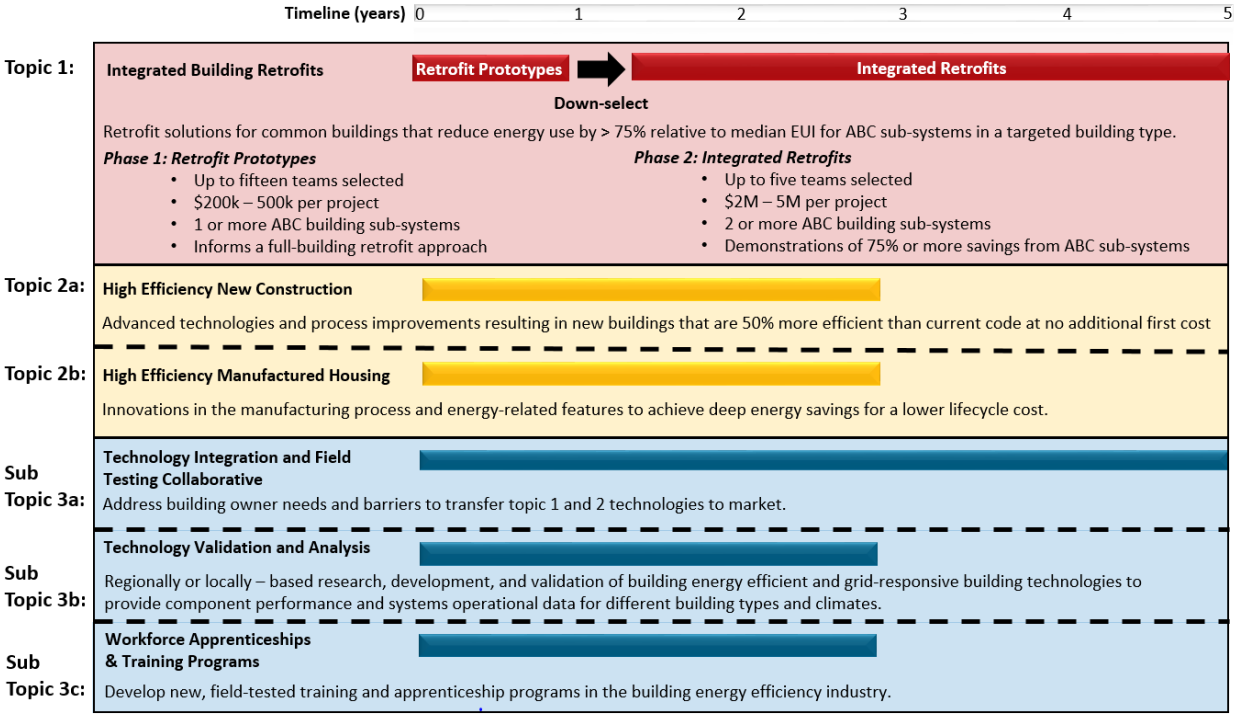

Figure 4: FOA topics and timeline

As indicated in Figure 4, Topic 1 will use a down-select process after the first 12 to 18 months of research. Full descriptions of these topics as well as proposal requirements can be found in the Topic Areas section and accompanying appendices of this FOA.

B. Topic Areas

i. Topic 1: Integrated Building Retrofits

This topic seeks proposals to research and develop a next generation of retrofit solutions that achieve deep operational and embodied energy savings and minimize life-cycle impacts, while being faster to implement, less disruptive, more affordable, and more desirable. Successful projects will lead to the development of scalable retrofit technologies and/or approaches that are applicable to at least one common building type and result in deep savings.[20]

[20] For the purpose of this FOA, BTO defines deep energy savings as an energy use intensity (EUI) for space heating, space cooling, water heating, and ventilation less than or equal to 75% below the median EUI for those loads in the

Successful proposals will include innovations that deliver deep energy savings and show significant promise in terms of replicability and scalability for one or more specific building types. Furthermore, while proposals may integrate some commercially available technologies, BTO is specifically interested in proposals that focus on original investigation, disruptive innovation, and experimentation.

Proposals should focus on one or more of the following areas:

- Advanced energy-saving components and systems (e.g., high-performance whole building envelope solutions; panelized envelope materials with low embodied energy that are particularly suited to retrofits; envelope-integrated heating, ventilation, and air conditioning (HVAC) components; other innovative sub assemblies that improve performance, installation or offer other benefits; packaged modules that provide heating and cooling, water heating, energy recovery for ventilation, controls, and connections to photovoltaics, batteries, electric vehicles, and other distributed energy resources);

- Advanced manufacturing approaches and technologies that promote affordability and scalability, such as rapid prototyping for customization of energy-saving retrofits or installation-ready systems created off site;

- Technologies and automation strategies that make onsite tasks faster, easier, or more productive, e.g., robots that can apply solutions to building areas inaccessible to humans and prefabrication of retrofit components; and,

- Digital tools and remote sensing that can seamlessly capture building information (e.g. dimensions) to inform retrofit design, manufacturing, and installation, and ultimately operation, commissioning, and measurement and verification.

Two-Phase Project Implementation

Projects submitted under this topic will be implemented and evaluated in two phases using a competitive project review (down-select process). Details on the down-select evaluation criteria are in Appendix H-Topic 1 Phase 1 Down Select.

targeted building type and location. See http://www.gbpn.org/sites/default/files/08.DR_TechRep.low_.pdf for further discussion.

Phase 1
BTO intends to select up to 15 teams for Phase 1. BTO has not pre-determined the number of selections that will be made for Phase 1 and may make fewer selections or none at all if requirements are not adequately met.

In Phase 1, selected awardees will receive between $200,000 and $500,000 for 12–18 months to design and prototype a technology or approach that provides a deep energy saving retrofit solution for one or more building energy systems (e.g., envelope, HVAC, water heating). Applications for this topic should provide a description of how the technical solution(s) from Phase 1 would be integrated into a comprehensive retrofit solution in field validations if selected for Phase 2.

Successful applicants will outline a compelling strategy for scaling the proposed retrofit technology or approach to at least one common building type and one climate zone. Applicants are further encouraged to demonstrate the ability to apply the technology or approach to multiple building types and/or climate zones, where feasible.

Applicants will initially compete for Phase 1 funding to support development of a prototype solution and initial plans for applying the solution to individual buildings. Applicants may propose solutions that apply to any one or multiple building types. Applications must state the targeted building type(s), climate zone(s), and market sector(s) (if relevant). Applicants are required to provide detailed justification as to how and why the proposed technology and approach will be scalable and applicable to at least one pre-identified building type and climate zone. Applicants should explain how the proposed technology and approach reduces disruption to occupants, through shortened installation times (maximum one week) and method of installation. Applicants are encouraged to estimate the extent to which the proposed technology and/or approach is likely to scale over time, including explanations for why additional building types may also be candidates for the proposed solution. Applicants should explain how and why the proposed technologies and/or approach show promise in terms of replication and estimate the scale of market penetration applicable.

Phase 2
Following the completion of Phase 1, BTO intends to conduct a competitive project review (down-select process) for Phase 2. BTO anticipates selecting approximately five teams from Phase 1 to receive up to $5 million each over 2–4 years for Phase 2. BTO has not determined the number of selections that will be made for Phase 2, and may make fewer selections or none at all if requirements are not adequately met.

In Phase 2, award recipients will develop and field-validate their retrofit solution on at least two occupied, operational buildings. In each case, the retrofit must achieve 75% or greater energy savings from the space heating, space cooling, water heating, and ventilation loads, compared to the building's baseline EUI for those loads or compared to the median site EUI for those loads for the target building type and location, whichever represents greater savings. To be considered for Phase 2, Phase 1 awardees will need to team with other research teams or add additional partners if their Phase 1 technical solution cannot achieve the 75% EUI reduction target on its own. Appendix I provides a table with BTO's preliminary EUI targets for Phase 2 by end use, building type, and major climate region.

Crosscutting Teams

In both phases, applicants are strongly encouraged to form dynamic and collaborative teams that can more successfully achieve all stated goals of the topic. Ideal teams will include one or more product/technology developers, manufacturing partners, contractors, buildings owners, local contractors and/or municipalities. Phase 1 teams may be reorganized and expanded for Phase 2, though the primary applicant should remain the same. For Phase 2, DOE will look for applicant teams that include partners representing diverse industry sectors and large portfolios of buildings, who are positioned to validate and rapidly deploy the technology beyond the initial pilot and across a portfolio or market sector.

Refer to the Technical Volume for specific application requirements for Topic 1.

ii. Topic 2: New Construction Technologies

BTO seeks innovations to accelerate the integration of advanced energy efficiency technologies, improved materials with lower lifecycle energy impacts, and advanced manufacturing techniques in new construction. The topic includes two subtopics: subtopic 2a focuses on strategies to improve construction and manufacturing techniques for new building construction; subtopic 2b focuses specifically on technologies and strategies pertaining to the manufactured housing industry.[21]

All proposals should focus on original investigation, include a validation component when appropriate, and outline how the work will lead to a scalable solution that applies to at least one specific, pre-identified building type and/or climate zone and

[21] The U.S. Code of Federal Regulations, 24 CFR 3280.2) defines manufactured homes as follows, in part: "manufactured homes are built as dwelling units of at least 320 square feet (30 square meters) in size with a permanent chassis to assure the initial and continued transportability of the home." These are differentiated from other types of prefabricated homes or modular homes and commonly referred to as "HUD Code housing."

meets the energy efficiency and cost criteria noted in the relevant subtopic. Applicants are encouraged to submit proposals that include more than one technology and/or process improvements. At a minimum, proposals should consider how the proposed innovation(s) would be integrated into construction industry processes and with the building's other systems.

Applicants to either subtopic are encouraged to submit proposals focused on one or more of the following research areas:

1. Advanced building materials and component R&D, including development and/or validation of promising new materials that enable significant energy savings through improved energy performance and/or reduction in embodied energy. Relevant technologies include, but are not limited to:
    a. Cross-laminated timber;
    b. Other innovative lightweight composite structural materials with superior insulation properties; and
    c. Innovative sub assemblies of construction materials and improved structural component connection systems for rapid, repeatable, and accurate on-site assembly at equivalent or lower cost.

2. Innovative manufacturing and construction technologies that improve the quality, productivity, and speed of construction,; increase industry productivity and cost competitiveness; and/or improve replicability without sacrificing design flexibility, while meeting required energy and cost targets. Relevant technologies include, but are not limited to:
    a. Robotics applications;
    b. On-site fabrication;
    c. Additive manufacturing (e.g., 3D printing) applications; and
    d. Other automated processes.

3. Digital technologies for building design and construction that improve the state-of-the-art. Relevant opportunities include, but are not limited to:
    a. "Art to part" digital solutions that seamlessly integrate all relevant processes from design and fabrication to installation; and,
    b. Integrated software that automatically connects building design and construction information with home management systems to facilitate improved operations and maintenance, including detection and response to faults in energy systems.

Subtopic 2a: High-Efficiency New Construction through Advanced Materials, Products, and Methods

Highly efficient buildings continue to be the exception rather than the norm. Most construction firms are reluctant to incur additional costs for research and validation or premium performance features, especially ones that do not improve aesthetics. Yet, advanced construction methods, along with more resilient and energy efficient materials and systems, are critical to increasing the competitiveness of U.S. construction businesses and their workforce.

