DEPARTMENT OF ENERGY (DOE)
OFFICE OF SCIENCE (SC)
ADVANCED SCIENTIFIC COMPUTING RESEARCH (ASCR)
BASIC ENERGY SCIENCES (BES)
BIOLOGICAL AND ENVIRONMENTAL RESEARCH (BER)

ENERGY EARTHSHOT RESEARCH CENTERS

DOE NATIONAL LABORATORY PROGRAM ANNOUNCEMENT NUMBER: LAB 23-2954

ANNOUNCEMENT TYPE: INITIAL

Announcement Issue Date:	**January 18, 2023**
Submission Deadline for Pre-Proposal:	**March 7, 2023 at 5:00 PM Eastern Time** **A Pre-Proposal is required.** **Pre-Proposals must be submitted by an authorized institutional representative**
Pre-Proposal Response Date:	**April 11, 2023 at 11:59 PM Eastern Time**
Submission Deadline for Proposals:	**May 31, 2023 at 5:00 PM Eastern Time**

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UPDATES AND REMINDERS

RECOMMENDATION

The Department of Energy (DOE) Office of Science (SC) encourages you to register in all systems as soon as possible. You are also encouraged to submit letters of intent, pre-proposals, and proposals before the deadline.

CURRENT AND PENDING SUPPORT AND BIOSKETCHES

The instructions for the content of current and pending support and biosketches have changed. Please read the instructions carefully and follow them.

PROMOTING INCLUSIVE AND EQUITABLE RESEARCH (PIER) PLAN

All new and renewal proposals must provide a Promoting Inclusive and Equitable Research (PIER) Plan as an appendix to the research narrative. Please read the instructions in Section IV and the associated review criteria in Section V.

INTERAGENCY FORMATS FOR CURRENT AND PENDING SUPPORT AND BIOGRAPHICAL SKETCHES

Interagency common instructions for preparing current and pending support and biographical sketches are being developed. The Science Experts Network Curriculum Vitae (SciENcv) system at https://www.ncbi.nlm.nih.gov/sciencv/ will be updated to support the forthcoming common instructions and formats. The fillable PDFs at https://nsf.gov/bfa/dias/policy/nsfapprovedformats/ may not be available in the future. When interagency common formats and instructions are promulgated, their use will be required. SC strongly encourages all researchers to use the online SciENcv system to ensure that their documents are prepared in the appropriate format with the least inconvenience.

INDIVIDUALS WHO SHOULD NOT SERVE AS MERIT REVIEWERS

Follow the updated instructions in Section VIII and consider the use of the template available at https://science.osti.gov/grants/Policy-and-Guidance/Agreement-Forms. Do not include this list as part of the biographical sketch.

ACKNOWLEDGMENT OF FEDERAL SUPPORT

SC guidance about how its support should be acknowledged is published at https://science.osti.gov/funding-opportunities/acknowledgements/.

PUBLIC ACCESS

Awards made under this Program Announcement are subject to DOE's Public Access Plan. Full-text versions of scientific publications must be made publicly accessible at no charge to readers.

SC Statement of Commitment

The DOE SC is fully and unconditionally committed to fostering safe, diverse, equitable, and inclusive work, research, and funding environments that value mutual respect and personal integrity. SC is committed to advancing belonging, accessibility, justice, equity, diversity, and inclusion across the portfolio of activities we sponsor. SC's effective stewardship and promotion of safe, accessible, diverse, and inclusive workplaces that value and celebrate the diversity of people, ideas, cultures, and educational backgrounds across the country and that foster a sense of belonging in our scientific community is foundational to delivering on our mission. We are committed to promoting people from all backgrounds, including individuals and communities that were historically underrepresented and minoritized in STEM fields and the activities we sponsor in recognition of our responsibility to serve the public. We also recognize that harnessing a broad range of views, expertise, and experiences drives scientific and technological innovation and enables the SC community to push the frontiers of scientific knowledge for U.S. prosperity and security. Discrimination and harassment undermine SC's ability to achieve its mission by reducing productivity, discouraging, or inhibiting talent retention and career advancement, and weakening the integrity of the SC enterprise overall. SC does not tolerate discrimination or harassment of any kind, including sexual or non-sexual harassment, bullying, intimidation, violence, threats of violence, retaliation, or other disruptive behavior at institutions receiving SC funding or other locations where activities funded by SC are carried out. All applicants and collaborators should familiarize themselves with the SC Statement of Commitment available at https://science.osti.gov/SW-DEI/SC-Statement-of-Commitment.

Updating Your Portfolio Analysis and Management System (PAMS) Profile

All applicants are encouraged to update their profiles in the PAMS website at https://pamspublic.science.energy.gov regularly, at least annually, to ensure SC has your most up to date information. The PAMS profile now requires that individuals provide responses to the demographic related fields. SC strongly encourages personnel at applicant and awardee institutions, including Principal Investigators (PIs), Co-PIs, and other Key Personnel, to provide their demographic information. By providing your demographic information, you are assisting with SC's continued commitment to advancing diversity, equity, and inclusion in its business practices. Alternatively, for information you wish not to disclose, please select, "Do not wish to provide." Your individual demographic information will not be shared with peer reviewers and the information in your PAMS profile is protected by the requirements established in the Federal Privacy Act of 1974. Aggregate, anonymized demographic information may be shared with confidential review committees who are charged to evaluate the quality and efficacy of SC's business practices. For example, summary statistics of all applicants to or award selections from a particular SC solicitation may be reviewed by a Committee of Visitors.

Portable Document Format (PDF) Generation

The research narrative in a proposal must be one single machine-readable PDF file that contains the DOE Title Page, project narrative, all required appendices, and other attachments. This single PDF file may not be scanned from a printed document and must be uploaded in PAMS. This must be a plain PDF file consisting of text, numbers, and images without editable fields,

signatures, passwords, redactions, or other advanced features available in some PDF-compatible software. Do not use PDF portfolios or binders. The research narrative will be read by SC staff using the full version of Adobe Acrobat: Please ensure that the narrative is readable in Acrobat. If combining multiple files into one research narrative, ensure that a PDF portfolio or binder is not created. If creating PDF files using any software other than Adobe Acrobat, please use a "Print to PDF" or equivalent process to ensure that all content is visible in the research narrative. Once a research narrative has been assembled, please submit the combined research narrative file through a "Print to PDF" or equivalent process to ensure that all content is visible in one PDF file that can be viewed in Adobe Acrobat.

Checklist for Avoiding Common Errors:

Item	**Issue**
Page Limits	Strictly followed throughout proposal, including particular attention to: - Project Narrative - Biographical sketches - Data Management Plan (DMP) - Promoting Inclusive and Equitable Research (PIER) Plan - Letter(s) of Collaboration, if any
Personally Identifiable Information	None present in the proposal
Research Narrative	Composed of one PDF file including all appendices
Project Summary / Abstract	Name(s) of applicant, PI(s), PI's institutional affiliation(s), Co-Investigator(s), Co-Investigator's institutional affiliation(s)
DOE Title Page	Follow instructions closely
Budget	Use current negotiated indirect cost and fringe benefit rates
Budget Justification (attached to budget)	Justify all requested costs
Biographical Sketches	Follow page limits strictly and do not include list of collaborators.
Current and Pending Support	Ensure complete listing of all activities including brief abstract of scope of work for all items listed, regardless of the source of support
List of Individuals who Should not Serve as Merit Reviews	Submit as separate file, not converted to PDF as part of the research narrative
Data Management Plans (DMP)	- If referring to an experiment's DMP, describe the relationship to the proposed research - Include a DMP even if no experimental data is expected
Promoting Inclusive and Equitable Research (PIER) Plan	PIER Plans are a new requirement for new and renewal proposals.
PDF Files	Ensure that all PDF files comply with the following standards: - Files must be machine-readable. - Files may not be scanned from a printed document. - Files must be plain PDF files consisting of text, numbers, and images without editable fields, signatures, passwords, redactions, or other advanced features

	available in some PDF-compatible software. - Files must be readable in the full version of Adobe Acrobat - If combining multiple files into one research narrative, ensure that a PDF portfolio or binder is not created. - If creating PDF files using any software other than Adobe Acrobat, please use a "Print to PDF" or equivalent process to ensure that all content is visible.
Institutions capable of being funded through the DOE Field Work System	Do not create new institutions in the PAMS website for any DOE/NNSA National Laboratory or DOE Site. Submissions will be evaluated for technical merit, but any resulting funding, work, or awards will be made under the laboratory or site's contract with DOE. No separate financial assistance awards will be made. No administrative provisions of this Announcement will apply to the laboratory or any laboratory subcontractor.

Section I – DOE NATIONAL LABORATORY OPPORTUNITY DESCRIPTION

ALL INQUIRIES ABOUT THIS ANNOUNCEMENT SHOULD BE DIRECTED TO:

EERC@science.doe.gov

SUMMARY

The Office of Science (SC) seeks proposals for Energy Earthshot Research Centers (EERCs) in support of the Department of Energy's Energy Earthshots™ initiative.[1] The Energy Earthshots drive integrated program development and execution across the Department of Energy's basic science and energy technology offices. They are part of an all-hands-on-deck approach to provide science and technology innovations that address the tough technological challenges required to achieve our climate and economic competitiveness goals.[2,3] The Energy Earthshots will accelerate breakthroughs towards more abundant, affordable, and reliable clean energy solutions. The EERCs will bring together multi-investigator, multi-disciplinary teams to address key basic research challenges facing the Energy Earthshots, with relevance to applied research and development (R&D) activities.

SUPPLEMENTARY INFORMATION

Six Energy Earthshots have been announced so far: Hydrogen Shot™,[4] Long Duration Storage Shot™,[5] Carbon Negative Shot™,[6] Enhanced Geothermal Shot™,[7] Floating Offshore Wind Shot™,[8] and Industrial Heat Shot™.[9] EERC proposals must address only one Energy Earthshot. Given the focus on fundamental research, some of the knowledge gained in an EERC may be relevant to scientific challenges faced by other EERCs, but the proposed project must remain focused on a single Energy Earthshot.

Applicant institutions are strongly encouraged to limit submissions to no more than one pre-proposal for each Energy Earthshot as the lead institution. However, a second pre-proposal can be submitted for up to three of the Energy Earthshot topics; thus, the maximum number of pre-proposals a laboratory may submit as the lead institution is nine. Be aware that following the pre-proposal review, not more than one pre-proposal per Energy Earthshot topic per laboratory will be encouraged to submit a proposal. An individual may not be named as the lead PI (EERC Director) on more than one pre-proposal or proposal.

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[1] https://www.energy.gov/policy/energy-earthshots-initiative
[2] U.S. Innovation to Meet 2050 Goals: Assessing Initial R&D Opportunities (2022). https://www.whitehouse.gov/wp-content/uploads/2022/11/U.S.-Innovation-to-Meet-2050-Climate-Goals.pdf
[3] The U.S. National Blueprint for Transportation Decarbonization: A Joint Strategy to Transform Transportation (2023). https://www.energy.gov/sites/default/files/2023-01/EERE-Decarbonization-Transportation-Report-508.pdf
[4] https://www.energy.gov/eere/fuelcells/hydrogen-shot
[5] https://www.energy.gov/eere/long-duration-storage-shot
[6] https://www.energy.gov/fecm/carbon-negative-shot
[7] https://www.energy.gov/eere/geothermal/enhanced-geothermal-shot
[8] https://www.energy.gov/eere/wind/floating-offshore-wind-shot
[9] https://www.energy.gov/eere/industrial-heat-shot

This Program Announcement to the DOE National Laboratories is being issued before other planned SC funding opportunities related to the cross-cutting Energy Earthshots. Institutions selected for funding as a subaward under this Program Announcement will not be selected for funding for the same scope of work under any other SC funding opportunity.

Program Objective

Each proposal must focus on addressing basic research challenges motivated by one of the six Energy Earthshots listed above. The specific research areas of interest associated with each Energy Earthshot are described below. The scientific knowledge from the basic research supported under this Program Announcement should impact applied research and development efforts currently of interest to the DOE technology offices. This lab call is a collaborative effort across ASCR, BES, and BER. Proposals should be multidisciplinary, addressing more than one SC research program. Additionally, the following common considerations apply to all Energy Earthshots:

Applicants should consider how innovative high-performance and scientific-computing techniques can contribute to advancing the goals of the proposed center. Innovative computing techniques include, but are not limited to, those exploiting leadership-scale computing resources[10] and/or programming environments, frameworks, and mathematical methods for: multi-scale simulations and physics-informed deep learning; uncertainty quantification and verification and validation techniques; processing, reduction, curation, intelligent analysis and integration of massive and heterogeneous data; high-performance edge computing; resilient coordination of distributed sensor networks; large-scale AI and knowledge extraction, including specific techniques for extracting structured information from publications and legacy data, and federated learning; adaptive strategies for controlling the real-time behavior of complex systems and for resilience under extreme conditions; and decision-support for planning and risk mitigation including digital twins. Applicants should also leverage the applications and software technologies developed by DOE's Exascale Computing Project (ECP)[11] to make use of computing at all scales.

Applicants should consider how to leverage data, software, models, and other information from recent and concurrent activities, including those funded by SC, other DOE departmental elements, and other agencies. SC resources include, but are not limited to, those with the Public Reusable Research (PuRe) Data designation[12]. Applicants are encouraged to consult the references posted on each Energy Earthshot's webpage for information on other potentially-leverageable resources.