This subtopic seeks innovations aimed at tackling productivity and building energy challenges hand-in-hand. Applications should focus on R&D that can result in the capability to construct homes or other buildings 50% more energy efficient than current code (i.e., 2018 International Energy Conservation Code and Standard ANSI/ASHRAE/IES 90.1-2016) at no additional first cost. Applicants are encouraged to propose breakthroughs in both on-site and off-site construction practices, as well as automated systems, new materials and energy systems, that can enable highly efficient buildings and homes to be built more affordably and to consistently higher levels of quality and performance than is typical today. BTO encourages solutions that can be applied to a variety of building types, including detached single-family homes, rowhouses, multifamily residences, and commercial buildings with an emphasis on offices, retail, and/or education.

BTO intends to select up to 4 proposals for subtopic 2a. BTO has not pre-determined the number of selections that will be made for Subtopic 2a and may make fewer selections or none at all if requirements are not adequately met. The selected awardees are anticipated to receive a maximum of $1 million for a three-year award period.

Subtopic 2b: High Efficiency Manufactured Housing through Advanced Materials, Products, and Methods

Manufactured housing accounts for approximately 6 percent of all homes in the United States[22] and approximately 9 percent of new housing starts in 2017.[23] Because the purchase price of manufactured homes is often significantly less than similarly sized site-built homes, this housing segment is an attractive option for lower income purchasers. Unfortunately, residents of manufactured homes spend on average, nearly twice as much on energy per square foot than site-built homes.[24]

[22] See U.S. Census Bureau, American Housing Survey 2017—National Summary Tables.

[23] https://www.manufacturedhousing.org/wp-content/uploads/2017/10/2017-MHI-Quick-Facts.pdf

[24] EIA 2008. Residential Energy Consumption Survey. http://www.eia.doe.gov/emeu/recs/contents.html. Washington, D.C. US Department of Energy.

This subtopic seeks innovations in both the manufacturing process as well as the homes' energy-related features to achieve deep energy savings and greater lifecycle affordability[25] for homeowners. Applicants are encouraged to develop solutions that concurrently address other challenges facing this particular building segment (e.g., "belly board" improvements, disaster resiliency, reduced maintenance costs, and fewer claim filings against manufacturer warranty). While the model energy codes do not apply to manufactured housing, applicants are encouraged to use the same target as subtopic 2a for purposes of driving innovation (i.e., 50% more energy efficient than 2018 International Energy Conservation Code at no additional cost).

BTO intends to select up to 4 proposals for subtopic 2b. BTO has not pre-determined the number of selections that will be made for Subtopic 2b and may make fewer selections or none at all if requirements are not adequately met. The selected awardees are anticipated to receive a maximum of $1 million for a three-year award period.

iii. Topic 3: Advanced Technology Integration

This topic seeks innovative approaches to analysis, validation, technical assistance, stakeholder engagement (e.g., building owners, contractors, utilities), and workforce training to inform technology development, address national, regional, state, and local barriers, and thereby help ensure wide scale and effective integration of energy efficiency solutions in existing buildings and new construction.

The topic includes three subtopics aimed at facilitating technology transition from research to the field. Projects will be aimed at identifying, de-risking and solving a range of field integration problems that impede large scale transition of energy efficient technologies in new and existing buildings. Collaboration is critical to ensuring that energy efficient solutions not only improve energy use without sacrificing comfort of building occupants or performance, but also address various building owner and occupant needs and concerns, take into account regional and even local building stock and utility grid differences, and suitably train the local workforce with skills needed to implement technological innovations effectively.

Subtopic 3a: Technology Integration and Field Testing Collaborative

This subtopic will support the creation of a new Collaborative entity to integrate and test multiple building technologies in complex controlled environments in the field. The complexities of the problems posed by this FOA and the number of

[25] Lifecycle defined as 10 years for purposes of this topic.

parties needed to help develop solutions call for a dedicated group to bring together key stakeholders.

The goal is to transition DOE-sponsored technologies and discoveries from the lab to the construction industry, and catalyze new investment by private sector (perhaps in conjunction with state and local governments). As part of this effort, the Collaborative will gather component and system performance and operational data and share it with disparate but key stakeholders across the buildings value chain, including buildingowners/operators, building/construction trades, state and local governments, and the real estate community, among others. The Collaborative should work closely with BTO, beresponsive to the Department's direction, and provide insight and leadership to the Department.

Potential areas of work include but are not limited to the following:

- Joint action plan amongst diverse stakeholders (with additional non-Federal financial commitments) to gather system performance and operational data for new technologies deployed in different building types and different climates.
- Model retrofit and new construction specifications and installation best practices for varied building types to facilitate eventual standardized procurements and interoperability.
- Widely disseminated test data under real operating conditions in multiple building types and conditions
- Expedited 3rd party testing processes for specific innovations through engagement of entities such as American Society of Testing & Materials (ASTM), Underwriters Laboratories and the National Fire Protection Association.
- Analysis and prioritization of implementation barriers that inhibit transition of research innovations into practice.

Applications must outline how the Collaborative will be created and managed, and how it will support BTO's goal of utilizing effective coordination, communication and collaboration to lead to widespread and affordable adoption of deep energy retrofits and highly efficient new buildings.

BTO intends to select 1 proposal for subtopic 3a. BTO has not pre-determined the number of selections that will be made for Subtopic 3a and may make more or none at all if requirements are not adequately met. The selected awardee is anticipated to receive a maximum of $5 million for a five-year award period.

Refer to the Technical Volume Subtopic 3a section on page 52 for more specific application requirements.

Subtopic 3b: Technology Validation and Analysis
This subtopic seeks on-the-ground projects that address region-specific characteristics to provide component performance and systems operational data for different building types, building stock/materials, and regional climate and resiliency needs. The objectives are to validate improved energy affordability, efficiency and resiliency to catalyze emerging technology adoption through partnerships with public and private entities at the regional level.

Building technology integration varies considerably across the nation, commonly influenced by building stock, climate, construction materials, preferences and practices, utility and grid conditions, and other regional factors. Addressing this diversity can be a challenge for new technologies, because what works in, say, the Northwest may not be optimal, or even feasible, in the Southeast. It is therefore critical to engage industry and regional, state, and/or local partners to ensure BTO's research investments address the range of regionally relevant and timely issues affecting technology integration.

This subtopic seeks creative and innovative approaches to address regional challenges and support technology integration. Applications should focus on at least one of the following areas: (a) Technology Validation (b) Technical Analysis and Planning; and (c) Technical Support and Coordination. Applicants should clearly describe how the proposed work and approach is applicable to a specific region, state and/or locality, and provide a quantitative justification for how the project advances not only energy efficiency but energy affordability, energy reliability, and/or addresses energy-related resilience challenges, and without sacrificing occupant comfort or productivity.

Applicants are also encouraged to partner with key parties such as utilities, grid operators, real estate developers and owners, technology companies, state and local governments, housing authorities, non-governmental organizations, academic institutions or others who can make substantive contributions to the project.

Areas of interest include but are not limited to:

- Field validation of new innovations developed by DOE National Labs, current BTO efforts or the private sector for retrofit or new construction to generate performance and operational data under real operating conditions.

- Systems analysis/optimization and then field testing of advanced sensors and control technologies that integrate various power electronics for building equipment and appliances to validate grid-interactive flexible building loads (that might include energy storage, controllable load systems, or dynamic facades) with particular emphasis on performance and impact on grid.

- "Manufactured" housing pilot manufacturing line, in partnership with insurance and finance sectors, to improve affordability and resilience of homes that have historically had high utility bills and particularly vulnerable to disasters.

- Aggregated purchasing of new, yet not widely used,highly efficient building equipment.

- Collection and analysis of representative data to validate construction trends, including the acceptance of energy-efficient technologies and construction, practices, with a priority on expanding BTO's commercial field studies.[26]

- Testing advanced technologies to streamline the application of code and verification at the jobsite, thus minimizing the time and costs associated with compliance demonstration

- Adaptation of advanced technologies and supporting analysis based on regional, state and local needs and priorities.

- Integrated energy analysis and planning, including incorporation of energy technologies and reliability goals in resilience planning and implementation.

BTO intends to select up to 6 proposals for subtopic 3b. BTO has not pre-determined the number of selections that will be made for Subtopic 3b and may make fewer or none at all if requirements are not adequately met. The selected awardees are anticipated to receive a maximum of $500,000 for a three-year award period.

Subtopic 3c: Workforce Apprenticeships and Training Programs

BTO seeks proposals to develop new training programs and apprenticeships to support the development of a skilled workforce in the building energy efficiency

[26] https://www.energycodes.gov/compliance/energy-code-field-studies

industry. A White House Fact Sheet on Workforce Development states, "Many American workers are being left behind as current education and training programs fail to equip them with the skills they need. Apprenticeships will not only keep jobs in America, but ensure that American workers are trained and hired to fill those jobs."[27] It takes skilled workers to build, retrofit, operate, and maintain energy efficient buildings, and America must be poised to take advantage of this opportunity. As the economy and energy efficiency industries grow, the country needs to lay a foundation of programs that train skilled and "future-focused" workers to produce and upgrade more affordable, comfortable, and high-quality homes and buildings.[28, 29, 30]

Additionally, the U.S. building construction sector has been slow to adopt new technology. Construction ranks second to last among industries in software solution usage, only above agriculture, leading to a significant productivity gap in the building construction and operations and maintenance (O&M) trades compared to the rest of the economy.[31] Even in times of record low unemployment, America's skilled labor workforce is deficient in personnel who can effectively assess, install, operate and maintain efficient building technologies.[32] Further, significant workforce shifts are expected in the near future for critical industry segments: a recent study conducted by the National Institute of Building Sciences reports 30 percent of the existing building official workforce is expected to retire in the next five years, and 80 percent within 15 years.[33] According to Energy Futures Institute (EFI) and the National Association of State Energy Officials (NASEO), 80 percent of employers hiring energy efficiency sector personnel[34] cite difficulty in hiring skilled labor, especially technicians,

[27] White House. June 2017. President Trump Leads on Workforce Development.

[28] American Council for an Energy Efficient Economy (ACEEE), 2018a.

[29] Jobs for the Future, 2015 Analyzing Building Energy Efficiency Job Opportunities.

[30] Mulvaney, Mick. "FY 2019 Administration Research and Development Budget Priorities." Executive Office of the President, 17 Aug. 2017, www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2017/m-17-30.pdf.

[31] McKinsey Global Institute, 2017. Memorandum for the Heads of Executive Departments and Agencies: FY 2019 Administration Research and Development Budget Priorities.

[32] ACEEE, 2018a; NASEO & EFI, 2018; McKinsey Global Institute, 2017 Reinventing Construction: A Route to Higher Productivity.; National Association of Home Builders, July 2017. Housing Market Index: Special Questions on Labor and Subcontractors' Availability.

[33] https://www.nibs.org/news/190033/Survey-of-Code-Professionals-Predicts-Substantial-Retirement-Exodus.htm

[34] Employees in the building energy efficiency workforce, "include not only the manufacture of ENERGY STAR appliances and other ENERGY STAR labeled products, but also building design and contracting services that provide insulation, improve natural lighting, and reduce overall energy consumption across homes and business" (EFI & NASEO, 2018).

technical support, and installation workers. These employers cite a lack of experience, training, or technical skills as the primary reasons for these hiring difficulties.[35]

Subtopic 3c seeks applications that support either one of the following areas of interest, each focused on critical industry segments.

> **Subtopic 3c.1:** Workforce that assesses the energy needs of a building, installs equipment and technology, as well as operates and maintains buildings.
>
> **Subtopic 3c.2:** Workforce that implements and verifies standard industry design and construction practices.

Applications should be for either subtopic 3c.1 or subtopic 3c.2, and should clearly identify which subtopic they are applying for. Each subtopic is described in additional detail in the subsections below.