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[10] For more information on ASCR's user facilities, see https://science.osti.gov/ascr/Facilities/User-Facilities. Several facility upgrade projects are scheduled for completion during the anticipated award periods, including the availability of the Frontier and Aurora exascale supercomputers, see https://science.osti.gov/ascr/Facilities/User-Facilities/Upgrades.

[11] For more information on the Exascale Computing Project, see https://www.exascaleproject.org/.

[12] For more information on SC's Public Reusable Research (PuRe) Data initiative, see https://science.osti.gov/Initiatives/PuRe-Data

In addition to computational research, applicants should consider how experimental facilities supported by BES (https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/BES) and BER (https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/BER) can contribute to the proposed research to accelerate progress towards the Energy Earthshot technical goals.

Hydrogen Shot
Technical Contact: EERC@science.doe.gov
Program Manager to select when submitting a pre-proposal: Jennifer Roizen

The first Energy Earthshot – Hydrogen Shot™ – was announced on June 7, 2021 and establishes an ambitious target of $1 per 1 kg of clean hydrogen in 1 decade, a cost reduction of 80%. The intent of this target is to accelerate innovations and spur demand for clean hydrogen by reducing the cost of its production. This effort is expected to depend on advances in fundamental research. **Research areas within the Hydrogen Shot topic of this solicitation are limited to the themes listed below. Pre-proposals and proposals in other research areas may be declined without review.**

Proposals for this topic area should focus on use-inspired fundamental research designed to observe and understand basic principles and/or formulate technologically relevant concepts in the following thematic areas.

Theme 1: Basic science needs for hydrogen production. Proposals with this thematic focus are expected to advance fundamental science associated with the following approaches for hydrogen production: low- or high-temperature electrolysis, thermal conversion that is amenable to carbon capture and storage, solar thermochemical or photoelectrochemical approaches to water splitting, or hydrogen generation through radiation-assisted approaches to splitting water, methane, or other chemicals. Research may target an understanding of reaction and/or degradation mechanisms, an understanding of defect chemistry and interphase formation, an approach to materials identification and development, or efforts to capture the evolution of systems under operating conditions so proposals may develop experimental characterization techniques and computational and data science approaches.

Proposals ***may*** explicitly address Priority Research Opportunities (PRO) 1, 3, and 4 as identified and defined in the *Basic Energy Sciences Roundtable on Foundational Science for Carbon-Neutral Hydrogen Technologies*. These PROs highlight opportunities to: Discover and Control Materials and Chemical Processes to Revolutionize Electrolysis (**PRO 1**), Elucidate the Structure, Evolution, and Chemistry of Complex Interfaces for Energy and Atom Efficiency (**PRO 3**), and/or Understand and Limit Degradation Processes to Enhance the Durability of Hydrogen Systems (**PRO 4**). All three PROs address fundamental challenges to achieving the Hydrogen Shot's goal of affordable clean hydrogen production from domestic resources.

Theme 2: Basic science needs related to hydrogen sources, sinks, and quantification. Proposals with this thematic focus are expected to enhance or develop methods for quantifying or modeling hydrogen emissions. These emissions may arise from geological hydrogen sources with proposals targeting assessment of the viability of geological hydrogen as a hydrogen source.

Alternatively, proposals may inform evaluations of the environmental and safety aspects of widespread hydrogen production. Relevant studies of hydrogen leaks could range from measuring fluxes from small scale fueling, transfer, and storage facilities up to leaks from a network of hydrogen production and storage facilities, pipelines, and other aspects anticipated as part of widespread hydrogen production. Proposals may incorporate measurements, modeling, including questions of how to scale models to afford information on the global atmosphere, and other methods for determining the magnitude of hydrogen uptake by soils, and potentially oceans, and other surfaces in the environment.

In addition, proposals are encouraged where research is explicitly structured to present basic research that contributes to production related "Key Program Targets 2022-2036" or the "Actions to support clean, affordable, and sustainable hydrogen production" articulated as part of the DOE National Clean Hydrogen Strategy and Roadmap (Draft).

Hydrogen Shot Resources

1. Hydrogen Shot: https://www.energy.gov/eere/fuelcells/hydrogen-shot
2. Hydrogen Shot Roadmap Draft: https://www.hydrogen.energy.gov/roadmaps_vision.html
3. H2@Scale Technical Reports: https://www.energy.gov/eere/fuelcells/h2scale
4. ASCR Resources: https://science.osti.gov/ascr/Facilities, https://www.nersc.gov/systems/perlmutter, https://alcf.anl.gov/aurora, https://www.olcf.ornl.gov/frontier, https://science.osti.gov/ascr/Facilities/User-Facilities/Upgrades
5. DOE Exascale Initiative and the DOE-led Exascale Computing Project: https://energy.gov/downloads/doe-exascale-initiative, https://www.exascaleproject.org, https://www.exascaleproject.org/research/#software
6. Department of Energy (DOE) Town Halls on Artificial Intelligence (AI) for Science: https://www.osti.gov/biblio/1604756
7. Data and Models: A Framework for Advancing AI in Science: https://www.osti.gov/biblio/1579323
8. BES reports listed below are publicly accessible at: https://science.osti.gov/bes/Community-Resources/Reports
    - Basic Energy Sciences Roundtable on Foundational Science for Carbon-Neutral Hydrogen Technologies
    - Basic Energy Sciences Roundtable on Liquid Solar Fuels
    - Basic Energy Sciences Computing and Data Requirements in the Exascale Age (BES Exascale Requirements Review)
9. Consortium: HydroGEN is a consortium of nine DOE National Laboratories that investigates all water splitting technologies, including direct photoelectrochemical and thermochemical methods. HydroGEN is part of the DOE Energy Materials Network and is funded by DOE's HFTO. https://h2awsm.org.
10. Consortium: H2NEW (Hydrogen from Next-generation Electrolyzers of Water) is a consortium of nine DOE National Laboratories that focuses on making large-scale low- and high-temperature electrolyzers, which produce hydrogen from electricity and water, more durable, efficient, and affordable. H2NEW is funded by DOE's Hydrogen and Fuel

Cell Technologies Office (HFTO) in the Office of Energy Efficiency and Renewable Energy (EERE). https://h2new.energy.gov.

Long Duration Storage Shot
Technical Contact: EERC@science.doe.gov
Program Manager to select when submitting a pre-proposal: Andrew Schwartz

The Long Duration Storage Shot™ (LDSS) was announced on July 14, 2021, with an aim to achieve affordable grid storage for clean power—anytime, anywhere—by reducing the cost of grid-scale energy storage by 90% within the decade for systems that deliver 10+ hours of duration. While energy storage deployment for the grid has increased in recent years to support today's level of renewable energy generation, long duration energy storage (LDES) technologies are needed as additional clean, but intermittent energy sources are deployed on the grid. The LDSS is designed to meet that need and considers all types of technologies that store energy for conversion back to electricity – including electrochemical, mechanical, thermal, chemical carriers, or any combination that has the potential to meet the necessary duration and cost targets for grid flexibility. To support a transformed energy grid powered by sources of clean energy, more diverse LDES technology options must be developed and deployed that have significant cost reduction potential, high materials availability and sustainability, sufficient performance, clear societal benefits, potential to support good-paying, high-quality jobs in the US, and in many cases flexible siting independent of geography.

Proposals for this topic should focus on basic research designed to address scientific barriers to broad deployment of LDES and drive innovation leading to reliable and effective clean energy storage on the grid across multiple regions. The scientific knowledge from the basic research supported under this topic should generally impact applied research and development efforts at higher technology readiness levels currently being supported by other DOE offices. As described in the Energy Storage Grand Challenge Roadmap, DOE has invested in over 30+ energy storage technologies and recognizes that basic research is required to address remaining scientific gaps in understanding for many of these technologies across the range of technology readiness levels. Similarly, the Office of Electricity (OE) has launched Storage Innovation 2030 with a goal to quantify the benefits of RD&D activities for the more mature of these LDES technologies while enabling emerging technologies that are particularly promising. Accordingly, basic research focused on scientific discovery and understanding for novel approaches to LDES at the lowest levels of technology readiness, or at higher levels where fundamental science questions are impeding progress, may also be supported where there is the potential to quickly transition to more applied research and development within the timeframe necessary to contribute to meeting the decadal LDSS goal.

For this topic, energy storage is defined as bidirectional conversion of electrical energy and another form of energy (e.g., chemical energy) for the purposes of storing electricity for later use. Basic research is sought to support LDES technology development across the following themes:

Theme 1: Electrochemical energy storage – interconversion of electricity and chemical potential energy of redox active materials by electrochemical means in a device generally with electrodes and a supporting electrolyte. Includes batteries, pseudo-capacitors, flow batteries, and similar devices where the majority of the energy is stored by electrochemical means. Improvements to Li-ion battery technology, including enabling the use of Li metal anodes, are already widely supported across DOE and will NOT be supported.

Theme 2: Electrothermal energy storage – storage of electrical energy by using electricity for heating or cooling processes involving a thermal storage media and subsequent conversion of stored heat energy to electricity using a heat engine or similar device. Thermal storage media include materials that store energy as: (a) sensible heat, (b) latent heat (phase change), and/or (c) thermochemical heat.

Theme 3: Chemical energy storage via energy carriers – interconversion of electricity and the chemical potential energy of an energy carrier via electrochemistry, electrocatalysis, or similar chemical conversion with the energy carrier generally being stored and potentially transported as a pure material or otherwise separate from the conversion device. Hydrogen research in this theme must focus on hydrogen utilization and/or storage; research relevant to hydrogen production technologies will be supported under the Hydrogen Shot™ topic and therefore will NOT be considered in this topic.

Theme 4: Electromechanical energy storage - use of mechanical methods to convert and store electrical energy. These systems include, but are not limited to, pumped water, compressed air, spinning flywheels, and emerging gravity storage systems. Research for electromechanical energy storage using pumped water or compressed air is only of interest where fundamental scientific advances could enable new technology development that greatly expand the geographical and geological locations where these approaches may be applied.

Electrical energy storage that stores electricity directly, such superconducting devices, or solely by interconversion with an electrical field, including dielectric capacitors, are not of interest for this topic and will not be supported. Furthermore, while LDES technologies can include non-bidirectional storage technologies that increase flexibility for generating stations (such as nuclear or fossil energy), such technologies are supported elsewhere within DOE and are specifically not of interest for this topic.

Proposals for this topic should closely integrate fundamental research in materials and chemical sciences with user facility characterization, applied mathematics, and computing to allow for efficient and predictive discovery, design, and characterization of novel materials, processes and systems that could address the ambitious LDSS goals. To do so will generally require the novel integration of multiple data sets and the development of analytic techniques that include but are not limited to: systems modeling and simulation, physics informed ML and AI, uncertainty quantification, verification and validation, data management methods for dealing with large and heterogeneous datasets, edge computing and distributed sensor networks, and adaptive strategies for controlling complex systems under extreme situations. DOE encourages proposals that leverage existing DOE software enhanced by Exascale Computing Project to scale up the performance of current or proposed modeling codes. EERC teams are strongly encouraged to

involve both mathematicians/computer scientists and domain experts in materials and chemistry to ensure multidisciplinary solutions.

Exclusions for the Long Duration Storage topic: Electrical energy storage that stores electricity directly, such superconducting devices, or solely by interconversion with an electrical field, including dielectric capacitors, are not of interest for this topic and will not be supported. Furthermore, while LDES technologies can include non-bidirectional storage technologies that increase flexibility for generating stations (such as nuclear or fossil energy), such technologies are supported elsewhere within DOE and are specifically not of interest for this topic. Finally, research relevant to hydrogen production technologies will be supported under the Hydrogen Shot™ topic and therefore will NOT be considered in this topic.

The focus of this topic is basic science to seed new or support existing technology development pathways to ensure the needed portfolio of LDES solutions within the next decade. While demonstration of the relevance of the scientific results to a LDES application is important and validation that the scientific understanding can be predictably exploited for that application is expected, *exploration of parameter space (e.g., materials, processes, conditions, design approach) primarily to optimize performance and/or reach performance requirements is applied research that will not be supported for this topic*.

Long Duration Storage Shot Resources

1. Energy Storage Grand Challenge: https://www.energy.gov/energy-storage-grand-challenge/energy-storage-grand-challenge
2. Energy Storage Grand Challenge Roadmap: https://www.energy.gov/energy-storage-grand-challenge/articles/energy-storage-grand-challenge-roadmap
3. Long Duration Storage Shot: https://www.energy.gov/eere/long-duration-storage-shot
4. Long Duration Storage Shot Summit: https://www.energy.gov/oe/long-duration-storage-shot-summit
5. BES Basic Research Needs for Next Generation Electrical Energy Storage (2017): https://science.osti.gov/-/media/bes/pdf/reports/2017/BRN_NGEES_rpt.pdf
6. Office of Electricity Storage Innovations 2030 - https://www.energy.gov/oe/storage-innovations-2030
7. ASCR Resources: https://science.osti.gov/ascr/Facilities, https://www.nersc.gov/systems/perlmutter, https://alcf.anl.gov/aurora, https://www.olcf.ornl.gov/frontier, https://science.osti.gov/ascr/Facilities/User-Facilities/Upgrades
8. DOE Exascale Initiative and the DOE-led Exascale Computing Project: https://energy.gov/downloads/doe-exascale-initiative, https://www.exascaleproject.org/, https://www.exascaleproject.org/research/#software

Carbon Negative Shot
Technical Contact: EERC@science.doe.gov
Program Manager to select when submitting a pre-proposal: Boris Wawrik

The Carbon Negative Shot™ calls for basic research on carbon dioxide removal (CDR) to

develop new technologies and/or refine existing approaches to remove carbon dioxide (CO_2) from the atmosphere and store it in stable forms at meaningful scales. These efforts seek to identify and resolve the basic science challenges that prohibit large scale carbon removal, sequestration, and storage mechanisms needed to assist in achieving a net-zero carbon economy. Progress towards this goal requires not only seeking alternatives to petroleum-based products but also active removal of carbon dioxide from the atmosphere in prodigious quantities. Some common CDR approaches that may be pursued include Direct Air Capture (DAC) methods, geologic storage methods, soil sequestration, and/or biomineralization mechanisms, among others. Each approach presents significant challenges, where additional basic research could lead to more efficient methods of carbon dioxide removal at scale and associated measurement and modeling capabilities to verify the quantities removed.

Proposed research within the Carbon Negative Shot topic should address at least one of the following four themes and are encouraged to address potential interfaces of these themes:

Theme 1: Biological sequestration and storage of carbon. Opportunities for enhancing soil carbon storage can be found in areas where active biomineralization (biologically mediated mineral formation) and/or organic matter stabilization occurs. Enhanced methods of soil carbon sequestration, particularly in association with agriculture, represent an enormous potential for CDR. Research to elucidate biological mechanisms among plants and their root-associated microbiomes to enhance carbonate mineralization offer opportunities to enhance soil carbon sequestration and storage and improve soil quality. The primary driver of soil carbon flux out of soils is microbial activity and is often enhanced by human activities. Research is needed to offer ways to reverse this trend. Among the basic science needs in these areas are:

- A better understanding of the genetic mechanisms that control the formation and utilization of extracellular organic matter by microorganisms, how they are influenced by soil physical and chemical conditions, and how living organisms leverage their metabolism to achieve biomineralization in the environment.
- Identifying and characterizing the underlying molecular and genetic features that influence CO2 solubility, super-saturation, carbonate nucleation, and crystal growth at the cellular and microbial community level.
- New insights into plant-microbial inter-species interactions and how they influence the production and interaction with abiotic soil components.
- Identification of principles of plant metabolism and genetics that can be leveraged to enhance interaction with microbes, thereby leading to enhanced soil carbon stabilization.
- Understand the contribution of mineral weatherization and/or mineral enhancements and its interplay with biological processes impacting carbon sequestration in soils.

Theme 2: Abiotic sequestration and storage of carbon. There is a potential to store significant amounts of carbon in inorganic soil carbon stocks and geological reservoirs. Fundamental research and technologies are needed that will complement existing applied research efforts to identify, assess, and characterize suitable storage facilities. These include but not limited to National Risk Assessment Partnership (NRAP), Science-informed Machine Learning for Accelerating Real-Time Decisions in Subsurface Applications (SMART) Initiative, and Energy Data eXchange (EDX). Basic research needs in this area include:

- Better reservoir characterization and simulation of reactive porous flow within subsurface

reservoirs which leverage existing and new multiscale, multi-physics models capturing the rates of solid carbonate precipitation or use digital twins to develop predictive models under different scenarios. Could include uncertainty quantification and verification and validation techniques; processing, reduction, curation, intelligent analysis and integration of massive and heterogeneous data; high performance edge computing; resilient coordination of distributed sensor networks; large-scale AI and knowledge extraction, including specific techniques for extracting structured information from publications and legacy data and federated learning.

- AI/ML applications for real time decision making to improve safety, enhance the speed of well operations, better optimization of injection rates and storage efficiency of reservoirs, managing stress rates and well bore failure, and mitigating risks associated with CO_2 leakage from injection sites.
- Understanding of the factors that enhance mineralization and weatherization of carbonate minerals in soils and subsurface environments
- Better characterization of chemical reactions between the carbonated fluid and different mineral species in the reservoir rocks, basic research in improvement of carbon absorption rate in subsurface reservoirs, characterization of new and currently unused reservoir rock types including subsurface saline aquifers.

Theme 3: Coupled experimental and computational research to better understand the fundamental kinetics of carbonization and CO_2 reactivity. Although many CDR approaches have been proposed for carbon dioxide removal, the scope of this theme is limited to use-inspired fundamental science that can advance the following approaches: direct capture of CO_2 from dilute sources (e.g., ambient air and surface waters that concentrate CO_2 from air), including the use of sorbent and solvent technologies and durable storage of CO_2 (e.g., conversion of CO_2 to durable forms) which includes CO_2 incorporation in earth materials (enhanced mineralization).

- Discover, understand, design, and control energy and mass transfer mechanisms to drive processes in separation systems, such as to regenerate capture media or to accelerate chemical-materials processes that influence CO_2 capture rate capacity and rates of CO_2 capture and desorption, under a wide range of environmental conditions (e.g., temperature and humidity).
- Mechanisms that employ electrochemical, magnetic, photo-induced, or reactive steps, or a synergistic confluence of such steps, are encouraged.
- Understand the fundamental materials and chemical mechanisms that lead to chemical, physical, and/or structural changes of separations media and cause the degradation of performance and durability.
- Couple mechanistic studies with the design and synthesis of innovative, robust capture materials and chemical processes that selectively capture, or capture and convert, CO_2 at high rates and require minimum energy for either release or conversion into a useful material, fuel or chemical via non-thermal, low-energy processes (compared to existing commercial processes).
- Characterization of different CO_2 phases and mechanisms of delivery

Theme 4: Measurement, monitoring, and validation. All approaches to CDR will require robust methods to measure and quantify CO_2 removal and storage to ensure accountability and

the proper functioning of a carbon marketplace. Basic research is this area would focus on developing the necessary CO_2 quantification tools, data-driven models, and robust methods that would enable assessment of CDR. Among the basic science needs are:

- New CO_2 quantification tools to measure point source carbon sequestration, storage and conversion for direct air, soil and geological mechanisms of carbon capture and dynamic methods to improve the accuracy of estimating baseline CO_2 fluxes. New capabilities are needed to track and quantify carbon forms within a wide variety of solid, liquid and environmental media such as soils and subsurface materials, in addition to gas flux measurements. When possible, autonomous data collection and transmission procedures should be developed to reduce costs and physical labor requirements.
- Airborne or geophysical systems to correlate and/or extrapolate point source measurements with larger scale measurements, particularly in environmental or geologic systems.
- Modeling capabilities to integrate measurement technologies and evaluate larger landscape-scale potential for and impacts of carbon sequestration efforts, particularly in soil and geologic systems.

Across all areas, applicants should consider how to best leverage and advance the state of the art in computational modeling and AI for understanding relevant physical systems at all scales as well as how AI and computational techniques can optimize the design and control of future CDR technologies. Innovative activities modeling and optimizing the global impact of the CDR methods under investigation as they might be deployed over the coming decades, including consideration, when relevant, of the availability of renewable energy sources and materials with supply-chain challenges, should be included to continually inform the goals of EERC's work.

Carbon Negative Shot Resources

1. Bettin, G., et al. Real Time Decision Making for the Subsurface, Carnegie Melon University (2019).
2. IEA. CO2 Capture and Utilisation (2022). IEA, Paris https://www.iea.org/reports/co2-capture-and-utilisation, License: CC BY 4.0
3. U.S. DOE. Foundational Science for Carbon Dioxide Removal Technologies (2022). Office of Basic Energy Sciences Roundtable (https://science.osti.gov/bes/Community-Resources/Reports)
4. U.S. DOE. Carbon Cycling and Biosequestration, Integrating Biology and Climate through Systems Science (2008). Office of Biological and Environmental Research, DOE-SC-108 (https://science.osti.gov/ber/Community-Resources/BER-Workshop-Reports)
5. U.S. DOE. Fossil Energy and Carbon Management Strategic Vision (2022). Office of Fossil Energy and Carbon Management (https://www.energy.gov/sites/default/files/2022-04/2022-Strategic-Vision-The-Role-of-Fossil-Energy-and-Carbon-Management-in-Achieving-Net-Zero-Greenhouse-Gas-Emissions_Updated-4.28.22.pdf)
6. U.S. DOE. Rules and Tools Crosswalk: A compendium of Computational Tools to Support Geologic Carbon Storage Environmentally Protective UIC Class IV Permitting (2022). DOE-NETL-2022/3731. (https://www.osti.gov/biblio/1870412)
7. U.S. DOE. Carbon Transport and Storage R&D Priorities for Repurposing Infrastructure (2022). Office of Fossil Energy and Carbon Management. DOE/NETL-2022/3789

(https://www.energy.gov/sites/default/files/2022-11/%5BWORKSHOP%5D-Carbon-Transport-and-Storage-R%26D-Priorities-for-Repurposing-Infrastructure.pdf)

8. National Risk Assessment Partnership (NRAP): https://edx.netl.doe.gov/nrap/
9. Science-informed Machine Learning for Accelerating Real-Time Decisions in Subsurface Applications (SMART) Initiative: https://edx.netl.doe.gov/smart/
10. Energy Data eXchange (EDX): https://edx.netl.doe.gov/

Enhanced Geothermal Shot
Technical Contact: EERC@science.doe.gov
Program Manager to select when submitting a pre-proposal: Barbara Gail McLean

Heat, water, and permeability (ability for fluid to flow through rock)—the principal elements needed to capture geothermal energy—can support cost-competitive rates of energy extraction when found together and in sufficient amounts. While heat exists everywhere on Earth, some locations lack adequate water and/or permeability to make it accessible. Enhanced Geothermal Systems (EGS) can be created where there are hot rocks (temperatures > ~150°C), but where favorable amounts of permeability and/or water do not exist. These reservoirs are created by first drilling wells and then pumping water to create permeability, in a process called EGS reservoir stimulation. The new EGS reservoir then has the three principal elements necessary for water to be circulated continuously and be used for electricity production or direct use. While there are technically over five terawatts of geothermal energy potential in the United States, enough to meet the electricity needs of the entire world many times over, most is in areas accessible only via new humanmade geothermal reservoirs such as EGS.

The Enhanced Geothermal Shot™ is a DOE-wide effort to dramatically reduce the cost of EGS by 90%, to $45 per megawatt hour by 2035. Investments in EGS can unlock affordable clean energy for over 40 million American homes and exponentially increase opportunities for geothermal heating and cooling solutions nationwide. However, advancing EGS toward this goal will require fundamental research and innovation in a variety of themes.

Proposals for this topic area should focus on use-inspired fundamental research aimed at overcoming the largest challenges in deploying cost effective EGS. To reduce the cost of EGS operations, basic science advances are needed to enable coupled high-precision observation and high-accuracy prediction of subsurface reservoirs and novel material development.
Proposed research within the Enhanced Geothermal Energy Earthshot topic should address at least one of the following three themes:

Theme 1: Experimental and computational efforts to understand mesoscale to regional subsurface constitutive mechanics and fluid injection response in EGS environments. This theme focuses on fundamental science to improve understanding of the collective properties, structures, and dynamical behavior of interacting fracture-fluid systems based on micro seismicity and other signatures to enable prediction, and ultimately control, of the multiphase physical/chemical interactions governing fluid permeability/heat extraction in EGS systems. To achieve the highest impact, fundamental research proposed for this theme should couple

experiment, computation, and field testing and validation. Prospective PIs are strongly encouraged to address Grand Challenge, Priority Research Directions, and Crosscutting Themes and Approaches laid out in "Controlling Subsurface Fractures and Fluid Flow: A Basic Research Agenda" including:

- Imaging subsurface stress
- Reactive flow in fractured systems
- Chemical mechanical coupling in stressed rocks
- Exascale computational methods for heterogeneous time-dependent geologic systems (both physics-based models and AI/ML approaches) including:
    - Exascale digital representation and multiphysics simulations of the subsurface environment including fluid leakage and chemical reaction near the borehole, impact of permeability evolution on reservoir scale heat and energy transport, and improved prediction of potential wellbore failure.
    - Exascale computational modeling and simulation of fracture interaction and propagation and prediction of microseismic events associated with fluid injection to elucidate relationships between microseismicity and permeability.

Exclusions for Theme 1: Proposed research for this theme that focuses only on modeling and that lacks active validation efforts in field-scale EGS environments may be declined without merit review. Similarly, projects that focus on experimental/field research without incorporation of advanced computational and data science approaches may be declined without merit review.

Theme 2: Innovative approaches for EGS data collection and analysis. This theme focuses on development and use of methods that can improve monitoring and characterization of subsurface flow pathways through novel integration of multiple data sets (geophysical, geochemical, geological), such as:

- Novel data analysis including processing, reduction, curation, and intelligent analysis; uncertainty quantification and verification and validation techniques; and integration of massive and heterogeneous data using novel AI/ML tools including physics informed machine learning.
- Novel field data collection methods including surface or in situ approaches for high-precision assessment and monitoring of the state of stress at a variety of scales (e.g., borehole, inter-well, reservoir), using novel computational tools and analyzing the results, possibly in real-time, to infer the evolution of the fracture network.
- New approaches for high resolution tracking of different parameters before, during, and after stimulation and for well integrity monitoring including but not limited to in situ temperature measurement, stress, fracture mapping, etc.