Applications should be specific and targeted toward one of the critical industry segments outlined in the subtopics. If applicants believe that their solution applies to both, the application must be clear as to how it can achieve all goals and objectives across both subtopics. Additionally, applicants are encouraged to target communities underrepresented in the current energy efficiency workforce as key elements of their proposals. Applications that focus on or otherwise strongly support veterans and/or active duty military-in-transition (for example, applications to develop workforce development programs to be administered as a registered Department of Defense SkillBridge training program) are also encouraged. See Appendix K for a more detailed description of identified workforce gaps.

To maximize the impact of federal funding provided for workforce training and apprenticeships as a part of this FOA, the Prime Recipient and Subrecipients of projects funded under this Subtopic 3c.1 and 3c.2 must license, under a Creative Commons Attribution License (CC BY), to the public all work related to training or education developed in the performance of the award. Please note that in certain circumstances regarding sensitive topics and material (e.g., sensitive cybersecurity course content), 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.

[35] Energy Futures Initiative. May 2018. U.S. Energy and Employment Report. ; NASEO, 2018

Additionally, DOE, at its sole discretion, with respect to subtopic 3c.2, for example, 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. By default, all materials that are not deemed too sensitive will be licensed with the CC BY license. This CC BY license allows subsequent users to copy, distribute, transmit, and adapt the copyrighted work and requires such users to attribute the work in the manner specified by the Prime Recipient or Sub-recipient. Notice of the License must be affixed to the work. Only work developed in the performance of or under the award must be licensed under the CC BY license. Pre-existing copyrighted materials licensed to, or purchased by the Prime Recipient or Sub-recipient from third parties remain subject to intellectual property rights the Prime Recipient or Sub-recipient receives under the terms of the particular license or purchase. For more information on this license, please visit http://creativecommons.org/licenses/by/4.0/.

Subtopic 3c.1: Building Assessments, Technology Installation, Operations, and Maintenance

BTO seeks proposals for training and apprenticeship programs that focus on holistic science-based assessment, installation, operations, and maintenance of energy efficiency technologies and strategies in residential and commercial buildings.

The existing gaps in the building energy efficiency workforce are interrelated and complex. Many students and recent graduates lack accurate knowledge about building energy efficiency careers, how to gain relevant skills for employment, or the positive impacts these jobs have on quality of life and conservation of natural resources.[36] Successful applications will address these informational gaps, as well as other barriers that inhibit a skilled and productive energy efficiency workforce, by developing innovative training and apprenticeship programs that leverage existing best installation and maintenance practices. See Appendix K for more information on identified workforce gaps and responsive applicant solutions.

Applications should clearly outline:

- key programmatic elements, including the proposed training venue (e.g., in-person location(s), in-field location(s), online, other);
- number of hours required of participants for completion;

[36] Electric & Gas Industries Association [EGIA] Foundation, 2018. 2018 Industry Study: Bridging the HVAC Employment Gap.

- how well the program blends with or leverages existing educational programs (certifications, high schools, trade schools, community colleges, etc.);
- how well the program addresses workforce needs in the targeted location and population;
- how the program will integrate best practices and state-of-the-art knowledge of whole-building energy and on-site integration issues;
- existing requirements for hiring in the relevant professions; and,
- how program success will be measured.

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

- Collaboration/partnerships between training providers and potential employers;
- Programs that focus on or otherwise strongly support veterans and/or active duty military personnel who are transitioning to the workforce (explicit efforts to upskill by leveraging existing skills and/or credentials, in addition to entry-level skill development);
- Third-party evaluation of developed systems, including pre-/post-knowledge; and skills testing to verify training program and/or apprenticeship success;
- Target of post-disaster regions where efficiency can be integrated into rebuilding efforts;
- Development of "train-the-trainer" approaches that can be scaled up;
- Extensive, demonstrated knowledge of skill gaps specific to the particular region and the building industry; and/or,
- An increased focus on state-of-the-art energy efficient building technologies, processes, and/or tools.

BTO intends to select up to 3 proposals for subtopic 3c.1. BTO has not pre-determined the number of selections that will be made for Subtopic 3c.1 and may make fewer or none at all if requirements are not adequately met. The selected awardees are anticipated to receive a maximum of $500,000 for a three-year award period.

Subtopic 3c.2: Industry Standard Design and Construction Practices

BTO seeks proposals for education and training programs that can assist a transitioning workforce in addressing new energy technologies as well as related design and construction practices. Most states administer education and training programs for construction industry professionals, including licensing, certification,

and continuing education for builders, contractors, designers, building officials, and other key stakeholders. Many states incorporate specific requirements based on minimally acceptable practices, typically based on applicable building codes. As industry building codes and standards are continually updated, existing education and training programs must adapt to incorporate modern practices, representing both a challenge and an opportunity for technological advancement.

Successful proposals under this subtopic would integrate with existing state licensing and training infrastructure. Applications that demonstrate partnering commitments from key stakeholder organizations, including relevant state government agencies, trade associations, academic institutions, and utilities are preferred. Proposals should be based on applicable building codes in the targeted region, and incorporate lessons learned from recent evidence-based research targeting key technologies and measures with the greatest impact on energy efficiency, specifically BTO's recent energy-efficiency field studies.[37] In addition, applicants are encouraged to incorporate a rationale supporting modern construction practices, including underlying building science concepts, as well as strategies for increased resilience and disaster mitigation in the built environment.

BTO intends to select up to 3 proposals for subtopic 3c.2. BTO has not pre-determined the number of selections that will be made for Subtopic 3c.2 and may make fewer or none at all if requirements are not adequately met. The selected awardees are anticipated to receive between $200,000 and $500,000 for a three-year award period.

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

C. Teaming Partner List

EERE strongly encourages applicants from different organizations, scientific disciplines, and technology sectors to form interdisciplinary and cross-sector teams that span organizational boundaries in order to enable and accelerate the achievement of scientific and technological outcomes that were previously viewed as extremely difficult, if not impossible.

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

[37] U.S. Department of Energy, 2019

The Teaming Partner List will be available on https://eere-Exchange.energy.gov under FOA DE-FOA-0002099 during the time of its release through its closing. 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 the Teaming List email (TeamingList-ABC-2019@hq.doe.gov) with the subject line "Teaming Partner Information":

Organization Name, Generic Organization Contact Email, Generic Contact Phone, Organization Type, Area of Technical Expertise, and Brief 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. EERE requests that each organization create a general e-mail address to receive queries. Direct personal e-mail addresses will not be posted. 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.

D. 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 this FOA):

- Applications that fall outside the technical parameters specified in Section I.B of this FOA.
- Applications that are focused primarily on deployment.
- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).

E. Authorizing Statutes

The programmatic authorizing statute is the Energy Policy Act (EPAct 2005; 42 USC §13201 et seq.) §911(a)(2)(B).

Awards made under this announcement will fall under the purview of 2 CFR 200 as amended by 2 CFR 910.

II. Award Information

A. Award Overview

i. Estimated Funding

EERE expects to make a total of approximately $33,500,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 20-40 awards under this FOA.

EERE may issue awards in one, multiple, or none of the following topic areas:

Topic 1: Integrated Building Retrofit:
EERE may issue approximately 10-15 awards in this topic area, with up to maximum $500,000 for Phase 1 and up to $5 million for Phase 2.

Topic 2: New Construction Technologies:
EERE may issue approximately 2-8 awards in this topic area,with a maximum award amount of $1 million. 1-4 awards are anticipated for topic 2a, and 1-4 awards are anticipated for topic 2b.

Topic 3: Advanced Technology Integration:
EERE may issue approximately 5-12 awards in this topic area. 1 award is anticipated for topic 3a, with a maximum award of $5 million. 2-6 awards are anticipated for topic 3b, with a maximum award amount of $500,000. 1-3 awards are anticipated for topic 3c.1, with an maximum award amount of $500,000. 1-3 awards are anticipated for topic 3c.2, with a maximum award amount of $500,000.

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.

The maximum award size and duration by sub-topic area is provided in **Table 1**:

Sub-topic	Maximum Award Size	Maximum Duration
1 Phase 1: Retrofit Prototypes	$500,000	18 months

1 Phase 2: Integrated Retrofits	$5 million	48 months
2a: High Efficiency New Construction	$1 million	36 months
2b: High Efficiency Manufactured Housing	$1 million	36 months
3a: Technology Integration and Field Testing Collaborative	$5 million	60 months
3b: Technology Validation and Analysis	$500,000	36 months
3c: Workforce Apprenticeships and Training Programs	$500,000	36 months

Table 1: Maximum Award Size and Duration

ii. Period of Performance

EERE anticipates making awards that will run up to 36 months in length, comprised of one or more budget periods, and potentially up to 60 months for Topic 1 across both phases and Subtopic 3a awards, also comprising one or more budget periods. Project continuation will be contingent upon satisfactory performance and Go/No-Go decision review. At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, milestone meeting objectives, compliance with reporting requirements, and overall contribution to the program goals and objectives. As a result of this evaluation, EERE will make a determination to continue to fund the project, recommend redirection of work under the project, place a hold on federal funding for the project, or discontinue funding the project.

iii. New Applications Only

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

B. EERE Funding Agreements

Through cooperative agreements and other similar agreements, EERE provides financial and other support to projects that have the potential to realize the FOA objectives. EERE does not use such agreements to acquire property or services for the direct benefit or use of the U. S. 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 this FOA for more information on what substantial involvement may involve.

ii. Funding Agreements with Federally Funded Research and Development Center

In most cases, Federally Funded Research and Development Centers (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. 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 recipient or subrecipient with the exception of Topic 3. For Topic 3, DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

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.

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 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

The 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.)

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.J.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.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, as 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 guidance on cost sharing.

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 this 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 due to server/connection congestion.

i. Compliance Criteria

1. Concept Papers

Concept Papers are deemed compliant if:

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

2. Full Applications

Full Applications are deemed compliant if:

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

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.E. 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.D. of the FOA, are deemed nonresponsive and will not be reviewed or considered.

E. Other Eligibility Requirements

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

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.

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 fieldwork 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.

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

An entity may submit more than one Concept Paper and Full Application to this FOA, provided that each application describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for each Full Application.

G. Questions Regarding Eligibility

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

IV. Application and Submission Information

A. Application Process

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

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

The Concept Paper, 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.

Applicants that experience issues with submissions that result in late submissions: In the event that an applicant experiences technical difficulties so severe that they are unable to submit their application by the deadline, 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 the applicant in resolving all issues (including finalizing submission on behalf of and with the applicant's concurrence). Please note, network traffic is at its heaviest during the final hours

and minutes prior to submittal deadline. Applicants who experience this during the final hours or minutes and are unsuccessful in uploading documents will not be able to use this process.

B. Application Forms

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

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10 MB. Files in excess of 10 MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10 MB but is still within the maximum page limit specified in the FOA, it must be broken into parts and denoted to that effect. For example:
ControlNumber_LeadOrganization_Project_Part_1
ControlNumber_LeadOrganization_Project_Part_2

C. Content and Form of the Concept Paper

To be eligible to submit a Full Application, applicants must submit a Concept Paper by the specified due date and time.

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 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, approach or process including its basic operating principles and how it is unique and innovative;

		• The target level of performance for the proposed technology, approach or process (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, approach or process 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 provide graphs, charts, or other data to supplement their Technology Description.

EERE makes an independent assessment of each Concept Paper based on the criteria in Section V.A.i. 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.