Theme 3: Understanding materials behavior and geochemical/geomechanical processes in EGS wellbore environments. This theme addresses fundamental science for understanding and predicting behavior of materials in (bio)corrosive hydrothermal environments under high pressures and temperatures to better understand borehole conditions. Such research could facilitate the design and deployment of tools and techniques that can improve EGS development

efficiency by reducing/eliminating costs associated with equipment failure from catastrophic high temperature damage. Materials of interest for this theme include but are not limited to:

- High temperature electronic components,
- High temperature elastomers or materials that can replace the functionality of elastomers,
- Coatings on downhole components that can survive long duration exposure to high temperature (e.g., wireline, casing, etc.),
- Materials or processes that could reduce cost by reducing and/or eliminating the need for well construction materials (e.g., cement),
- Processes or materials that can reduce life cycle costs of a geothermal well.

This solicitation seeks to support use-inspired fundamental research to advance understanding rather than to address commercial opportunities. Pre-proposals and proposals for research related to commercial activity may be declined without merit review.

Exclusions for the Enhanced Geothermal topic: Pre-proposals and proposals considered *out of scope* for this topic include, but are not limited to, projects that:

- Lack a primary focus on settings, tools, or processes relevant to EGS and instead address other systems such as oil and gas or carbon capture utilization and storage (CCUS) settings.
- Do not specifically and convincingly enhance potential deployment of EGS in settings consistent with those found in the U.S.
- Focus on sensor development without strong connections to Themes 1-3 above.

Enhanced Geothermal Shot Resources

1. U.S. DOE. GeoVision: Harnessing the Heat Beneath Our Feet Executive Summary (2019). Geothermal Technologies Office.
2. Utah Forge (https://utahforge.com/)
3. EGS Collab (https://www.energy.gov/eere/geothermal/egs-collab)
4. Geothermal Data Repository (https://gdr.openei.org/)
5. Basic Energy Sciences Roundtable on Controlling Subsurface Fractures and Fluid Flow

Floating Offshore Wind Shot
Technical Contact: EERC@science.doe.gov
Program Manager to select when submitting a pre-proposal: Hal Finkel

Offshore wind is well-suited to provide clean energy to densely populated coastal regions, which have high energy demand but limited space for utility-scale land-based clean energy and transmission. However, about two-thirds of the United States' offshore wind potential exists over bodies of water too deep for "fixed-bottom" wind turbine foundations that are secured to the sea floor. Harnessing power over waters hundreds to thousands of feet deep requires floating offshore wind technology—turbines mounted to a floating foundation or platform that is anchored to the seabed with mooring lines. These installations are among the largest rotating machines ever constructed. Innovations from basic scientific research are needed to increase the

efficiency and resilience of floating offshore-wind technology and enable deployment in ever-more-punishing maritime environments. The Floating Offshore Wind Shot™ seeks to reduce the cost of floating offshore wind energy by at least 70%, to $45 per megawatt-hour by 2035 for deep sites far from shore. The focus areas for basic science research include:

Theme 1: Materials, Modeling, and Control for Floating Wind Turbines. Research on materials adapted for the challenging maritime environment of offshore wind farms, and the overall structure of the wind turbines. Areas of interest include:

- Predicting and understanding advanced functional materials for structural components, turbine blades, magnets, power electronics, cables, and conductors with improved performance such as increased resiliency and longer lifetime, lighter weight with higher mechanical strength, lower cost, reduced maintenance, greater safety, or similar parameters.
- Understanding fundamental phenomena that could enable the development of components for floating offshore wind installations from materials with 1) greater sustainability and/or earth abundancy or 2) with advanced manufacturing processes that support production at scale and/or recycling.
- Understanding, predicting, and preventing corrosion and other chemical effects from the saltwater environment.
- Understanding fracturing and other limiters on long-term lifespan for the blades and/or other components and predicting materials with tolerance to wind speed and turbulence, variable temperature (icing), and precipitation.
- Modeling of impacts of extreme conditions on the turbines, including the impact on anchoring components, turbine blades, and turbine operations.
- Creating novel approaches to automated resiliency, repair, and/or control to enhance lifetime and/or efficiency, including the use of AI and advanced computational methods.
- Understanding fundamental phenomena that could enable the creation of a control system with enhanced sensors for measuring the environment and monitoring components to then adapt operations and maintenance.

Theme 2: Modeling and Measuring the Wind-Farm and Surrounding Environment. Research on the local and global environment and its interactions with collections of wind turbines to inform design, efficiency, and potential siting of offshore floating wind farms. Areas of interest include:

- Improved capabilities and computational performance of multi-scale coupled atmospheric-ocean models for characterizing atmospheric, ocean, and coastal processes relevant to offshore floating wind deployments on sub-seasonal to multi-decadal time scales. Areas of relevance include:
    - Improved understanding and model representation of atmospheric and oceanic processes important to simulations of hub-height wind speed and wind shear including wind regime shifts in the lower troposphere, atmospheric stability and stratification, low-level jets, boundary layer depth, boundary layer turbulence, air-sea fluxes, mesoscale ocean features, and stratification and stability of the upper ocean.

    - Improved techniques for modeling probabilities and characteristics (e.g., frequency, intensity) of extreme conditions (e.g., atmospheric rivers, winter storms, tropical cyclones, extreme winds, extreme wave heights, extreme precipitation, icing) in regions relevant to floating offshore wind and how these will evolve with climate change.
    - New techniques for two-way coupling and/or parameterization of floating offshore wind farms in earth system models to understand impacts of wind farms on local and large-scale atmospheric and oceanic circulations over short term and long term (i.e., up to decadal scales).
- Modeling of the interaction of a system of wind turbines, including the adaptation of land-based models for wakes and aerodynamics to larger turbines and the maritime environment.
- New techniques for coupling modeling and measurements of floating offshore wind farms and the surrounding environment. Areas of relevance include:
    - Understanding fundamental phenomena that could enable improved data assimilation techniques for wind applications.
    - Observing System Simulation Experiments (OSSEs) to inform the development of next generation in situ and remote sensing instruments for offshore wind.
    - Development of digital twins of floating offshore wind farms, including assimilation of observational data, edge computing, artificial intelligence/machine learning, and high-resolution physically based modeling to inform design, optimization, and control of the wind farms, individual turbines, and the control systems.
    - Development of improved metrics and diagnostics for model simulations using existing or new remote sensing and in situ measurements including novel algorithms or analysis techniques, application of machine learning, and/or scaling techniques.

Theme 3: Transmission, Co-Generation, and Storage. Energy generated at sea needs to be stored and/or transmitted back to land where it contributes to the power grid. As floating turbines are positioned farther from land, the challenges associated with storage and transmissions compound. These challenges lead to research opportunities for:

- Developing new materials and components, advanced computational modeling and algorithms, and/or novel system designs, including offshore energy storage, to enable cost effective transmission from offshore wind sources that minimizes energy loss during transmission, provides reliable power to the onshore grid to meet demand, and addresses challenges associated with upgrading onshore connection and transmission infrastructure.
- Understanding and predicting materials and/or developing techniques for power electronics adapted for remote marine environments enabling cost effective transmission, including high voltage direct current (HVDC) and offshore transmission design options.
- Developing or improving techniques enabling integrated modeling of the evolving energy system, demands, and connected and interdependent infrastructures; systems resilience under climate and compounding stressors and influences; and capacity for integration of offshore wind energy resources in context of broader energy system transitions
- Understanding fundamental phenomena that could enable co-generation technologies for

cost effective deployment offshore on floating platforms, such as hydrogen or ammonia generation, carbon capture with fuel production, water desalination, energy storage for maritime usage, or similar alternatives to electricity transmission to the onshore electrical grid.

Note that research can be proposed that is motivated by innovative approaches to offshore wind power, including approaches that represent a significant departure in design from current approaches.

Floating Offshore Wind Shot Resources

1. Floating Offshore Wind Shot: https://www.energy.gov/eere/wind/floating-offshore-wind-shot
2. Floating Offshore Wind Shot Fact Sheet: https://www.energy.gov/sites/default/files/2022-09/floating-offshore-wind-shot-fact-sheet.pdf
3. Offshore Wind Energy Strategies (2022). https://www.energy.gov/sites/default/files/2022-01/offshore-wind-energy-strategies-report-january-2022.pdf
4. 2020 Cost of Wind Energy Review (2022 Revision). https://www.nrel.gov/docs/fy22osti/81209.pdf
5. Transmission Alternatives for California North Coast Offshore Wind, Volume 4: Cost-Benefit Analysis Report (2022). https://doi.org/10.2172/1865116
6. National Offshore Wind Research and Development Roadmap Version 3.0 (2021). https://nationaloffshorewind.org/wp-content/uploads/Roadmap-3.0-June-30-2021.pdf
7. The Netherlands' Long-Term Offshore Wind R&D Agenda (2019). https://www.topsectorenergie.nl/en/nieuws/netherlands-long-term-offshore-wind-rd-agenda
8. Workshop on Research Needs for Offshore Wind Resource Characterization (2019). https://doi.org/10.2172/1572142
9. Consortium: The National Offshore Wind Research and Development Consortium, established in 2018, is a not-for-profit public-private partnership focused on advancing offshore wind technology in the United States through high-impact research projects and cost-effective and responsible development to maximize economic benefits. https://www.energy.gov/eere/wind/national-offshore-wind-rd-consortium

Industrial Heat Shot
Technical Contact: EERC@science.doe.gov
Program Manager to select when submitting a pre-proposal: Dawn Adin

Decarbonizing the U.S. industrial sector—defined here as the energy-consuming manufacturing sector that consists of all facilities and equipment used for producing, processing, or assembling goods—is a challenge due to the diversity of energy inputs and the wide array of industrial processes and operations that need to be considered. In 2020, the industrial sector accounted for 33% of the Nation's primary energy use and 30% of energy-related carbon dioxide (CO_2) emissions. Many industries use heat to transform materials into useful products including

removing moisture, separating chemicals, treating metals, melting plastics, and much more. This industrial heat accounts for nearly half of the emissions in industry—8% of the entire U.S. emission footprint—and 90% of the heat produced is from burning fossil fuels.

The Industrial Heat Shot™ was launched to reduce emissions from the energy-intensive process of industrial heating by developing cost-competitive industrial heat decarbonization technologies with at least 85% lower greenhouse gas emissions by 2035. Achieving this goal would help put the American industrial sector on course to reduce its carbon-equivalent emissions by 575 million metric tons by 2050.

Innovative and novel approaches are needed to achieve the success metrics proposed through the Industrial Heat Shot. Basic research will enable the development of innovative low- or no-heat process technologies to decarbonize industrial heat, and the EERCs should aim to be a key driver of this energy transition. EERCs supporting the Industrial Heat Shot will provide a platform for collaborative research to tackle basic science challenges in support of the development of cost-competitive industrial heat decarbonization technologies to lower greenhouse gas emissions. Several use-inspired fundamental research themes were identified as critical to achieving the Industrial Heat Shot targets. These include:

Theme 1: Reduce the carbon footprint of heating. Fundamental knowledge to generate, exchange, or conserve heat without combustion of fossil fuels, to facilitate the transition to low-emissions heat sources and reduce total greenhouse gas (GHG) emissions.

Theme 2: Develop alternatives to heat-requiring processes and/or reduce requirements for thermal energy. Fundamental knowledge underlying new chemistries, physical interactions, materials, and/or biotechnological approaches to provide new strategies for making products, while reducing GHG emissions. Such strategies should eliminate or substantially reduce the use of heat.

Theme 3: Advance opportunities for heat recovery and use. Fundamental knowledge to improve materials and processes to use heat more efficiently, to limit heat loss, and/or to recover, store, and deploy heat from systems for more circular and sustainable industrial production.

Proposed EERCs should address at least one of these themes through research that may include, but are not limited to, the following topic areas:

- Develop revolutionary new energy deposition methods to replace conventional approaches, such as combustion, to heating. Examples could include use of photons (such as microwave radiation or other parts of the spectrum), electricity, low temperature plasmas, or other methods to pinpoint delivery and recovery of energy. This could include development of designer thermal materials with properties intimately connected to different heating modalities/technologies, functionalization of molecules with optically active moieties to enable localized heating, plasmonic approaches to localized optical heating, reducing the amount of heating needed by enabling photocatalysis or

photoelectrocatalysis, etc.