D. Content and Form of the Full Application

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

Applicants will have approximately 30 days from receipt of the Concept Paper Encourage/Discourage notification 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. Full Applications must conform to the following requirements:

Submission	Components	File Name
Full Application (PDF, unless stated otherwise)	Technical Volume (PDF format. See chart in Section IV.D.ii.)	ControlNumber_LeadOrganization_TechnicalVolume
	Statement of Project Objectives (SOPO) (Microsoft Word format)	ControlNumber_LeadOrganization_SOPO
	SF-424 Application for Federal Assistance (PDF format)	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 WP for NNSA/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)	ControlNumber_LeadOrganization_SF-LLL
	Foreign Entity and Performance of Work in the United States waiver requests, if applicable (PDF format)	ControlNumber_LeadOrganization_Waiver
	U.S. Manufacturing Plan (PDF format)	ControlNumber_LeadOrganization_USMP
	Data Management Plan (Microsoft Word format)	ControlNumber_LeadOrganization_DMP
	Open Source Software Distribution Plan (PDF format)	ControlNumber_LeadOrganization_OSSDP
	Excel Tools for Building Energy Savings Technical Potential (Microsoft Excel format. Topic 1 ONLY)	ControlNumber_LeadOrganization_BES
	Technical Potential Calculation (Microsoft Excel format. Topic 2 ONLY)	ControlNumber_LeadOrganization_TPC
	Payback Calculation (Microsoft Excel format. Topic 2 ONLY)	ControlNumber_LeadOrganization_PC

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10 MB. Files in excess of 10 MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10 MB 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 10 MB.

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

ii. Technical Volume

The Technical Volume must be submitted in PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If application exceeds 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 using the following convention for the title: "ControlNumber_LeadOrganization_TechnicalVolume."

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

The Technical Volume to the Full Application may be up to 25 pages, including cover page, table of contents, citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below as well as the Statement of Project Objectives (SOPO). The Technical Volume and the SOPO together must not exceed 25 pages. Applicants can distribute the 25 pages between the two documents as they deem appropriate 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, the specific FOA Topic Area being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.

Project Overview (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 being addressed in the Full Application. • Project Goal: The applicant should explicitly identify the targeted improvements or innovations to the baseline technology, approach or process and the critical success factors in achieving that goal. Applications should also include the targeted building type(s), climate zone(s), where relevant. • 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, approach or process, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. • Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology, approach or process and capability of achieving the anticipated performance targets, including a description of previous work done and prior results. • Innovation: The applicant should describe the current state-of-the-art in the applicable field, the specific innovation of the proposed technology, approach or process, the advantages of proposed technology, approach or process over current and emerging technologies, approaches, or processes. • Impacts: The applicant should discuss the overall impact on advancing the state-of-the-art/technical and impacts, positive or negative, on occupant comfort, occupant productivity, or product performance, if the project is successful. ○ For Topic 1: Applicants are required to estimate per building energy savings and total technical potential. Applicants are required to provide detailed justification as to how and why the proposed technology and approach will be scalable and applicable to at least one pre-identified building type and climate zone. Applicants

	should explain how and why the proposed technologies and/or approach can achieve performance goals for the targeted market, and include explanations for why additional building types may also be candidates for the proposed solution. Applicants should use the Excel tools provided in Appendix I to estimate total technical potential for the proposed technology innovation. Follow the directions in the Excel file to compute total market size (in site TBtu). See section IV.D.xvi. Technical Volume and Appendix I for further guidance. Appendix I also provides a table with BTO's preliminary EUI targets for Phase 2 by end use, building type, and major climate region. ○ For Topic 2: Applicants are required to provide an estimate of two performance metrics: primary energy savings and cost effectiveness, as measured by the simple payback. Applicants are required to use the BTO Baseline Energy Calculator web tool to estimate the primary energy savings for the proposed technology. The web tool will allow applicants to compute total market size (in TBtu). The applicants will also need to provide an estimate of the % energy savings applicable to this market, with supporting analysis, and the product of the % energy savings and the energy market size yields the primary energy savings technical potential. See Section IV.D.xvii and IV.D.xviii. Technical Volume and Appendix J for further guidance. ○ For Topic 3: The applicant should describe the overall impact on advancing the current state/baseline if the project is successful. The application should include a justification for the impact assessment approach and impact claim (e.g., performance improvement expectations and ramifications, cost model with references, future market opportunity size, etc.) as well as a description of the pathway to achieve stated impact after the end of the proposed project's period of performance.
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 for Topic Area 1 applications should describe the scope for both budget periods, but should emphasize Phase 1 activities and budget. Please see the **FOA Specific Requirements** section of this table for additional details regarding Topic 1 and 3 as related to the Workplan section.

	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. Structure the Workplan with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard WBS. 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. The summary provided should be consistent with the Milestone Summary Table in the SOPO. • Go/No-Go Decision Points: The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. A Go/No-Go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success

	in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one project-wide Go/No-Go decision point for each budget period (12- to 18-month period) of the project. The applicant should also provide the specific technical criteria to be used to make the Go/No-Go decision. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered SMART and can fulfill the requirement for an annual SMART milestone.
	• End of Project Goal: The applicant should provide a summary of the end of project goal(s). Unless otherwise specified in the FOA, the minimum requirement is that each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO.
	• Project Schedule (Gantt chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and Go/No-Go decision points.
	• Project Management: The applicant should discuss the team's proposed management plan, including the following:
	  ○ 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
	
	• For Topics 1 and 2, the Technology Transition Plan section in the application should use plain language to describe the state of the technology and include a summary of the Value Proposition & Market Opportunity, Risk Mitigation Strategy, and Team. The significant impact sought by DOE depends upon successful projects finding a path to large-scale adoption. DOE projects are not required to achieve commercial deployment by the end of the project period, but the applicant should define a reasonable path for the proposed technology toward commercial success. Topic 3, including related subtopics, does not require completion of the Technology Transition Plan.
	
	• For Topics 1 and 2, 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. ○ Team: Identification of technology transition project team lead responsible for leading and coordinating all technology transition activities for the project.
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. • Attach one-page resumes for key participating team members as an appendix. Resumes do not count towards the page limit. Multi-page resumes are not allowed. • Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable. • Attach letters of commitment from all subrecipient/third party cost share providers as an appendix. Letters of commitment do not count toward the page limit. • Attach any letters of commitment from partners/end users as an appendix (1 page maximum per letter). Letters of commitment do not count toward the page limit.

	• 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; and
	  ○ Communication plans

FOA-Specific Requirements	• Refer to the Topic descriptions in Section I.B for topic-applicable requirements and preferred components of the application. Applications will be evaluated using the requirements and preferred aspects as outlined in each topic description. Applications that are missing required elements may be found to be non-responsive.
	
	• As described in Section I.B, Topic Area 1 will consist of two budget periods separated by a down-select review in which DOE may select approximately five projects to proceed into Budget Period 2 to complete design, building, and testing of a prototype in a laboratory setting. While the Workplan for Topic Area 1 applications should describe the scope for both budget periods, applicants should emphasize Budget Period 1 activities and budget. Scope and budget for Budget Period 2 will be evaluated in greater detail during the down-select review.
	
	• Topic 1 applications must address the following specific requirements:
	
	  ○ The Technical Description must include an overview of the intended Phase 2 retrofit and explain how the work of Phase 1 will inform the work of developing and field-validating the retrofit solution in Phase 2.
	
	• Topic 1 applications must describe:
	  ○ A specific target building typology or typologies (such as 2-4 unit apartments, commercial offices, etc.) within one or more climate zones, representing a large number of buildings that in aggregate consume a significant amount of energy. The proposal should provide a preliminary assessment of the number of buildings that could be retrofitted with the proposed solution.
	  ○ A detailed description of the Phase 1 retrofit prototype and the energy savings it is expected to achieve per

	building. Energy savings should be described in absolute terms, as a percentage of the targeted building sub-system(s), and as a percentage of overall energy consumption. ○ An estimate of total technical potential energy savings achievable if the intended Phase 1 retrofit prototype is applied to all buildings of the particular building typology and climate(s) selected. ○ An explanation of how the proposed prototype reduces disruption to occupants, through shortened installation times (maximum one week) or method of installation. ○ An estimate of technology and installation costs initially and over time given projected adoption. ○ An explanation of how cost reduction strategies will be integrated as part of initial prototyping and scaling up. ○ An explanation of how this prototype will make retrofits more desirable. ○ An overview of the intended Phase 2 retrofit and the energy savings it is expected to achieve per building, particularly for heating, cooling, ventilation, and hot water loads. ○ An estimate of total technical potential energy savings achievable if the intended Phase 2 retrofit is applied to all buildings of the particular building typology/climate(s) selected. ○ An expanded set of target building typologies that can potentially be retrofitted by using a variation of the initial technology approach. • Topic 3a applications may suggest a variety of activities including but not limited to: ○ Widely disseminated test data under real operating conditions in multiple building types; ○ Joint action plan amongst diverse stakeholders (with additional non-Federal financial commitments) to gather system performance and operational data for new technologies deployed in different building types and different climates; ○ Model retrofit and new construction specifications and installation best practices for varied building types to facilitate eventual standardized procurements and interoperability; ○ Expedited 3rd party testing processes for specific innovations through engagement of entities such as ASTM, Underwriters Laboratories and the National Fire Protection Association;

	○ Prioritization of implementation barriers to ensure transition of research innovations to practice (by builders/trades); ○ Methods to measure and reducing embodied energy and other lifecycle properties of innovative technologies and approaches; ○ Strategies to ensure an inclusive stakeholder engagement process, including the building industry, state and local governments, utilities, labor unions, community organizations, building portfolio owners, and other key organizations; ○ Prposals for innovative financing options; ○ Plans to address workforce development and help workers transition to new advanced bulding construction jobs; ○ Commitments from large building portfolios for advanced building construction retrofits and new construction that can be used to aggregate demand for new technologies and approaches. • Topic 3b applications may describe: ○ Field validation of new innovation developed by DOE National Labs, current BTO efforts or the private sector for retrofit or new construction to generate performance and operational data under real operating conditions; ○ Systems analysis/optimization and then field testing of advanced sensors and control technologies that integrate various power electronics for building equipment and appliances to validate grid-interactive flexible building loads that that might include energy storage, tunable load systems, dynamic facades) with particular emphasis on performance and impact on grid; ○ A “manufactured” housing pilot manufacturing line, in partnership with insurance and finance sectors, to improve affordability and resilience of homes that have historically had high utility bills and particularly vulnerable to disasters; ○ The targeted location(s) which may be defined using local or state boundaries, climate zones, regional electric grid operators, or other parameters; ○ The targeted building types and technologies; ○ How relevant regional or local conditions (e.g., weather, demographics, energy supply and generation profiles, state/local regulations, utility programs, building characteristics and occupancy) are critical to the proposal and will be addressed; ○ The relevant partners and stakeholders‘ experience with regional, state, or local energy efficiency issues;

	○ The expected outcomes (e.g., estimated energy savings) of the project and how those outcomes support the advancement of energy efficiency solutions within the locality or region; and ○ A description of how energy efficiency and other performance metrics will be measured. • Topic 3c applications must address the following questions: ○ What new building technologies or building efficiency approaches will be covered by the new program? ○ Which labor and skill gaps will be addressed? Why are these skills and careers being targeted? ○ How will the applicant leverage existing training programs, certification programs, relevant coursework, curricula, and workforce guidelines, including those provided by DOE? See Appendix L for a list of relevant resources on DOE websites. ○ Who is the target audience/population of the proposed training or apprenticeship program? How well positioned is the applicant to reach this target audience? Please show how this target population is underrepresented within the existing building industry workforce locally or nationally, and discuss relevant barriers to participation among this group (literacy level, native language(s), post-incarceration, negative perception of industry, etc.). ○ Which specific, measurable, achievable, realistic, and time-bound (SMART) metrics will be tracked, and over what time intervals? Metrics of success may include: ▪ Increased participant knowledge of building industry technology or practices; ▪ Rate at which trainees find full-time employment in the field of choice; ▪ Average starting salary once trainees achieve full-time employment; ▪ Average increase in salary once trainees complete the program; and/or ▪ Percent of trained individuals with full time job placements supporting efficiency in the building industry.

iii. Statement of Project Objectives

Applicants are required to complete a Statement of Project Objectives (SOPO). A SOPO template is available on EERE Exchange at https://eere-

Exchange.energy.gov/. The SOPO, including the Milestone Table, and the Technical Volume together must not exceed 25 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 using the following naming convention: "ControlNumber_LeadOrganization_SOPO."

iv. SF-424: Application for Federal Assistance

Complete all required fields in accordance with the instructions on the form. The list of certifications and assurances in Field 21 can be found at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms, under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase, or other subset of the project period. Save the SF-424 in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_App424".

v. Budget Justification Workbook

- Applicants are required to complete the Budget Justification Workbook. This form is available on EERE Exchange at https://eere-Exchange.energy.gov/.
- Prime recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the prime recipient, 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 using the following convention for the title "ControlNumber_LeadOrganization_Budget_Justification."

vi. Summary/Abstract for Public Release

Applicants are required to submit a one-page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document

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

vii. Summary Slide

Applicants are required to provide a single PowerPoint slide summarizing the proposed project. The slide must be submitted in Microsoft PowerPoint format. This slide is used during the evaluation process. Save the Summary Slide in a single file using the following convention for the title "ControlNumber_LeadOrganization_Slide."