- Develop processes that exploit low-temperature synthesis and processing routes of bulk materials, such as C–H bond activation or activation of assembly precursors, to drive materials transformations and manufacturing. This will require fundamental knowledge of how to synergistically couple electrical, radiative, and mechanical energy at primary activation sites to selectively target and control transformations under realistic conditions and/or with reduced complexity of processing steps.
- Develop innovative catalysis and separations processes that significantly reduce the amount of heating needed (e.g., photochemistry, biochemistry, mechanochemistry, electrochemistry, etc.). Processes could involve the production of high-value chemicals or critical materials. Research approaches could include:
    - Innovative catalytic and separation processes that aim to maximize the atom and energy efficiency of chemical transformations involving low-carbon fuels and feedstocks for heat production, which could include clean hydrogen fuels and feedstocks, biofuels, and/or biofeedstocks.
    - Improved understanding of the molecular-level mechanism and energetics involved with the coupling of electrical, thermal, radiative, and mechanical energy to target low-temperature conversions and direct the process selectively, for instance, through development of tandem/sequential reactions.
    - Direct coupling of photochemical processes with infrared harvesting to achieve selective chemical transformations at modest temperatures by efficiently utilizing the entire solar spectrum.
- Develop multiscale computational, modeling, and simulation tools to improve process efficiency, innovation, and intensification. Modeling may range from digital twins of full systems to individual materials, chemistries, and/or components.
- Use of biomanufacturing – using microorganisms or cell-free biomolecular systems – to produce materials and/or chemicals requiring lower overall energy input than currently used technologies. Topics could take advantage of the design-build-test-learn cycle to accelerate the development of a variety of new bioprocesses to produce valuable, commodity compounds that currently require significant heat input for their manufacturing (e.g., oleochemicals, ammonia, etc.).
- Understand the fundamental processes that impact the challenges associated with scaling up of biological and chemical processes relevant to reducing heat from industrial processes.

Industrial Heat Shot Resources

1. Basic Research Needs for Transformative Manufacturing (2020). https://science.osti.gov/-/media/bes/pdf/reports/2020/Manufacturing_BRN_Report_Combined.pdf
2. New Directions for Chemical Engineering (2022). http://nap.nationalacademies.org/26342
3. A Research Agenda for Transforming Separation Science (2019). http://nap.nationalacademies.org/25421
4. Basic Research Needs Workshop for Catalysis Science (2017). https://science.osti.gov/-/media/bes/pdf/reports/2017/BRN_CatalysisScience_rpt.pdf
5. Basic Research Needs Workshop on Synthesis Science for Energy Relevant Technology (2017). https://science.osti.gov/-/media/bes/pdf/reports/2017/BRN_SS_Rpt_web.pdf

6. Sustainable Ammonia Synthesis – Exploring the scientific challenges associated with discovering alternative, sustainable processes for ammonia production (2016). https://science.osti.gov/-/media/bes/pdf/reports/2016/SustainableAmmoniaReport.pdf
7. What would it take for renewably powered electrosynthesis to displace petrochemical processes? (2019) http://dx.doi.org/10.1126/science.aav3506
8. The 2022 Plasma Roadmap: low temperature plasma science and technology (2022). https://doi.org/10.1088/1361-6463/ac5e1c
9. Manufacturing energy and greenhouse gas emissions associated with the production of organic petrochemicals (2023). https://doi.org/10.1021/acssuschemeng.2c05417.

Management, Impact, and Output

The Principal Investigator (PI) on the proposal will serve as the EERC Director. Each EERC proposal must identify a single Director; no co-directorship is allowed. The EERC Director will serve as the primary contact responsible for communications with the DOE Program Manager on behalf of all of the personnel in the EERC.

Each EERC must identify a management structure in the form of an organization chart and a management plan that enable it to function efficiently and to collaborate effectively. The plan should address the highly complex, multidisciplinary nature of the research and inherent challenges in managing a multi-institutional research team, including the need for research evaluation, adding or modifying research partners and projects, succession planning, and sunsetting unproductive or completed research. The management plan must address how research findings in one area will inform research directions in other areas. The plan must address management structure, leadership, and communications responsibilities and authority and should also consider such topics as contingency planning for technical risk, scientific mentoring, training and retention of staff, turnover and succession planning, diversity inclusion, harassment prevention, and scientific misconduct. Key roles should be identified including personnel who would be responsible for implementation of the PIER Plan and DMP. The management plan must demonstrate how early- and mid-career researchers will be incorporated into the management structure and be given opportunities to take on more responsibility and gain management experience. The plan should also describe the communication and coordination among different parts of the EERC, with other EERCs, the broader Earthshot activities, including research or demonstration activities supported by the DOE applied program offices. EERCs must include a scientific advisory committee with industrial representation.

Successful EERCs will fully exploit a “team science” model, working closely together in an integrated, centrally managed, synergistic center to address a well-defined set of scientific challenges. EERCs should be clearly focused on challenges facing the Energy Earthshots, with well-defined 4-year scientific research goals. The EERCs will support integrated, multi-disciplinary teams of researchers performing fundamental science; therefore, dissemination of results through peer-reviewed publications is a necessary measure of success. In addition, DOE anticipates that some EERC basic research will have potential technological value. EERCs are encouraged to explore opportunities to accelerate the transition of promising scientific results to

technology development and commercial applications outside of the EERC; EERC awards must not support applied research and technology development. A variety of methods will be used to regularly assess the ongoing progress of the EERCs.

Note that this Program Announcement places requirements on the Data Management Plan (DMP) appendix in Section IV that supplement the standard requirements found in Section VIII.

PI Meetings

The selected awardees will be expected to attend one annual PI meeting and participate in coordination activities with other Energy Earthshot-related projects. Applicants should anticipate a need for travel to effectively communicate with other researchers and request appropriate funding in their budgets.

Open Science

SC is dedicated to promoting the values of openness in Federally-supported scientific research, including, but not limited to, ensuring that research may be reproduced and that the results of Federally-supported research are made available to other researchers. These objectives may be met through any number of mechanisms including, but not limited to, data access plans, data sharing agreements, the use of archives and repositories, and the use of various licensing schemes.

The use of the phrase "open-source" does not refer to any particular licensing arrangement, but is to be understood as encompassing any arrangement that furthers the objective of openness.

Multi-Institutional Teams

EERCs will bring together multi-investigator, multi-disciplinary teams to address key basic research challenges relevant to one of the Energy Earthshots. EERC teams will be led by a national laboratory and are strongly encouraged to partner with academia, other national laboratories, not-for-profit organizations, or industry. This lab call is a collaborative effort across ASCR, BES, and BER. Proposals should be multidisciplinary, addressing more than one research program.

The lead institution must request more funding from DOE than any other team member. The lead PI of a multi-institutional team must be an employee of the lead institution. If a proposal is received in which the lead institution does not request a greater percentage of the total budget than each of the other institutional partners, team members, or subrecipients, the proposal may be declined without further review.

SC is committed to promoting the diversity of investigators and institutions it supports, as indicated by the ongoing use of program policy factors (see Section V.B.2) in making selections of awards. To strengthen this commitment, proposals are encouraged from multi-institutional

teams that include the participation of MSIs[13] that are underrepresented in the SC portfolio[14] as well as researchers from groups historically underrepresented in STEM.[15]

SC uses two different mechanisms to support teams of multiple institutions.

COLLABORATIVE PROPOSALS

Collaborative proposals will not be accepted under this Announcement.

SUBAWARDS

Multi-institutional teams must submit one proposal from a designated lead institution with all other team members proposed as subawards.

Other Federal agencies, and another Federal agency's FFRDCs[16] may be proposed as subawardees.

Note that the value of any such proposed subaward will be removed from any such prime award: DOE may make separate awards to Federally-affiliated institutions.

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[13] MSI designations are based on the Department of Education eligibility matrix (https://www2.ed.gov/about/offices/list/ope/idues/eligibility.html). MSIs of interest include Asian American and Native American Pacific Islander Serving Institutions (AANAPISIs), Alaska Native and Native Hawaiian Serving Institutions (AANHs), Hispanic Serving Institutions (HSIs), Native American Serving Non-Tribal Institutions (NASNTI), Predominantly Black Institutions (PBIs), Historically Black Colleges and Universities (HBCUs), and Tribally Controlled Colleges and Universities (TCCUs).

[14] Information about Office of Science awards can be found in the Portfolio Analysis and Management System – https://pamspublic.science.energy.gov/WebPAMSExternal/Interface/Awards/AwardSearchExternal.aspx.

[15] https://science.osti.gov/SW-DEI/Community-Resources

[16] An authoritative list of all Federally Funded Research and Development Centers (FFRDCs) may be found at https://www.nsf.gov/statistics/ffrdclist/

Section II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding laboratory work authorizations under this DOE National Laboratory Program Announcement.

Any awards made under this Announcement will be subject to the provisions of the contract between DOE and the awardee National Laboratory.

B. ESTIMATED FUNDING

DOE anticipates that, subject to the availability of future year appropriations, a total of $200 million in current and future fiscal year funds will be used to support four-year awards under this Announcement.

DOE is under no obligation to pay for any costs associated with preparation or submission of proposals. DOE reserves the right to fund, in whole or in part, any, all, or none of the proposals submitted in response to this Announcement.

C. MAXIMUM AND MINIMUM AWARD SIZE

The award size will depend on the number of meritorious proposals and the availability of appropriated funds.

Ceiling

$5,000,000 per year

Floor

$3,000,000 per year

D. EXPECTED NUMBER OF AWARDS

Approximately 10 to 16 awards are expected. The exact number of awards will depend on the number of meritorious proposals and the availability of appropriated funds. Note that awards are planned for each of the 6 topical areas of the Energy Earthshots and that the discipline balance across ASCR, BES, and BER will be an award consideration.

E. ANTICIPATED AWARD SIZE

It is anticipated that award sizes may range from $3,000,000 per year to $5,000,000 per year. The award size will depend on the number of meritorious proposals and the availability of appropriated funds.

F. PERIOD OF PERFORMANCE

DOE anticipates making awards with a project period of four years.

Continuation funding (funding for the second and subsequent budget periods) is contingent on: (1) availability of funds appropriated by Congress and future year budget authority; (2) progress towards meeting the objectives of the approved proposal; (3) submission of required reports; and (4) compliance with the terms and conditions of the award.

G. TYPE OF PROPOSAL

DOE will accept new DOE National Laboratory proposals under this DOE National Laboratory Announcement. Please only submit a PAMS lab technical proposal in response to this Announcement; do not submit a DOE Field Work Proposal (FWP) at this time. SC will request FWPs later from those selected for funding consideration under this Announcement.

Section III – ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS AND TOPICS

This is a DOE National Laboratory-only Announcement. FFRDCs from other Federal agencies are not eligible to submit in response to this Program Announcement (but may be part of a team led by a DOE National Laboratory).

B. COST SHARING

Cost sharing is not required.

Cost sharing is not required of DOE/NNSA National Laboratories, other Federal agencies, another Federal agency's FFRDC, or their subcontractors at any tier. DOE/NNSA National Laboratories, other Federal agencies, and another Federal agency's FFRDC may impose cost-sharing requirements on their contractors subject to their policies and procedures.

Cost sharing, whether required by statute, provided to protect intellectual property rights, or provided voluntarily, will not be considered as a factor during merit review or award selection.

C. ELIGIBLE INDIVIDUALS

Eligible individuals with the skills, knowledge, and resources necessary to carry out the proposed research as a Principal Investigator (PI) are invited to work with their organizations to develop a proposal. Individuals from underrepresented groups as well as individuals with disabilities are always encouraged to apply.

D. LIMITATIONS ON SUBMISSIONS

Applicant institutions are strongly encouraged to limit submissions to no more than one pre-proposal for each Energy Earthshot as the lead institution. However, a second pre-proposal can be submitted for up to three of the Energy Earthshot topics; thus, the maximum number of pre-proposals a laboratory may submit as the lead institution is nine. Be aware that following the pre-proposal review, not more than one pre-proposal per Energy Earthshot topic per laboratory will be encouraged to submit a proposal. An individual may not be named as the lead PI (EERC Director) on more than one pre-proposal or proposal.

- Pre-proposals must include the signature of the National Laboratory Director or their designate. All pre-proposals from one institution must be signed by the same person.
- Pre-proposals in excess of the limited number of submissions may be declined without review.
- Proposals in excess of the limited number of submissions may be declined without review.
- There is no limitation to the number of proposals on which an institution appears as a partner (not the lead institution).
- There is no restriction on the number of pre-proposals or proposals in which an individual may participate as senior/key personnel.

- Proposals that are not submitted with substantially similar titles, teams, researchers, and proposed research to a pre-proposal may be declined without review.

E. OTHER ELIGIBILITY REQUIREMENTS

The lead institution identified in a proposal must be the same lead institution identified in the required pre-proposal. If a proposal is received for which the lead organization has changed since submission of the pre-proposal (see Section IV.B), then the proposal may be declined without further review. The lead PI (EERC Director) should not be changed unless unavoidable and only minor edits should be made, if necessary, to the title of the project. Requests to change the lead PI after a proposal is submitted may result in the proposal being declined unless the request is the result of the lead PI's death, incapacitation, retirement, or relocation. If necessary, the applicant may make changes to other senior/key personnel and other participating institutions, although DOE discourages extensive changes. Proposals for multi-institutional teams must ensure that that the lead institution requests more funding from DOE than any other team member. If a proposal is received in which the lead organization does not request a greater percentage of the total budget than each of the other institutional partners, team members, or subrecipients, the proposal may be declined without further review.

Section IV – PROPOSAL AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST PROPOSAL PACKAGE

Proposal submission instructions are available in this Announcement on the DOE SC Portfolio Analysis and Management System (PAMS). Screenshots showing the steps in DOE National Laboratory proposal submission are available in the PAMS External User Guide, accessible by navigating to https://pamspublic.science.energy.gov and clicking on the "PAMS External User Guide" link.

Proposals submitted outside of PAMS will not be accepted.