The Summary Slide template requires the following information:

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

viii. 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% of the total work effort (whichever is less). The budget justification must include the same justification information described in the "Budget Justification" section above. Applicants must use the template available in the EERE Exchange. Save each subrecipient budget justification in a Microsoft Excel file using the following convention for the title "ControlNumber_LeadOrganization_Subrecipient_Budget_Justification."

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

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

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

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with the contractor's authority under its award. Save the Authorization in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FFRDCAuth."

xi. 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" (https://www.grants.gov/web/grants/forms/sf-424-individual-family.html) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

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

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

xii. Waiver Requests: Foreign Entities and Performance of Work in the United States (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**
   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. Appendix C lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

Save the waivers in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_Waiver."

xiii. U.S. Manufacturing Plan

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. For an applicant that 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.K. Title to Subject Inventions).

Save the U.S. Manufacturing Plan in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_USMP.”

xiv. Data Management Plan

Applicants whose Full Applications are selected for award negotiations will be required to submit a Data Management Plans (DMP) during the award negotiations phase.

An applicant may select one of the template DMPs listed below. Alternatively, instead of selecting one of the templates, an applicant may submit another DMP provided that it, 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.

For Topics 1 and 2 **(Where recipients have the right to mark certain generated data as Protected Data):** For the deliverables under the award, the recipient **may not plan on making** the research data supporting the findings in the deliverables publicly available for up to 5 years after the data were first produced because in these cases, 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 **may** 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, or images in the publications.

For Topic 3 **(Where recipients do not have the right to mark certain generated data as Protected Data):** 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, or images in the publications.

For Topic 3b, data regarding building codes gathered through the projects would be made available to the public via the BECP technical assistance website (https://www.energycodes.gov/) including raw data, data collection methods and instruments, and publications on project findings. Other data gathered through the projects may be made available to the State and Local Solution Center maintained by the DOE Weatherization and Intergovernmental Programs Office.

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

XV. Open Source Software Distribution Plan

Applicants are required to submit an Open Source Software Distribution Plan as part of their Full Application if it is applicable. This plan will describe how

software produced under this FOA will be distributed. Submission of an Open Source Software Distribution Plan is required; failure to submit a complete plan may result in a determination of non-compliance for your Full Application. Guidance for preparing an Open Source Software Distribution Plan is included in Appendix D of this FOA.

Save the Open Source Software Distribution Plan in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_OSSDP."

xvi. **Excel Tools for Building Energy Savings Technical Potential (Topic 1)**

Applicants under Topic 1 are required to estimate per building energy savings and total technical potential. Applicants should use the Excel tools described in Appendix I to estimate total technical potential for the proposed technology innovation. The Excel tools allows applicants to compute total market size (in TBtu).

Save the Building Energy Savings Technical Potential in a single Excel file using the following convention for the title "ControlNumber_LeadOrganization_BES."

xvii. **Technical Potential Calculation (Topic 2)**

Applicants under Topic 2 that are proposing a technology, except for enabling technologies and design tools, must provide an estimate of the percent energy savings applicable to this market for their proposed technology innovation, with supporting analysis as described in Appendix J. The applicant will present the primary energy savings technical potential: the product of the percent energy savings and the energy market size as calculated by the Baseline Energy Calculator.

Save the Technical Potential Calculation in a single Excel file using the following convention for the title "ControlNumber_LeadOrganization_TPC."

xviii. **Payback Calculation (Topic 2)**

Applicants under Topics 2 that are proposing a technology, except for enabling technologies and design tools, will need to provide cost effectiveness, as measured by simple payback calculation. This is a second metric that will be used to evaluate Topic 2 applications.

An explicit approach is described in Appendix J, which applicants should follow to compute the payback for their proposed technology. An acceptable maximum payback (in years) will not be specified, because that figure can vary significantly depending on the end use.

Save the Payback Calculation in a single Excel file using the following convention for the title "ControlNumber_LeadOrganization_PC."

E. Content and Form of Replies to Reviewer Comments

EERE will provide applicants with reviewer comments following 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 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 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 pages in length, EERE will review only the first three pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
Text	2 pages	Applicants may respond to one or more reviewer comments or supplement their Full Application.
Optional	1 page	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.

F. 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; and
- Environmental Questionnaire.

G. Dun and Bradstreet Universal Numbering System Number and System for Award Management

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 System for Award Management (SAM) at https://www.sam.gov before submitting its application; (2) provide a valid Dun and Bradstreet Universal Numbering System (DUNS) number in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable DUNS and SAM requirements. If an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, DOE will determine that the applicant is not qualified to receive a federal award and may proceed with evaluation and selection of another federal award applicant.

H. 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.

I. Intergovernmental Review

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

J. 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 200 Subpart E - Cost Principles for all other non-federal entities.

ii. Pre-Award Costs

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

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

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

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

   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 costs where the prime recipient incurred the costs prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that 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 and such costs may not be recognized as allowable cost share. 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. 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.

iii. Performance of Work in the United States

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 if the work is performed by the prime recipient, subrecipients, contractors or other project partners.

3. Waiver

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

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.

Foreign travel costs are allowable only with the written prior approval of the Contracting Officer assigned to the award.

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. The rules for property disposition are set forth in 2 CFR 200.310 – 200.316 as amended by 2 CFR 910.360.

vii. Lobbying

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

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

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

viii. Risk Assessment

Prior to making a federal award, the DOE is required by 31 U.S.C. 3321 and 41 U.S.C. 2313 to review information available through any Office of Management and Budget (OMB)-designated repositories of government-wide eligibility qualification or financial integrity information, such as SAM Exclusions and "Do Not Pay."

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

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

ix. Invoice Review and Approval

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

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

V. Application Review Information

A. Technical Review Criteria

i. Concept Papers

All topics will use the same review criteria for Concept Papers outlined below. All sub-criteria are of equal weight.

Concept Paper Criterion: Overall FOA Responsiveness and Viability of the Project (Weight: 100%)
This criterion involves consideration of the following factors:

- The applicant clearly describes how the proposed technology, approach, or process is unique and innovative, and how the technology, approach or process 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 for their respective Topics. Topic 1 will use different criteria than Topics 2 and 3.

1. Topic 1 Merit Review Criteria

Full Applications
Applications will be evaluated against the merit review criteria shown below. All sub-criteria are of equal weight. Please note that Phase 1 proposed activities will be given greater emphasis over Phase 2 proposed activities during the Merit Review. Phase 2 applications will be evaluated in greater detail during the Down-Select Review.

Criterion 1: Technical Merit, Innovation, and Impact (60% total)
Innovation

- Extent to which the proposed technology(s) or approach is innovative;

- Degree to which the current state of the retrofit strategies and the proposed advancement are clearly described; and
- Extent to which the application specifically and convincingly demonstrates how the applicant will move the state-of-the-art to the proposed advancement.

Technical Merit

- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious, including relevant data, calculations and discussion of prior work in the literature with analyses that support the viability of the proposed work;
- 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;
- The level of clarity in the definition of and the technical methodology used to calculate the baseline, metrics, and milestones; and
- Relative to a clearly defined experimental baseline, the strength of the quantifiable metrics, milestones, and a mid-point deliverables defined in the application, such that meaningful interim progress will be made.

Impact of Technology Advancement

- How the project supports the topic area objectives and target specifications and metrics (see Appendix I for a table with BTO's preliminary EUI targets for Phase 2 by end use, building type, and major climate region);
- The potential impact of the project on advancing the state-of-the-art; and
- The likelihood that the technology and strategy can be viably scaled to achieve stated goals for intended building types and climate zones.

Criterion 2: Project Research and Technology Transition Plan (20%)

Research Approach, Workplan and SOPO

- Degree to which the approach and critical path have been clearly described and thoughtfully considered;
- 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;
- Clarity and significance of deliverables; and
- Degree to which the integration of Phase 1 outputs is likely to achieve Phase 2 goals.

Technology Transition Plan

- Comprehensiveness of Technology Transition Plan including but not limited to articulating a clear understanding of the market opportunity, competitive advantage, and value proposition;
- Demonstrated understanding of the major market and commercialization issues, barriers, and risk areas involved in the development and eventual deployment or dissemination of the proposed solution, and the quality of the mitigation strategies to address them; and
- Comprehensiveness of Data Management Plan and U.S. Manufacturing Plan.

Criterion 3: Team and Resources (20%)

- 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 responds to the topic area objectives and 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.

2. Topic 2 and 3 Merit Review Criteria

Topics 2 and 3, including subtopics under Topic 3, will use the same criteria outlined below. All sub-criteria are of equal weight.

Criterion 1: Technical Merit, Innovation, and Impact (50%)
This criterion involves consideration of the following factors:

Technical Merit and Innovation

- Extent to which the proposed technology, approach or process is innovative;
- Degree to which the current state of the technology, approach or process 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;
- Likelihood the proposed solution, if successful, could be scaled to have a broader impact or be maintained at a sufficiently large scale after project completion; 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, Approach or Process Advancement

- How the project supports the topic area goals and objectives as well as target specifications and metrics;
- The extent to which the claimed impacts are feasible and justified;
- The extent of differentiation with respect to existing solutions or programs; and
- The potential impact of the project on advancing the state-of-the-art.

Criterion 2: Quality and Feasibility of the Project Plan (30%)
This criterion involves consideration of the following factors:

Approach, Workplan and SOPO

- Degree to which the approach and critical path have been clearly described and thoughtfully considered;
- Degree to which the stated goals of the project are SMART (Specific, Measurable, Aggressive (but achievable), Relevant, and Timely), whether they are likely to be accomplished within the scope of this project, and does the proposal show a clear path for growth and improvement over time;
- 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;
- Level of validation (letters of support/interest, partners, customer trials, data from prior work, report references, technical baselines established, etc.);
- Reasonableness of the assumptions used to form the execution strategy, (e.g., market size, customer participation, costs, throughput at full scale, speed of proposed scale-up or adoption, and mode of funding); and

- The reasonableness of the overall funding requested to achieve the proposed project and objectives.