B. LETTER OF INTENT AND PRE-PROPOSAL

1. Letter of Intent

Not applicable.

2. Pre-proposal

PRE-PROPOSAL DUE DATE

The pre-proposal due date is printed on the cover of this Announcement.

ENCOURAGE/DISCOURAGE DATE

Pre-proposals will be reviewed for responsiveness of the proposed work to the research topics identified in this Announcement. DOE will send a response by email to each applicant encouraging or discouraging the submission of a proposal by the date indicated on the cover of the Announcement. Applicants who have not received a response regarding the status of their pre-proposal by this date are responsible for contacting the program to confirm this status.

Only those applicants that receive notification from DOE encouraging submission of a proposal may submit proposals. No other proposals will be considered.

The pre-proposal should include, on a separate cover page, the following information:

Title of Pre-proposal
Principal Investigator Name, Job Title
Institution
PI Phone Number, PI Email Address
Laboratory Announcement Number: Indicated on the cover of this Announcement
Name of Energy Earthshot (select one from list): Hydrogen, Long Duration Storage, Carbon Negative, Enhanced Geothermal, Floating Offshore Wind, or Industrial Heat
Relevant Program Offices (select from list): ASCR, BES, BER

This information must be followed by a clear and concise description of the objectives and technical approach of the proposed research. The pre-proposal may not exceed five pages, excluding the cover page, when printed using standard letter-size (8.5 inch x 11 inch) paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point. Figures and references, if included, must fit within the five-page limit.

In addition, the pre-proposal must include, under separate submission, a listing of individuals who should not serve as merit reviewers of a subsequent proposal. Detailed instructions for how to craft such a listing are provided in Section VIII of this Program Announcement. This listing will not count toward the pre-proposal's page limit. The list of individuals must be sent via email to EERC@science.doe.gov.

The pre-proposal must be machine readable. Do not submit a scanned image of a printed document.

PRE-PROPOSAL REVIEW

SC may evaluate all or some portion of pre-proposals to determine their competitiveness within an Energy Earthshot.

Any review will be based on the following criteria:
1. Responsiveness to the objectives of the Announcement.
2. Scientific and technical merit.
3. Appropriateness of the proposed research approaches.
4. Likelihood to impact Energy Earthshot goals.

Any such review will be conducted by no less than three DOE-affiliated personnel, under the direction of Federal program managers chosen for their topical knowledge and diversity of perspective.

Reviews within an Energy Earthshot will be a comparative review with priority given to scientifically innovative and forward-looking basic research with the highest likelihood of success as a proposal. The results of the review will be documented.

Applicants with the highest rated pre-proposals will be encouraged to submit proposals; others will be discouraged from submitting proposals. SC aims to encourage a diverse pool of applicants to submit proposals.

Written feedback about preproposals will be provided upon request after award selections have been announced.

Energy Earthshots with comparatively few pre-proposals may not make use of such pre-proposal reviews. The ratio of encourage/discourage results may differ between Energy Earthshots.

SC is committed to ensuring that a sufficient number of applicants will be encouraged to submit

proposals to foster a competitive merit review of the proposals for each Energy Earthshot. SC's intent in discouraging submission of certain proposals is to save the time and effort of applicants in preparing and submitting proposals with a negligible likelihood of success.

The PI will be automatically notified when the pre-proposal is encouraged or discouraged. The DOE SC Portfolio Analysis and Management System (PAMS) will send an email to the PI from PAMS.Autoreply@science.doe.gov, and the status of the pre-proposal will be updated at the PAMS website https://pamspublic.science.energy.gov/. Notifications are sent as soon as the decisions to encourage or discourage are finalized.

PRE-PROPOSAL SUBMISSION

Pre-proposals are created in the software system of your choice and must be submitted electronically through the DOE SC Portfolio Analysis and Management System (PAMS) website https://pamspublic.science.energy.gov/. You cannot draft or edit a pre-proposal in PAMS.

A PI will only be able to submit the pre-proposal to an authorized institutional official. The pre-proposal may only be submitted to DOE by a user at the PI's institution with the "Submit to DOE" privilege in PAMS.

Applicants are strongly encouraged to inform their DOE Program Manager if teaming arrangements, proposed personnel, topics, or the anticipated title change between submitting the pre-proposal and when a proposal is submitted, to ensure that their proposal is properly linked to their pre-proposal and that reviewers are properly assigned to the proposal.

Detailed instructions about how to submit a pre-proposal are in Section VIII of this Announcement.

C. PROPOSAL SUBMISSION AND CONTENT

1. Summary of Proposal Contents

Each DOE National Laboratory proposal will contain the following sections:

- A Cover Page, entered into PAMS as structured data using the on-screen form
- Budget, entered into PAMS as structured data using the PAMS budget form
- Abstract (one page), entered into PAMS as a separate pdf
- Budget justification, entered into PAMS as a separate pdf
- Proposal, combined into a single pdf containing the following information:
    - Proposal Title Page
    - Table of Contents
    - Project Narrative (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, and responsibilities of key project personnel)
    - Appendix 1: Biographical Sketch(es)
    - Appendix 2: Current and Pending Support

- Appendix 3: Bibliography and References Cited
- Appendix 4: Facilities and Other Resources
- Appendix 5: Equipment
- Appendix 6: Data Management Plan
- Appendix 7: Promoting Inclusive and Equitable Research (PIER) Plan
- Appendix 8: Other Attachments (optional)

SUBMISSION INSTRUCTIONS

Completed proposals must be submitted into the DOE SC Portfolio Analysis and Management System (PAMS) at https://pamspublic.science.energy.gov.

Important Instructions to the Sponsored Research Office of Submitting Institutions: SC requires that you create one single machine readable PDF file that contains the DOE Title Page, project narrative, biographical sketch, current and pending support, bibliography and references cited, facilities and other resources, equipment, data management plan, and other attachments. This single PDF file may not be scanned from a printed document and must be uploaded in PAMS. This must be a plain PDF file consisting of text, numbers, and images without editable fields, signatures, passwords, redactions, or other advanced features available in some PDF-compatible software. Do not use PDF portfolios or binders. The research narrative will be read by SC staff using the full version of Adobe Acrobat: Please ensure that the narrative is readable in Acrobat. If combining multiple files into one research narrative, ensure that a PDF portfolio or binder is not created. If creating PDF files using any software other than Adobe Acrobat, please use a "Print to PDF" or equivalent process to ensure that all content is visible in the research narrative. Once a research narrative has been assembled, please submit the combined research narrative file through a "Print to PDF" or equivalent process to ensure that all content is visible in one PDF file that can be viewed in Adobe Acrobat.

> **WARNING**: The PAMS website at https://pampspublic.science.energy.gov will permit you to edit a previously submitted proposal in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

PROPOSAL DUE DATE

The proposal due date is printed on the cover of this Announcement.

LETTERS

Letters from collaborators or from institutions providing access to data, models, software, equipment, and/or facilities may be appended to your research narrative and are not considered part of the research narrative's page count. Please ensure that letters from collaborators or from institutions providing access to data, models, software, equipment, and/or facilities only describe the nature of the collaboration and/or the access to data, models, software, equipment and/or facilities. Proposals may not include letters of support or recommendation.

2. Abstract

The project summary/abstract is a summary of the proposed activity suitable for distribution to the public and sufficient to permit potential reviewers to identify conflicts of interest. It must be a self-contained document. Provide the name of the applicant, the project title, the PI and the PI's institutional affiliation, any coinvestigators and their institutional affiliations, the objectives of the project, a description of the project, including methods to be employed, and the potential impact of the project (i.e., benefits, outcomes). A sample is provided below:

Project Title A. Smith, Lead Institution (Principal Investigator) A. Brown, Institution 2 (Co-Investigator) A. Jones, Institution 3 (Co-Investigator) Text of abstract

The project summary must not exceed 1 page when printed using standard letter-size (8.5 inch x 11 inch) paper with 1-inch margins (top, bottom, left and right) with font not smaller than 11 point. The one-page project summary/abstract should be placed in a separate, single pdf document and attached on the appropriate screen in PAMS.

If a proposal is recommended for award, the project summary will be used in preparing a public abstract about the award. Award abstracts and titles form a Government document that describes the project and justifies the expenditure of Federal funds in light of the DOE and SC mission statements at https://energy.gov/mission and https://science.osti.gov/about/.

- Do not include any proprietary or sensitive business information.
- DOE may use the abstract may to prepare public reports about supported research.

3. Budget and Justification

The budget must be submitted into PAMS using the PAMS budget form.

Budgets are required for the entire project period. A budget form should be completed for each budget period of the award, and a cumulative budget form for the entire project period will be populated by PAMS. PAMS will calculate the cumulative budget totals for you.

A written justification of each budget item is to follow the budget pages. The budget justification should be placed in a separate, single pdf document and attached on the appropriate screen in PAMS. Further instructions regarding the budget and justification are given below and in the PAMS software.

4. Proposal

DOE TITLE PAGE

(PART OF PROJECT NARRATIVE)

The following proposal title page information may be placed on a plain page. No form is required. This cover page will not count in the project narrative page limitation.

- The project title:
- Applicant/Institution:
- Street Address/City/State/Zip:
- Postal Address:
- Administrative Point of Contact name, telephone number, email:
- Lead PI name, telephone number, email:
- DOE National Laboratory Announcement Number:
- PAMS Pre-proposal tracking number:
- Name of Energy Earthshot (select one from list): Hydrogen, Long Duration Storage, Carbon Negative, Enhanced Geothermal, Floating Offshore Wind, or Industrial Heat
- Relevant Program Offices (select from list): ASCR, BES, BER

Senior/Key Personnel

- Senior/Key Personnel Name, Institution
- Senior/Key Personnel Name, Institution
- Senior/Key Personnel Name, Institution
- **…**

Institution	**Year 1 Budget**	**Year 2 Budget**	**Year 3 Budget**	**Year 4 Budget**	**Total Budget**

PROJECT NARRATIVE

The project narrative **must not exceed a page limit of 40 pages** of technical information, including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard letter-size (8.5 inch x 11 inch) paper with 1-inch margins (top, bottom, left, and right). The font must not be smaller than 11 point. Merit reviewers will only consider the number of pages specified in the first sentence of this paragraph. This page limit does not apply to the Title Page, Budget Page(s), Budget Justification, biographical material, publications and references, and appendices, each of which may have its own page limit defined later in this Announcement.

Do not include any Internet addresses (URLs) that provide supplementary or additional information that constitutes a part of the proposal. Merit reviewers are not required to access Internet sites; however, Internet publications in a list of references will be treated identically to

print publications. See Section VIII for instructions on how to mark proprietary proposal information.

Project Objectives: This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.

Background/Introduction: Explanation of the importance and relevance of the proposed work as well as a review of the relevant literature.

Proposed Research and Methods: Identify the hypotheses to be tested (if any) and details of the methods to be used including the integration of experiments with theoretical and computational research efforts.

Timetable of Activities: Timeline for all major activities including milestones and deliverables.

Management Plan: Proposals must include a project management plan that clearly indicates the roles and responsibilities of each organization and indicates how activities will be coordinated and communicated among team members.

Each EERC must identify a management structure in the form of an organization chart and a management plan that enable it to function efficiently and to collaborate effectively. The plan should address the highly complex, multidisciplinary nature of the research and inherent challenges in managing a multi-institutional research team, including the need for research evaluation, adding or modifying research partners and projects, succession planning, and sunsetting unproductive or completed research. The management plan must address how research findings in one area will inform research directions in other areas. The plan must address management structure, leadership, and communications responsibilities and authority and should also consider such topics as contingency planning for technical risk, scientific mentoring, training and retention of staff, turnover and succession planning, diversity inclusion, harassment prevention, and scientific misconduct. Key roles should be identified including personnel who would be responsible for implementation of the PIER Plan and DMP. The management plan must demonstrate how early- and mid-career researchers will be incorporated into the management structure and be given opportunities to take on more responsibility and gain management experience. The plan should also describe the communication and coordination among different parts of the EERC, with other EERCs, the broader Earthshot activities, including research or demonstration activities supported by the DOE applied program offices. EERCs should include a scientific advisory committee that includes an industrial member.

The Project Narrative comprises the research plan for the project. It should contain enough background material in the Introduction, including review of the relevant literature, to demonstrate sufficient knowledge of the state of the science. The major part of the narrative should be devoted to a description and justification of the proposed project, including details of the method to be used. It should also include a timeline for the major activities of the proposed project, and should indicate which project personnel will be responsible for which activities. There should be no ambiguity about which personnel will perform particular parts of the project, and the time at which these activities will take place.

APPENDIX 1: BIOGRAPHICAL SKETCH

Provide a biographical sketch for the PI and each senior/key person as an appendix to your technical narrative.

- Provide the biographical sketch information as an appendix to your project narrative.
- Do not attach a separate file.
- The biographical sketch appendix will not count in the project narrative page limitation.
- The biographical information (curriculum vitae) for each person must not exceed 3 pages when printed on letter-size (8.5 inch x 11 inch) paper with 1-inch margins (top, bottom, left, and right) with font not smaller than 11 point.

Detailed instructions may be found in Section VIII of this Announcement.

> **WARNING**: These instructions have been significantly revised to require disclosure of a variety of potential conflicts of interest or commitment, including participation in foreign government-sponsored talent recruitment programs.
>
> The PI and each senior/key person at the prime applicant and any proposed subaward must provide a list of all sponsored activities, awards, and appointments, whether paid or unpaid; provided as a gift with terms or conditions or provided as a gift without terms or conditions; full-time, part-time, or voluntary; faculty, visiting, adjunct, or honorary; cash or in-kind; foreign or domestic; governmental or private-sector; directly supporting the individual's research or indirectly supporting the individual by supporting students, research staff, space, equipment, or other research expenses. All foreign government-sponsored talent recruitment programs must be identified in current and pending support.

APPENDIX 2: CURRENT AND PENDING SUPPORT

Provide a list of all current and pending support for the PI and senior/key personnel, including subawardees. Provide the Current and Pending Support as an appendix to your project narrative. Concurrent submission of a proposal to other organizations for simultaneous consideration will not prejudice its review.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

Detailed instructions may be found in Section VIII of this Announcement.

APPENDIX 3: BIBLIOGRAPHY & REFERENCES CITED

Provide a bibliography of any references cited in the Project Narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication.

For research areas where there are routinely more than ten coauthors of archival publications, you may use an abbreviated style such as the *Physical Review Letters* (PRL) convention for citations (listing only the first author). For example, your paper may be listed as, "A Really Important New Result," A. Aardvark et. al. (MONGO Collaboration), PRL 999. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. Provide the Bibliography and References Cited information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 4: FACILITIES & OTHER RESOURCES

This information is used to assess the capability of the organizational resources, including subawardee resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. For proposed investigations requiring access to experimental user facilities maintained by institutions other than the applicant, please provide a document from the facility manager confirming that the researchers will have access to the facility. Please provide the Facility and Other Resource information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 5: EQUIPMENT

List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. Provide the Equipment information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 6: DATA MANAGEMENT PLAN

Provide a Data Management Plan (DMP) as an appendix to the research narrative.

- This appendix should not exceed a page limit of 4 pages including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard letter-size (8.5 inch x 11 inch) paper with 1-inch margins (top, bottom, left, and right)
- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

The standard requirements for a DMP may be found in Section VIII of this Announcement.

In addition, the DMP must specifically address:

- How FAIR (Findable, Accessible, Interoperable, and Reusable)[17] principles will apply to the anticipated data sets, software[18], and models[19] to be developed.
- What developed software, data sets, and models will be made available using an "opensource" licensing arrangement, noting the Software Package Data Exchange (SPDX) identifier(s) (https://spdx.org/licenses/) when possible, and where deviation in this arrangement is expected from The Open Source Initiative's "Open Source Definition" (https://opensource.org/osd), a specific justification must be provided.
- How best practices in scientific software development will be applied to any development activities. For more information on best practices, see Better Scientific Software (https://bssw.io/).

APPENDIX 7: PROMOTING INCLUSIVE AND EQUITABLE RESEARCH (PIER) PLAN

All new and renewal proposals that are not for conference support must provide a Promoting Inclusive and Equitable Research (PIER) Plan as an appendix to the research narrative. The PIER plan should describe the activities and strategies of the applicant to promote equity and inclusion as an intrinsic element to advancing scientific excellence in the research project within the context of the proposing institution and any associated research group(s). Plans may include, but are not limited to: strategies of your institution (and collaborating institutions, if applicable) for enhanced recruitment of undergraduate students, graduate students, and early-stage investigators (postdoctoral researchers, and others), including individuals from diverse backgrounds and groups historically underrepresented in the research community; strategies for creating and sustaining a positive, inclusive, safe, and professional research and training environment that fosters a sense of belonging among all research personnel; and/or training, mentoring, and professional development opportunities.[20] Plans may incorporate or build upon existing diversity, equity, accessibility, and inclusion efforts of the project key personnel or applicant institution(s), but should not be a re-statement of standard institutional policies or broad principles. The complexity and detail of a PIER is expected to increase with the size of the research team and the number of personnel to be supported. Resources about PIER plans are available at https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans.

- Do not attach a separate file.
- This appendix should not exceed a page limit of 3 pages when printed using standard

[17] Wilkinson, M. D. et al. The FAIR Guiding Principles for Scientific Data Management and Stewardship. Sci. Data 3:160018, 2016. https://doi.org/10.1038/sdata.2016.18

[18] Chue Hong, N. P., Katz, D. S., Barker, M., Lamprecht, A-L, Martinez, C., Psomopoulos, F. E., Harrow, J., Castro, L. J., Gruenpeter, M., Martinez, P. A., Honeyman, T., et al. (2022). FAIR Principles for Research Software version 1.0. (FAIR4RS Principles v1.0). Research Data Alliance. DOI: https://doi.org/10.15497/RDA00068

[19] Ravi, N., Chaturvedi, P., Huerta, E.A. et al. FAIR principles for AI models with a practical application for accelerated high energy diffraction microscopy. Sci Data 9, 657 (2022). https://doi.org/10.1038/s41597-022-01712-9

[20] Please see additional information at https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/Q-and-As#definitions.

letter-size (8.5 inch x 11 inch) paper with 1-inch margins (top, bottom, left, and right) This appendix will not count in the project narrative page limitation

APPENDIX 8: OTHER ATTACHMENT

If you need to elaborate on your responses to the PAMS Cover Page, please provide the Other Attachment information as an appendix to your project narrative. Information not easily accessible to a reviewer may be included in this appendix, but do not use this appendix to circumvent the page limitations of the proposal. Reviewers are not required to consider information in this appendix.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS

If selected for award, DOE reserves the right to request additional or clarifying information.

E. SUBMISSION DATES AND TIMES

1. Letter of Intent Due Date

Not applicable.

2. Pre-proposal Due Date

The pre-proposal due date is printed on the cover of this Announcement.

You are encouraged to submit your pre-proposal well before the deadline. Pre-proposals may be submitted at any time between the publication of this Announcement and the stated deadline.

3. Proposal Due Date

The proposal due date is printed on the cover of this Announcement.

You are encouraged to transmit your proposal well before the deadline. Proposals may be submitted at any time between the publication of this Announcement and the stated deadline.

4. Late Submissions

Proposals received after the deadline may not be reviewed or considered for award.

Delays in submitting pre-proposals and proposals may be unavoidable. DOE has accepted late submissions when applicants have been unable to make timely submissions because of widespread technological disruptions or significant natural disasters. DOE has made accommodations for incapacitating or life-threatening illnesses and for deaths of immediate family members. Other circumstances may or may not justify late submissions. Unacceptable

justifications include the following:

- Failure to begin submission process early enough.
- Failure to provide sufficient time to complete the process.
- Failure to understand the submission process.
- Failure to understand the deadlines for submissions.
- Failure to satisfy prerequisite registrations.
- Unavailability of administrative personnel.

You are responsible for beginning the submission process in sufficient time to accommodate reasonably foreseeable incidents, contingencies, and disruptions.

Applicants must contact the Program Office/Manager listed in this Program Announcement to discuss the option of a late submission. Contacting the Program Office/Manager after the deadline may reduce the likelihood that a request will be granted.

DOE notes that not all requests for late submission will be approved.

Section V - PROPOSAL REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for the award; (2) the information required by the Program Announcement has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the Program Announcement, and (5) the proposed project is not duplicative of programmatic work. Proposals that fail to pass the initial review will not be forwarded for merit review and will be eliminated from further consideration.

2. Merit Review Criteria

Proposals will be subjected to scientific merit review (peer review) and will be evaluated against the following criteria.

- Scientific and/or Technical Merit of the Proposed Research;
- Appropriateness of the Proposed Method or Approach;
- Strength of the EERC Management Plan;
- Quality and Efficacy of the Promoting Inclusive and Equitable Research (PIER) Plan;
- Competency of Applicant's Personnel and Adequacy of Proposed Resources; and
- Reasonableness and Appropriateness of the Proposed Budget.

The evaluation process will also include program policy factors such as the relevance of the proposed research to the terms of the DOE National Laboratory Announcement and the agency's programmatic needs, the balance of activities within the program, and the utility of the proposed activities to the broader scientific community. Note that external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Both Federal and non-Federal reviewers may be used, and submission of a proposal constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

The questions below are provided to the merit reviewers to elaborate the criteria:

SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROPOSED RESEARCH

- What is the scientific innovation of the proposed research?
- How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?
- To what extent does the proposed research appropriately balance fundamental science and use-inspired basic research?
- How does the proposed work address critical knowledge gaps for the Energy Earthshot?
- What is the likelihood to impact the Energy Earthshot goals?
- How does the proposed work compare with other efforts in its field, both in terms of

scientific and/or technical merit and originality?
- How is the Data Management Plan suitable for the proposed research? To what extent does it support the validation of research results? To what extent will research products, including data, be made available and reusable to advance the field of research?

Appropriateness of the Proposed Method or Approach

- How logical and feasible are the approaches?
- How does the proposed research employ innovative concepts or methods?
- How well justified and adequately developed are the conceptual framework, methods, and analyses, and how likely are they to lead to scientifically valid conclusions?
- How well does the applicant recognize significant potential problems and how appropriate are the alternative strategies to address these potential problems?
- How well does the proposal justify the need for a well-integrated, collaborative EERC? Consider, for example, whether the stated goals could be achieved by similar researchers working independently, or whether the research challenges to be addressed are those that are likely to be overcome most efficiently by a centrally-managed, well-integrated team.
- How does the proposed work develop or utilize distinctive facilities, capabilities, or approaches?
- How does the EERC connect to the applied research ecosystem for the Energy Earthshot?

Strength of the EERC Management Plan

- How effectively has the applicant presented a comprehensive management plan that includes a strong lead organization, a leadership structure with clear roles and responsibilities, and a qualified and empowered EERC Director?
- How appropriate, substantive, and well-defined are the roles for each team member?
- How well does the organizational structure align with the proposed research efforts?
- How does the management plan address research evaluation, adding or modifying research partners and projects, succession planning, sunsetting unproductive or completed research, and the handling of research misconduct?

Quality and Efficacy of the Promoting Inclusive and Equitable Research Plan

- How is the proposed Promoting Inclusive and Equitable Research (PIER) Plan suitable for the size and complexity of the proposed project and an integral component of the proposed project?
- To what extent is the PIER plan likely to lead to participation of individuals from diverse backgrounds, including individuals historically underrepresented in the research community?
- What aspects of the PIER plan are likely to contribute to the goal of creating and maintaining an equitable, inclusive, encouraging, and professional training and research environment and supporting a sense of belonging among project personnel?
- How does the proposed plan include intentional mentorship and are the associated mentoring resources reasonable and appropriate?

COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES

- What is the past performance and potential of the research team members?
- How well qualified is the research team to carry out the proposed work?
- How adequate are the research environment and facilities for performing the proposed work?
- What evidence does the proposal present that the lead institution and the EERC Director have proven records of success in program and personnel management of diverse teams of scientific and technical professionals for projects of comparable complexity and magnitude?

REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET

- How well are the proposed budget and staffing levels aligned with the proposed work?
- How reasonable and appropriate is the budget for the proposed work?

B. REVIEW AND SELECTION PROCESS

1. Merit Review

Proposals that pass the initial review will be subjected to a formal merit review and will be evaluated based on the criteria above.

2. Program Policy Factors

The Selection Official may consider any of the following program policy factors in making the selection, listed in no order of significance:

- Availability of funds
- Relevance of the proposed activity to SC priorities
- Ensuring an appropriate balance of activities within SC programs and across the Energy Earthshot topics
- Performance under current awards
- Promoting the diversity of supported investigators
- Promoting the diversity of institutions receiving awards
- Increasing participation of institutions historically underrepresented in the SC research portfolio
- Training of the next generation of researchers
- Participation of multi-institutional teams

3. Selection

The Selection Official will consider the findings of the merit review and may consider any of the Program Policy Factors described above.

4. Discussions and Award

The Government may enter into discussions with a selected applicant for any reason deemed necessary. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

It is anticipated that the award selection will be completed by the fourth quarter of Fiscal Year 2023.

Section VI - AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES

1. Notice of Selection

Selected Applicants Notification: DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance.

Non-selected Notification: Organizations whose proposals have not been selected will be advised as promptly as possible. This notice will explain why the proposal was not selected.

2. Notice of Award

A work authorization/contract modification issued by the contracting officer is the authorizing award document.

B. ADMINISTRATIVE AND POLICY REQUIREMENTS

The following additional policy provisions are applicable to this Announcement. The full text of each provision is in Section VIII of this Announcement and may be accessed by navigating to the hyperlinks below:

C. REPORTING

Annual progress reports from the award investigator will be required and will be due 90 days before the end of each budget year.

Section VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS

For help with PAMS, click the "External User Guide" link on the PAMS website, https://pamspublic.science.energy.gov/. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this DOE National Laboratory Program Announcement should reference the Announcement number printed on the cover.

Please contact the PAMS help desk for technological issues with the PAMS system.

Questions regarding the specific program areas and technical requirements may be directed to the technical contacts listed for each program within the DOE National Laboratory Program Announcement or below.

Please contact the program staff with all questions not directly related to the PAMS system.