Identification of Technical Risks

- Discussion and demonstrated understanding of the project risks and challenges involved in the proposed work and the soundness of the mitigation strategies and methods that will be used to address them.

Baseline, Metrics, and Deliverables

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

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, Data Management Plan, Open Source Software Distribution Plan, U.S. manufacturing plan, and product distribution.

Criterion 3: Team and Resources (20%)

This criterion involves consideration of the following factors:

- The training, capabilities, and experience 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. Extent to which this team (including proposed Subrecipients) will be able to achieve the final results on time and to specification;
- Extent to which the team has access to facilities, equipment, people, expertise, data, knowledge, and any other resources required to complete the proposed project. The sufficiency of the facilities to support the work;

- The degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed technologies;
- The level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan;
- Extent to which the assembled team has shown success in the past. DOE encourages new entrants and new ideas, but past successes and/or failures will be noted; and
- Extent to which the final team required to complete this project is fully assembled and committed to the project (e.g., Are there any key members that are "to be hired at a later date").

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, 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).

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.ii 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 (See Section V.D.iii. of the FOA). 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.J.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.J.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:

4. **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**.

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

6. **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 an Marketing Partner ID Number (MPIN) are important steps in SAM registration. Please update your SAM registration annually.

7. **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.

8. **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.

9. **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 200 as amended by 2 CFR 910.

iii. Foreign National Access to DOE Sites

All applicants that ultimately enter into an award resulting from this FOA will be subject to the following requirement concerning foreign national involvement.

Upon DOE's request, prime recipients must provide information to facilitate DOE's responsibilities associated with foreign national access to DOE sites, information, technologies, and equipment. A foreign national is defined as any person who was born outside the jurisdiction of the United States, is a citizen of a foreign government, and has not been naturalized under U.S. law. If the prime recipient or subrecipients, contractors or vendors under the award, anticipate utilizing a foreign national person in the performance of an award, the prime recipient is responsible for providing to the Contracting Officer specific information of the foreign national(s) to satisfy compliance with all of the requirements for access approval.

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 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 USC 4321, *et seq.*). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at http://nepa.energy.gov/.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project. If DOE determines certain records must be prepared to complete the NEPA review process (e.g.,

biological evaluations or environmental assessments), the costs to prepare the necessary records may be included as part of the project costs.

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), or as part of the down-select process as described in Appendix H.

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

x. Intellectual Property Management Plan

As a Quarter 1 milestone if selected for award, applicants must submit an executed Intellectual Property Management Plan (IPMP) between the members of the consortia or team if directed by the technology manager assigned to the award.

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 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.

In addition, all awarded projects for Topics 1 & 2 will be required to submit data during the project period of performance for analysis by BTO software programs such as Scout, ResStock, ComStock, etc. This consists of the following for the proposed technology under each relevant topic:

- Topic 1: Relevant market, including number of relevant buildings by climate zone,
- Topic 1 & 2: Efficiency improvement relative to the baseline technology it replaces,
- Topic 1 & 2: Incremental installed cost relative to the baseline technology that it replaces,
- Topic 1 & 2: Expected lifetime of installed measures.

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 Milestone Summary Table stated in Attachment 1 of the award; (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 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, Uniform Commercial Code (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.

C. Program Down-Select

In addition to the Go/No-Go Reviews required for each project, EERE intends to conduct a competitive project review (down-selection process) upon the completion of Phase 1 for all projects selected under Topic 1. Recipients will present their projects to EERE individually (not to other recipients). Subject matter experts from academia, national laboratories, and industry may be used as reviewers, subject to conflict of interest and non-disclosure considerations. Projects will be evaluated based on the following criteria found in Appendix H – Phase 1 Down Select For Topic 1.

Upon completion of the competitive project review (down-selection process), EERE will select which projects will receive federal funding beyond Phase 1. Due to the availability of funding and program considerations, only a portion of the recipients will be selected to receive funding for project continuation. As a result of this down-select process, certain projects will not receive federal funding beyond Phase 1 even if the project is meeting the pre-defined metrics.

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: ABC2019FOA@ee.doe.gov. Questions must be submitted not later than 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 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

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

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.

The use of protective markings such as “Do Not Publicly Release – Trade Secret” or “Do Not Publicly Release – Confidential Business Information” is encouraged. However, applicants should be aware that the use of protective markings is not dispositive as to whether information will be publicly released pursuant to the Freedom of Information Act, 5 U.S.C. §552, et. seq., as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175. (See Section I of this document, “Notice of Potential Disclosure Under the Freedom of Information Act (FOIA)” for additional information regarding the public release of information under FOIA.

Applicants are encouraged to employ protective markings in the following manner:

The cover sheet of the application must be marked as follows and identify the specific pages containing trade secrets or commercial or financial information that is privileged or confidential:

Notice of Restriction on Disclosure and Use of Data:
Pages [list applicable pages] of this document may contain trade secrets or commercial or financial information that is privileged or confidential, and 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 trade secrets or commercial or financial information that is privileged must be marked as follows: "May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure."

In addition, each line or paragraph containing trade secrets or commercial or financial information that is privileged or confidential must be enclosed in brackets.

E. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, the Go/No-Go Review and Peer Review, the Government may seek the advice of qualified non-federal personnel as reviewers. The Government may also use non-federal personnel to conduct routine, nondiscretionary administrative activities, including EERE contractors. The applicant, by submitting its application, consents to the use of non-federal reviewers/administrators. Non-federal reviewers must sign conflict of interest (COI) and non-disclosure acknowledgements (NDA) prior to reviewing an application. Non-federal personnel conducting administrative activities must sign an NDA.

F. Notice Regarding Eligible/Ineligible Activities

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

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

EERE reserves the right to conduct an independent third party review of financial capability for applicants that are selected for negotiation of award (including

personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

H. Notice of Potential Disclosure Under Freedom of Information Act

Under the Freedom of Information Act (FOIA; 5 U.S.C. §552, et. seq., as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175) any information received from the applicant is considered to be an agency record, and as such, subject to public release under FOIA. The purpose of the FOIA is to afford the public the right to request and receive agency records unless those agency records are protected from disclosure under one or more of the nine FOIA exemptions. Decisions to disclose or withhold information received from the applicant are based upon the applicability of one or more of the nine FOIA exemptions, not on the existence or nonexistence of protective markings or designations. Only the agency's designated FOIA Officer may determine if information received from the applicant may be withheld pursuant to one of the nine FOIA exemptions. All FOIA requests received by DOE are processed in accordance with 10 C.F.R. 1004.

I. 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.

J. 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.

K. 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

- DEC: Each applicant 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.

L. 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.

M. 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"). For awards permitting Protected Data, the protected data must be marked as set forth in the awards intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

N. 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.

The Prime Recipient and Subrecipients of projects funded under Topics 3c.1 and 3c.2 may assert copyright in educational or learning materials developed under an award without DOE's permission only if the Prime Recipient and Subrecipients license the materials to the public under a Creative Commons Attribution License (CCBY).

To maximize the impact of federal funding provided for workforce training and apprenticeships as a part of this FOA, the Prime Recipient and Sub-recipients of projects funded under subtopics 3c.1 and 3c.2 must license, under a Creative Commons Attribution License (CCBY), to the public all work related to training or education developed in the performance of the award. Please note that, in certain circumstances regarding sensitive topics and material (e.g., sensitive building energy management system cybersecurity course content), 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. Additionally, the DOE, at its sole discretion, with respect to Subtopic 3c.2, for example, may choose not to require CCBY licensing at the time of project negotiation if there is a reasonable basis consistent with the objectives of this FOA not to require it. By default, all materials that are not deemed too sensitive will be licensed with the CCBY license. This CCBY license allows subsequent users to copy, distribute, transmit and adapt the copyrighted work and requires such users to attribute the work in the manner specified by the Prime Recipient or Sub-recipient.

Notice of the License must be affixed to the work. Only work developed in the performance of or under the award must be licensed under the CCBY license. Pre-existing copyrighted materials licensed to, or purchased by the Prime Recipient or Sub-recipient from third parties remain subject to the intellectual property rights the Prime Recipient or Sub-recipient receives under the terms of the particular license or purchase. For more information on this License, please visit http://creativecommons.org/licenses/by/4.0/.

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 – 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 31); and
- 2 CFR 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 subrecipeint(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.

   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 200 Subpart E - Cost Principles for all other non-federal entities.

DOE Financial Assistance Rules 2 CFR200 as amended by 2 CFR 910

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

(A) Acceptable contributions. All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the prime recipient's cost sharing if such contributions meet all of the following criteria:

(1) They are verifiable from the recipient's records.

(2) They are not included as contributions for any other federally-assisted project or program.

(3) They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.

(4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:

a. For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A–122 is determined in accordance with the for-profit cost principles in 48 CFR 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 200 Subpart E.

(5) They are not paid by the federal government under another award unless authorized by federal statute to be used for cost sharing or matching.

(6) They are provided for in the approved budget.

(B) Valuing and documenting contributions

(1) Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item

will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or

b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

(2) Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.

(3) Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

(4) Valuing property donated by third parties.

a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.

b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:

i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.

ii. The value of loaned equipment must not exceed its fair rental value.

(5) Documentation. The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.

b. The basis for determining the valuation for personal services and property must be documented.

APPENDIX B – SAMPLE COST SHARE CALCULATION FOR BLENDED COST SHARE PERCENTAGE

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

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

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

Each task must be calculated individually as follows:

Task 1
$1,000,000 divided by 80% = $1,250,000 (Task 1 Cost)
Task 1 Cost minus federal share = Non-federal share
$1,250,000 - $1,000,000 = $250,000 (Non-federal share)

Task 2
$500,000 divided 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 C – WAIVER REQUESTS AND APPROVAL PROCESSES:

1. FOREIGN ENTITY PARTICIPATION AS THE PRIME RECIPIENT

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;
- 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 D – OPEN SOURCE SOFTWARE DISTRIBUTION

Applicants that are applying to one or more Topic Areas for which open source software distribution is applicable must submit a plan describing how software produced under this FOA will be distributed. For a DOE National Laboratory or a FFRDC, the data rights clause, including rights and requirements pertaining to computer software, in its Management and Operating (M&O) Contract shall apply and shall take precedence over any requirement set forth in this appendix. The plan must include the following elements:

1. A complete description of any existing software that will be modified or incorporated into software produced under this FOA, including a description of the license rights. The license rights must allow the modified or incorporated software to be distributed as open source.

2. A discussion of the open source license that the applicant plans to use for the software it plans to produce under the FOA, and how that choice furthers the goals of this FOA. The discussion must also address how the license conforms to the conditions listed below.

3. A method for depositing the software in a source code repository.

4. A method for sharing and disseminating the software and other information to team members or others when multiple parties will contribute to the development of the software or the FOA requires that the software or other information be shared or disseminated to others.

Open Source Definition: Open source licenses must conform to all of the following conditions:

Free Redistribution
The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale. The rights attached to the software must apply to all to whom the software is redistributed without the need for execution of an additional license by those parties.

Source Code
The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost preferably, i.e., downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program.

Deliberately obfuscated source code and intermediate forms such as the output of a preprocessor or translator are not allowed.

Derived Works
The license must allow modifications and derived works, and permit the option of distributing the modifications and derived works under the same terms as the license of the original software.

Integrity of the Author's Source Code
The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

No Restriction Against Fields of Endeavor
The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

License Must Not Be Specific to a Product or Technology
The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution. No provision of the license may be predicated on any individual technology or style of interface.

License Must Not Restrict Other Software
The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

Examples of Acceptable Licenses
Apache License, 2.0
http://www.apache.org/licenses

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APPENDIX E – GLOSSARY

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

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

i. A report on the Recipient's progress towards meeting the objectives of the project, including any significant findings, conclusions, or developments, and an estimate of any unobligated balances remaining at the end of the budget period. If the remaining unobligated balance is estimated to exceed 20 percent of the funds available for the budget period, explain why the excess funds have not been obligated and how they will be used in the next budget period.

ii. A detailed budget and supporting justification if there are changes to the negotiated budget, or a budget for the upcoming budget period was not approved at the time of award.

iii. A description of any planned changes from the negotiated Statement of Project Objectives and/or Milestone Summary Table.

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

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

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

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

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

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

APPENDIX F – LIST OF ACRONYMS

ABC	Advanced Building Construction
AFDD	Automated Fault Detection Diagnostics
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BEM	Building Energy Modeling
BTO	Building Technologies Office
Btu	British thermal unit
COI	Conflict of Interest
COP	Coefficient of Performance
Cx	Commissioning
DEC	Determination of Exceptional Circumstances
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
EERE	Energy Efficiency and Renewable Energy office
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 Building
HIL	Hardware-in-the-Loop
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air-Conditioning
IECC	International Energy Conservation Code
IPMP	Intellectual Property Management Plan
LED	Light-Emitting Diode
lm/w	lumens per watt
M&O	Management and Operating
M&V	Measurement and Verification
MPIN	Marketing Partner ID Number
MYPP	Multi-Year Program Plan
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NGHP	Natural Gas Heat Pump
NNSA	National Nuclear Security Agency
OLED	Organic Light-Emitting Diode
OMB	Office of Management and Budget
OSTI	Office of Scientific and Technical Information

PCM	Phase Change Material
PII	Personal Identifiable Information
R&D	Research and Development
RD&D	Research, Development and Demonstration
RFI	Request for Information
RFP	Request for Proposal
S&C	Sensors and Controls
SAM	System for Award Management
SSL	Solid State Lighting
SOPO	Statement of Project Objectives
SPOC	Single Point of Contact
TIA	Technology Investment Agreement
TOU	Time Of Use
TRL	Technology Readiness Level
TSV	Time-sensitive Valuation
UCC	Uniform Commercial Code
WBS	Work Breakdown Structure
WP	Work Proposal

APPENDIX G – DATA MANAGEMENT PLAN

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

DMP Requirements

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

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

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

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

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

APPENDIX H – TOPIC 1 PHASE 1 DOWN SELECT

In addition to periodic the Go/No Go Reviews required for each project, EERE intends to conduct a competitive project review (down-selection process) following the completion of Phase 1. At the completion of Phase 1 (12-18 months), DOE will make a competitive down select resulting in approximately five Recipients being authorized to proceed into Phase 2 (up to 3 years).

Sixty (60) days before the completion of Phase 1, the Recipient will submit the reports outlined below to the DOE Technical Project Officer. These reports are used by the DOE Project Review Committee to conduct a project review against the criteria listed above. Approximately thirty (30) days before the completion of Budget Period 1, the Recipient will give a presentation to the DOE Project Review Committee, as outlined below, via webinar. The reports will be available for internal use only by the review committee; however, any data delivered should be marked as specified in the terms and conditions of the award.

Recipients interested in competing for continued funding into Phase 2 will be required to submit a Down-Select Application which will include a Phase 1 presentation, a Phase 1 Technical Report, and a Phase 2 Project Proposal. The decision for funding Phase 2 will be based upon the Phase 1 presentation, Phase 1 Technical Report, and Phase 2 Project Proposal, in addition to the completion of all Phase 1 deliverables as listed in the SOPO.

The Down-Select Application should include the reports below. The final application documents and the Down-Select Application process will be defined by way of an amendment to the Phase 1 awards.

- Phase 1 Technical Report
    - Project Overview. *Overview summarizing project objectives, Phase 1 progress by task, high-level Phase 1 results, technical objectives and quantitative metrics achieved in Phase 1.*
    - Energy-Savings Potential. *Describes the specific energy-savings available for each applicable building typology, the aggregate technical potential for energy-savings from all applicable buildings in the US, and the methods used for calculating these numbers.*
    - Technical/Engineering Design. *Describes technical/engineering design including modular and standard features, integration requirements, implementation diversity, and ability to operate efficiently across a broad range of buildings.*
    - Cost Modeling and Analysis. *Describes the cost modeling considerations, analysis approach, and results for the phase 1 retrofit technologies or strategies.*
- Phase 2 Project Proposal

  - Project Overview. *Overview summarizing project goals, intended objectives and specific tasks for Phase 2, and a detailed timeline with measurable project milestones.*
  - Energy-Savings Potential. *Describes the specific energy-savings intended for each applicable building typology, the aggregate technical potential for energy-savings from all applicable buildings in the US, and the methods used for calculating these numbers.*
  - Technical/Engineering Design. *Describes the intended technical/engineering design including modular and standard features, integration requirements, implementation diversity, and ability to operate efficiently across a broad range of buildings.*
  - Cost Modeling and Analysis. *Describes the target cost modeling considerations and analysis approach for the phase 2 whole-building retrofit technologies or strategies.*
- Updated SOPO
- Updated Budget for all Phases and Budget Periods
- Budget Period 1 Presentation. *Describes Phase 1 progress by task. Summarizes technical/engineering design considerations, key design/technology features, and cost modeling and analysis results. Details how the technology achieves the FOA objectives. Outlines quantitative metrics to be achieved in Phase 2, as well as any required changes to the work plan and/or budget.*

All Phase 1 Recipients are required to submit a Phase 1 Technical Report, regardless of whether or not the Recipient intends to submit a Down-Select Application. Only Phase 1 Recipients are eligible to submit Down-Select Applications, which are requests for additional funding. Applicants that are selected to proceed beyond Phase 1 are hereby advised that the Phase 2 terms and conditions (for example, NEPA, cost share and Intellectual Property) will be subject to renegotiation and a financial viability review of the Applicant will be performed.

The details and logistics of the Phase 1 presentation will be provided to the Phase 1 Recipients approximately 30 days prior to the dates scheduled for the presentation. Recipients will present their projects to EERE individually. Subject matter experts from academia, national laboratories, and industry may be used as reviewers, subject to conflict of interest and non-disclosure considerations.

Recipients desiring to compete for funding for Phase 2 will be required to submit an updated cost proposal consistent with their defined scope. Note: Updated cost estimates will be required of all Phase 2 Recipients at all Go/No-Go decision and down-select points.

The Down-Select Application will be evaluated based on the following criteria:

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

Technical Merit and Innovation

- Extent to which the proposed whole-building retrofit strategies for Phase 2 are innovative;
- Degree to which the current state of the retrofit strategies 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

The applicant provides a detailed explanation of the proposed technologies and retrofit strategies, how the approach is unique and innovative, and how approach will achieve the FOA objectives.

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

Criterion 2: Project Research and Technology Transition Plan (30%)

Research Approach, Workplan and SOPO

- Degree to which all milestones and deliverables from Phase 1 have been sufficiently met;
- 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 and the technical methodology used to calculate the baseline, metrics, and milestones; and
- Relative to a clearly defined experimental baseline, the strength of the quantifiable metrics, milestones, and a mid-point deliverables defined in the application, such that meaningful interim progress will be made.

Technology Transition Plan

- Comprehensiveness of Technology Transition Plan including but not limited to articulating a clear understanding of the market opportunity, competitive advantage, and value proposition.

- Demonstrated understanding of the major market and commercialization issues, barriers, and risk areas involved in the development and eventual deployment or dissemination of the proposed solution, and the quality of the mitigation strategies to address them.
- Comprehensiveness of Data Management Plan and U.S. Manufacturing Plan.

Criterion 3: Team and Resources (20%)

- The capability of the Principal Investigator(s) and the proposed team to address all aspects of the proposed work with a high probability of success. The qualifications, relevant expertise, and time commitment of the individuals on the team;
- The sufficiency of the facilities to support the work;
- The degree to which the proposed consortia/team responds to the topic area objectives and 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.

Upon completion of the competitive project reviews (down-select process), EERE will select which projects will receive Federal funding beyond Phase 1 for Phase 2. Due to the availability of funding and program considerations, only a portion of the recipients will be selected to receive funding for project continuation. As a result of this down-select process, certain projects will not receive Federal funding beyond Phase 1 even if the project meets the pre-defined metrics.

For those Recipients not selected to proceed to Phase 2 or those that do not intend to submit a Phase 2 Down-Select Application, the Phase 1 Technical Report will constitute the Final Project Report.

APPENDIX I – TOPIC 1 EXCEL TOOLS FOR BUILDING ENERGY SAVINGS TECHNICAL POTENTIAL CALCULATION

Three Excel Tools are available on EERE Exchange along with this document:

- Residential Pivot Table Tool using RECS 2015 Data
- Commercial Pivot Table Tool using CBECS 2012 Data
- BTO's preliminary EUI targets for Phase 2 by end use, building type, and major climate region

Applicants should use the first two Excel tools to estimate total energy savings potential for Topic 1 on Integrated Building Retrofits. The tools use data from the EIA's 2015 Residential Building Energy Consumption Survey (RECS) and 2012 Commercial Building Energy Consumption Survey (CBECS) and allow a user to select buildings based on their types, geographies, vintages, façade types, heating equipment types, and cooling equipment types. The tools also allow a user to manually enter estimated potential site energy reductions for retrofit interventions for building heating, cooling, electricity, and overall energy usage.

Full instructions for using the tools are included in a "Directions" tab in each Excel document. The below Excel documents are available on the EERE Exchange website, under "Required Application Documents" within this FOA number:

- Residential Pivot Table Tool using RECS 2015 Data
- Commercial Pivot Table Tool using CBECS 2012 Data

The third excel tool is provided as a starting point to assist applicants in developing appropriate EUI targets.

APPENDIX J – TOPIC 2 TECHNICAL POTENTIAL AND PAYBACK CALCULATION

One performance metric used to evaluate applications will be the 2030 primary energy savings technical potential. Each application must describe a technology or approach that leads to a minimum annual primary energy savings technical potential in 2030 of at least 250 Trillion British Thermal Units (TBtu), i.e., 0.25 Quads. All applicants proposing a technology innovation should provide the *Primary Energy Savings Technical Potential* (TBtu), and the *Simple Payback* (years). The *Primary Energy Savings Technical Potential* is calculated from Equation F1:

$$\left[\begin{array}{c}\text{Primary Energy Savings}\\ \text{Technical Potential}\\ \text{(TBtu)}\end{array}\right] = \left[\begin{array}{c}\text{\% Energy Savings}\\ \text{Over Typical New}\\ \text{Technology}\end{array}\right] \times \left[\begin{array}{c}\text{2030 Energy Market}\\ \text{Size}\\ \text{(TBtu)}\end{array}\right] \quad \text{(F1)}$$

The *2030 Energy Market Size* (TBtu) can be determined from the building type addressed by the technology (residential or commercial), the end use (cooling, lighting, cooking, refrigeration, etc.), the climate zone (1 – 5), and other information. The BTO Baseline Energy Calculator tool facilitates the determination of the *2030 Energy Market Size*. If a proposed technology or approach affects energy use in multiple end uses (e.g., an HVAC technology that operates in both heating and cooling modes), the Baseline Energy Calculator will need to be run multiple times to obtain the market size for each affected end use. Detailed instructions on how to use the Baseline Energy Calculator are provided on the website.

The "Typical New Technology" in Equation F1 is the technology that is being replaced. For "covered" technologies, that is, technologies subject to minimum efficiency standards,[38] Applicants should assume the efficiency of the "Typical New Technology" to be greater than or equal to the applicable efficiency standard. For "covered" and other technologies, Table F1 presents the projected 2030 stock and average stock efficiency for a variety of residential equipment that may be used in this calculation. Corresponding 2030 average stock efficiencies for commercial units are provided in Table F2. In all cases applicants should ensure that if a "covered" technology is being replaced, the efficiency of the "Typical New Technology" is equal to or greater than the applicable efficiency standard.

Table F1 2030 Residential equipment stock and average efficiency[39]

Equipment Class (efficiency rating)	Stock (million units)	Stock Average Efficiency
Main Space Heaters		

[38] https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program

[39] Residential Sector Equipment Stock and Efficiency, AEO 2017 Reference case: https://www.eia.gov/outlooks/aeo/data/browser/ - /?id=30-AEO2017&cases=ref2017&sourcekey=0

Electric Heat Pumps (HSPF)	15.74	9.85
Natural Gas Heat Pumps (GCOP)	0.38	1.30
Geothermal Heat Pumps (COP)	1.52	3.78
Natural Gas Furnace (AFUE)	67.57	0.86
Distillate Furnace (AFUE)	5.60	0.88
Space Cooling		
Electric Heat Pumps (SEER)	15.75	17.19
Natural Gas Heat Pumps (GCOP)	0.38	0.67
Geothermal Heat Pumps (EER)	1.52	19.14
Central Air Conditioners (SEER)	77.46	14.54
Room Air Conditioners (EER)	47.16	11.20
Water Heaters		
Electric (EF)	60.02	0.99
Natural Gas (EF)	65.94	0.63
Distillate Fuel Oil (EF)	1.66	0.65
Propane (EF)	2.63	0.62
Refrigeration		
Refrigerators (kWhr/yr.)	167.35	466.89
Freezers (kWhr/yr.)	43.63	409.36

Table F2 2030 Commercial equipment average efficiency[40]

Equipment Class	**Stock Average Efficiency**[41]
Space Heating	
Electricity	1.79
Natural Gas	0.79
Distillate Fuel Oil	0.81
Space Cooling	
Electricity	3.90
Natural Gas	0.80
Water Heating	
Electricity	1.09
Natural Gas	0.87
Distillate Fuel Oil	0.79
Ventilation (cfm/Btu)	0.71
Refrigeration	3.10

[40] Commercial Sector Energy Consumption, Floorspace, and Equipment Efficiency, AEO 2017 Reference case: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=32-AEO2017&cases=ref2017&sourcekey=0. Note that the stock (millions of units) are not available from this source.

[41] Unless noted otherwise, efficiencies are in units of Btu of energy output divided by Btu of energy input.

If the provided information is not used to calculate the *Energy Market Size* (TBtu), then a comparable approach can be applied, with corresponding justification.

A second performance metric used to evaluate applications will be the cost effectiveness, as measured by the Simple Payback. This will be 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. Proposers should compute the *Simple Payback* for their proposed technology innovation per Equation F2:

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

$$= \frac{\left[\begin{array}{c}\text{Incremental Initial}\\ \text{Cost of Proposed}\\ \text{Technology at Scale }(\$)\end{array}\right]}{\left[\begin{array}{c}\text{Unit Energy Consumed by}\\ \text{Typical New Technology}\\ \text{Per Year }(\text{kWh/Yr})\end{array}\right]\left[\begin{array}{c}\text{Energy}\\ \text{Cost}\end{array}\left(\frac{\$}{\text{kWh}}\right)\right]\left[\begin{array}{c}\text{\% Energy Savings}\\ \text{Over Typical New}\\ \text{Technology}\end{array}\right]} \qquad \text{(F2)}$$

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

$$\left[\begin{array}{c}\text{Incremental Initial}\\ \text{Cost of Proposed}\\ \text{Technology at Scale }(\$)\end{array}\right] = \left[\begin{array}{c}\text{Unit Cost of}\\ \text{Proposed Technology}\\ \text{at Scale }(\$)\end{array}\right] - \left[\begin{array}{c}\text{Unit Cost of}\\ \text{Typical New}\\ \text{Technology }(\$)\end{array}\right] \qquad \text{(F3)}$$

Note that the *% Energy Savings Over Typical New Technology* term in Equation F2 is the same as that in Equation F1. The "Energy Cost" can be specified alternatively in $/MMBtu (i.e., for natural-gas-fired systems), or in whatever units are most appropriate. The nationally averaged energy costs specified in Table F3 *must* be used for this calculation. The proposer 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.

Table F3 Retail energy 2015 pricing (year-to-date)

Sector	Electricity, ¢/kWh[42]	Natural Gas	
		$/Thousand Cubic Feet[43]	$/MMBTU[44]
Residential	12.64	12.36	12.02
Commercial	10.65	8.15	7.93

Proposers of non-technological solutions (e.g., modeling approaches) are also required to provide an estimate of primary energy savings potentially resulting from their innovation, as well as an analysis of their cost effectiveness. The approaches used in these analyses need to be appropriately justified.

[42] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_3
[43] http://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_a.htm
[44] http://www.eia.gov/tools/faqs/faq.cfm?id=45&t=8

APPENDIX K – TOPIC 3C.1 WORKFORCE PROBLEMS/OPPORTUNITIES AND POTENTIAL RESPONSIVE APPLICATIONS

The Building Technologies Office is interested in a variety of different approaches to address workforce needs under "Topic 3c.1: Building Assessments, Technology Installation, Operations and Maintenance." The table below provides some examples of problems in the energy efficiency workforce cited in literature on the subject. Potential responsive application ideas are also provided as high-level examples. These are meant to be a starting point to assist applicants in framing workforce gaps and developing tailored solutions within their own jurisdictions; however, applicants are not required to address these problems and/or solutions directly.

Existing Workforce Problems/Opportunities	**Potential Responsive Applications**
Example Target Careers	
Operations & Maintenance Staff for Commercial Buildings: In 2013, nearly 94,000 building O&M professional job listings were unfilled, and 64% of existing professionals are expected to retire before 2033. There exists limited academic and training programs preparing workers for this sector. (Jobs for the Future, 2015).	Increase programs supporting recruitment, training, and apprenticeship of skilled workers in building operations and maintenance through new and innovative recruitment and training programs.
Construction Trades for Installing and Maintaining Efficient Residential Building Technologies: Smaller specialty trade segments and remodeling are the most fragmented subsectors of construction, which is strongly related to overall productivity. Among the lowest productivity and highest fragmentation are residential remodelers and single-family housing (McKinsey Global Institute, 2017).	Increase programs supporting recruitment, training, and apprenticeship of skilled workers in residential building remodeling and maintenance, as well as advanced construction practices, through new and innovative recruitment and training programs.
Science, Technology, Engineering, and Mathematics (STEM) Training for Technology of the Future: As flexible efficiency technologies and sensors & controls enable buildings to become more interactive with the grid, the building efficiency workforce will require new skills in information science and data analysis. (ACEEE, 2018a).	Integrate STEM skillsets related to building science, new digital energy management system technology, Internet of Things (IoT), and grid-interactive technology into existing training programs.
Example Target Regions	

Post-Disaster Recovery Regions: "A variety of barriers exist to better integrating energy efficiency in disaster recovery… the disaster recovery period poses a unique opportunity to ensure that the affected community is better prepared for the next disaster" (ACEEE, 2018b).	Develop the knowledge and skillsets of program administrators and construction trades in post-disaster regions to enable energy efficient reconstruction through training and/or apprenticeships. Where applicable, applicants will leverage Community Development Block Grant Disaster Recovery (CDBR-DR) funds for maximized impact.
Example Target Populations	
High School Students: Fifty-four percent of high school juniors and seniors report they are "not at all" familiar with HVAC work, and only three percent report being "definitely interested" in pursuing a career in HVAC work (EGIA Foundation, 2018). Among building science occupations, 58% of 2014 employees are expected to retire over the next 20 years (Jobs for the Future, 2015).	Attract a younger workforce by targeting high school, community college, and trade school students and correcting biases and negative perceptions about energy efficiency workforce careers. Showcase potential for stability, personal growth, problem-solving, reliable income, and positive impacts from a career in energy efficiency.
Women: Although women make up about 47% of the national workforce, women make up just 23% of the energy efficiency workforce, 3.4% of building energy auditors, and less than 1.7% of the HVAC workforce (ACEEE, 2018a; Jobs for the Future, 2015; EGIA Foundation, 2018). Sixty-nine percent of contractors surveyed identified a negative public perception of HVAC work as for men only (EGIA Foundation, 2015).	Attract women to building science, auditor, and HVAC workforce by featuring women in these careers, providing women mentors for apprentices, and showcasing the potential for stability, personal growth, problem-solving, reliable income, and positive impacts from a career in energy efficiency.
Veterans & Active Duty Military in Transition: Although veterans make up 11% of the energy efficiency workforce, there are significant gaps between enlisted military job duties and the job task analyses for Better Buildings Workforce Guidelines (BBWG) (NASEO & EFI, 2018; Solutions for Information Design [SOLID], 2014). Therefore, fit for BBWG job titles will require some bridge training for active duty and former military personnel (SOLID, 2014).	Train veterans and/or active duty military in transition to excel in energy efficiency jobs uniquely suited to their problem-solving (mission-driven) talents by crosswalking military occupant codes (MOC) and DOD's Credentialing Opportunities On-Line (COOL) resources to effectively identify and address skill gaps through targeted competency-based, applied and soft skill development training. For example, programs that go beyond a "one and done" approach; showcase the potential for stability, personal growth, reliable income, and

	other positive impacts from a career in energy efficiency; develop employer partner relationships with an emphasis on training and credential reciprocity; impact the greater energy efficiency workforce by registering new and/or updated apprenticeships, training and credentialing models with the Department of Labor, and applying for approval of training and credentialing models for use of GI Bill benefits from Department of Veterans Affairs.
Communities of Color: Black and African American workers are underrepresented, making up 8% of the energy efficiency workforce as compared to 12% of the national workforce. Hispanic and Latino workers are also underrepresented but to a lesser extent (ACEEE, 2018a; NASEO & EFI, 2018).	Attract new talent pools to the energy efficiency workforce by leveraging community partnerships, economic development programs, and paid apprenticeship programs. Translate tools as needed for attracting and training participants. Showcase the potential for stability, personal growth, problem-solving, reliable income, and positive impacts from a career in energy efficiency.

APPENDIX L – TOPIC 3C RELEVANT U.S. DEPARTMENT OF ENERGY RESOURCES

Building America Solution Center: https://basc.pnnl.gov/

- Resource Guides: https://basc.pnnl.gov/resource-guides
- Sales Tool: https://basc.pnnl.gov/sales-tool
- Program Checklists: https://basc.pnnl.gov/program-checklists
- Code Briefs: https://basc.pnnl.gov/code-compliance

Better Buildings Workforce Guidelines:
https://betterbuildingssolutioncenter.energy.gov/workforce/better-buildings-workforce-guidelines

- Factsheet: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Better-Buildings-Workforce-Guidelines-FactSheet.pdf
- Job Task Analyses Registration Page: https://www.nibs.org/page/cwcc_jtareg

Building Energy Codes & Standards:

- Resource Center: https://www.energycodes.gov/resource-center
- Publications: https://www.energycodes.gov/resource-center/publications
- Training: https://www.energycodes.gov/training

Guidelines for Building Science Education:
https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24143Rev2.pdf