B. AGENCY CONTACTS

PAMS Customer Support	855-818-1846 (toll-free) 301-903-9610 sc.pams-helpdesk@science.doe.gov
Technical Contact	EERC@science.doe.gov

C. DEPARTMENT OF ENERGY, OFFICE OF INSPECTOR GENERAL HOTLINE:

The Office of Inspector General (OIG) maintains a Hotline to facilitate the reporting of allegations of fraud, waste, abuse, or mismanagement in DOE programs or operations. If you wish to report such allegations, you may call, send a letter, or email the OIG Hotline ighotline@hq.doe.gov. Allegations may be reported by DOE employees, DOE contractors, or the general public. OIG contact information is available at https://energy.gov/ig/services.

Section VIII – SUPPLEMENTARY MATERIAL

A. HOW-TO GUIDES

1. How Consortia May be Used

INCORPORATED CONSORTIA

Incorporated consortia are eligible to apply for funding as a prime recipient (lead organization) or subrecipient (team member).

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 DOE contracting officer. There is no requirement that subawards be formalized into incorporated consortia.

UNINCORPORATED CONSORTIA

Unincorporated consortia (team arrangements) must designate one member of the consortium to serve as the prime recipient/consortium representative (lead organization). There is no requirement that subawards be formalized into unincorporated consortia.

Upon request, unincorporated consortia must provide the DOE 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.

Note that a consortium is applied for in one proposal and results in one award with subawards to consortia members. Multi-institutional teams may, if permitted under this Announcement, submit collaborative proposals with each institution submitting its own proposal with an identical research narrative, resulting in multiple awards to the collaborating institutions.

2. How to Submit Letters of Intent

It is important that the LOI be a single file with extension .pdf, .docx, or .doc. The filename must not exceed 50 characters. The PI and anyone submitting on behalf of the PI must register for an account in PAMS before it will be possible to submit a letter of intent. **All PIs and those submitting LOIs on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.**

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

Submit Your Letter of Intent:

- Create your letter of intent outside the system and save it as a file with extension .docx, .doc, or .pdf. Make a note of the location of the file on your computer so you can browse for it later from within PAMS.
- Log into PAMS and click the Proposals tab. click the "View DOE National Laboratory Announcements" link and find the current announcement in the list. Click the "Actions/Views" link in the Options column next to this Announcement to obtain a dropdown menu. Select "Submit Letter of Intent" from the dropdown.
- On the Submit Letter of Intent page, select the institution from which you are submitting this LOI from the Institution dropdown. If you are associated with only one institution in the system, there will only be one institution in the dropdown.
- Note that you must select one and only one PI per LOI; to do so, click the "Select PI" button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the "Actions" link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose "Select PI."
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the "Invite PI" link at the top left of the "Select PI" screen. You can enter an optional personal message to the PI in the "Comments" box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the LOI. Save the LOI for later work by clicking the "Save" button at the bottom of the screen. It will be stored in "My Letters of Intent" for later editing.
- Enter a title for your letter of intent.
- Select the appropriate technical contact from the Program Manager dropdown.
- To upload the LOI file into PAMS, click the "Attach File" button at the far right side of the screen. Click the "Browse" (or "Choose File" depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the "Upload" button to upload the file.
- At the bottom of the screen, click the "Submit to DOE" button to save and submit the LOI to DOE.
- Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the LOI.

You are encouraged to register for an account in PAMS at least a week in advance of the LOI submission deadline so that there will be no delays with your submission.

> **WARNING**: The PAMS website at https://pamspublic.science.energy.gov/ will permit you to edit a previously submitted LOI in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a

valid submission. Please pay attention to the deadline.

3. How to Submit a Pre-Proposal

It is important that the pre-proposal be a single file with extension .pdf, .docx, or .doc. The filename must not exceed 50 characters. The PI and anyone submitting on behalf of the PI must register for an account in PAMS before it will be possible to submit a pre-proposal. All PIs and those submitting pre-proposals on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

Submit Your Pre-Proposals:

- Create your pre-proposal (called a preproposal in PAMS) outside the system and save it as a file with extension .docx, .doc, or .pdf. Make a note of the location of the file on your computer so you can browse for it later from within PAMS.
- Log into PAMS and click the Proposals tab. click the "View DOE National Laboratory Announcements" link and find the current announcement in the list. Click the "Actions/Views" link in the Options column next to this Announcement to obtain a dropdown menu. Select "Submit Preproposal" from the dropdown.
- On the Submit Preproposal page, select the institution from which you are submitting this preproposal from the Institution dropdown. If you are associated with only one institution in the system, there will only be one institution in the dropdown.
- Note that you must select one and only one PI per preproposal; to do so, click the "Select PI" button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the "Actions" link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose "Select PI."
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the "Invite PI" link at the top left of the "Select PI" screen. You can enter an optional personal message to the PI in the "Comments" box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the preproposal. Save the preproposal for later work by clicking the "Save" button at the bottom of the screen. It will be stored in "My Preproposals" for later editing.
- Enter a title for your preproposal.
- Select the appropriate technical contact from the Program Manager dropdown.
- To upload the preproposal file into PAMS, click the "Attach File" button at the far right side of the screen. Click the "Browse" (or "Choose File" depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the "Upload" button to upload the file.
- At the bottom of the screen, click the "Submit to DOE" button to save and submit the preproposal to DOE.

- Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the preproposal.

You are encouraged to register for an account in PAMS at least a week in advance of the preproposal submission deadline so that there will be no delays with your submission.

> **WARNING**: The PAMS website at https://pamspublic.science.energy.gov will permit you to edit a previously submitted pre-proposal in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

4. How to Prepare and Submit a Proposal

SUBMITTING A PROPOSAL

The following information is provided to help with proposal submission. Detailed instructions and screen shots can be found in the user guide. To find the user guide, click the "External User Guide" link on the PAMS home page. Onscreen instructions are available within PAMS.

- Log into PAMS. From the proposals tab, click the "View DOE National Laboratory Announcements" link and find the current announcement in the list. Click the "Actions/Views" link in the Options column next to this Announcement to obtain a dropdown menu. Select "Submit Proposal" from the dropdown.
- Note that you must select one and only one Principal Investigator (PI) per proposal; to do so, click the "Select PI" button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the "Actions" link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose "Select PI."
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the "Invite PI" link at the top left of the "Select PI" screen. You can enter an optional personal message to the PI in the "Comments" box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the proposal. Save the proposal for later work by selecting "Save" from the dropdown at the bottom of the screen and then clicking the "Go" button. It will be stored in "My Proposals" for later editing. As a minimum, you must complete all the required fields on the PAMS cover page before you can save the proposal for the first time.
- The cover page, budget, and attachments sections of the lab proposal are required by PAMS before it can be submitted to DOE.
- Complete the sections in PAMS one at a time, starting with the cover page and following the instructions for each section.

- Click the "+View More" link at the top of each section to expand the onscreen instructions. On the budget section, click the "Budget Tab Instructions" link to obtain detailed guidance on completing the budget form.
- Save each section by selecting either "Save" (to stay in the same section) or "Save… and Continue to the Next Section" (to move to the next section) from the dropdown menu at the bottom of the screen, followed by clicking the "Go" button.
- If you save the proposal and navigate away from it, you may return later to edit the proposal by clicking the "View My Existing Proposals" or "My Proposals" links within PAMS.
- You must enter a budget for each annual budget period.
- You must also enter a budget for each proposed sub-award. The sub-award section can be completed using the same steps used for the budget section.
- In the attachments section of the lab proposal, the abstract, the budget justification, and the proposal narrative are required and must be submitted as separate files.
- You must bundle everything other than the budget, abstract, and budget justification into one single PDF file to be attached under "Proposal Attachment."
- Do not attach anything under "Other Attachments."
- To upload a file into PAMS, click the "Attach File" button at the far right side of the screen. Click the "Browse" (or "Choose File" depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the "Upload" button to upload the file.
- Once you have saved all of the sections, the "Submit to DOE" option will appear in the dropdown menu at the bottom of the screen.
- To submit the proposal, select "Submit to DOE" from the dropdown menu and then click the "Go" button.
- Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the proposal.
- The proposal will also appear under My Proposals with a Proposal Status of "Submitted to DOE."

Please only submit a PAMS lab technical proposal in response to this Announcement; do not submit a DOE Field Work Proposal (FWP) at this time. SC will request FWPs later from those selected for funding consideration under this Announcement.

PROPOSAL PREPARATION

All files submitted a part of a proposal must be PDF files unless otherwise specified in this Announcement. Attached PDF files must be plain files consisting of text, numbers, and images without editable fields, signatures, passwords, redactions, or other advanced features available in some PDF-compatible software. Do not use PDF portfolios or binders.

Please note the following restrictions that apply to the names of all files attached to your proposal:

- Please limit file names to 50 or fewer characters
- Do not attach any documents with the same name. All attachments must have a unique name.

- Please use only the following characters when naming your attachments: A-Z, a-z, 0-9, underscore, hyphen, space, period, parenthesis, curly braces, square brackets, ampersand, tilde, exclamation point, comma, semi colon, apostrophe, at sign, number sign, dollar sign, percent sign, plus sign, and equal sign. Attachments that do not follow this rule may cause the entire proposal to be rejected or cause issues during processing.

RESUBMISSION OF PROPOSALS

Proposals submitted under this announcement may be withdrawn from consideration by using the PAMS website at https://pamspublic.science.energy.gov. Proposals may be withdrawn at any time between when the applicant submits the proposal and when DOE makes the proposal available to merit reviewers. Such withdrawals take effect immediately and cannot be reversed. Please exercise due caution. After the proposal is made available to merit reviewers, the applicant may contact the DOE program office identified in this Announcement to request that it be withdrawn.

After a proposal is withdrawn, it may be resubmitted, if this Announcement is still open for the submission of proposals. Such resubmissions will only count as one submission if this Announcement restricts the number of proposals from an applicant.

IMPROPER CONTENTS OF PROPOSALS

Proposals submitted under this Announcement will be stored in controlled-access systems, but they may be made publicly available if an award is made. As such, it is critical that applicants follow these guidelines:

- Do not include information subject to any legal restriction on its open distribution, whether classified, export control, or unclassified controlled nuclear information.
- Do not include sensitive and protected personally identifiable information, including social security numbers, birthdates, citizenship, marital status, or home addresses. Pay particular attention to the content of biographical sketches and curriculum vitae.
- Do not include letters of support from Federal officials.
- Do not include letters of support on Federal letterhead. Letters that are not letters of support (such as letters confirming access to sites, facilities, equipment, or data; or letters from cognizant contracting officers) may be on Federal letterhead.
- Clearly mark all proprietary or trade-secret information.

5. How to Prepare a Biographical Sketch

A biographical sketch is to provide information that can be used by reviewers to evaluate the PI's potential for leadership within the scientific community. Examples of information of interest are invited and/or public lectures, awards received, scientific program committees, conference or workshop organization, professional society activities, special international or industrial partnerships, reviewing or editorship activities, or other scientific leadership experiences.

SC requires the use of the format approved by the National Science Foundation (NSF), which may be generated by the Science Experts Network Curriculum Vitae (SciENcv), a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/, and is also available at

https://nsf.gov/bfa/dias/policy/nsfapprovedformats/biosketch.pdf. If an interagency common format for a biographical sketch has been promulgated, that format must be used in a proposal. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats.

Requested information may be appended to a biographical sketch, whether produced from a fillable PDF or in SciENcv.

SC strongly recommends the use of SciENcv to reduce administrative burden by allowing the use of digital persistent identifiers, including the Open Researcher and Contributer ID (ORCiD).

Do not attach a listing of individuals who should not be used as merit reviewers: This information is no longer collected as part of a biographical sketch.

6. How to Prepare a List of Individuals Who Should Not Serve as Reviewers

To assist in identifying individuals who should not serve as merit reviews, provide the following information for each and every senior/key person who is planned to be or is identified in Section A of the proposal budget for the applicant and any proposed subrecipients:

- Advisees (graduate students or postdocs) of the senior/key person
- Advisors of the senior/key person while a graduate student or a postdoc
- Close associates of the senior/key person over the past 48 months
- Co-authors of the senior/key person over the past 48 months
- Co-editors of the senior/key person over the past 48 months
- Co-investigators of the senior/key person over the past 48 months
- Collaborators of the senior/key person over the past 48 months

Do not identify any personnel at the applicant institution or any proposed subrecipient or team institution: Those personnel are prohibited from serving as merit reviewers.

Large collaborations of 10 or more researchers do not require that all collaborators be identified: rather, only list the researchers with whom the senior/key person actually collaborated.

For all identified individuals, provide the following information:

- The senior/key person to whom the individual was an advisee, advisor, close associate, co-author, co-editor, co-investigator, or collaborator, identified by first name and last name
- The individual's first (given) name
- The individual's last (family) name
- The individual's Open Researcher and Contributor ID (ORCiD), if known
- The individual's institutional affiliation spelling out acronyms (For joint appointments, separate each institution with a slash ("/"). Do not list departmental affiliations.)
- The reason for listing the individual (advisee, advisor, close associate, co-author, co-editor, co-investigator, collaborator)
- The year when the individual last was a close associate, co-author, co-editor, co-investigator, or collaborator

You may also provide a list of all senior/key personnel who are planned to be or are identified in Section A of the proposal budget for the applicant and any proposed subrecipients.

The lists do not need to be sorted in any method.

The lists must be submitted in tabular format, preferably as Microsoft Excel (.xls or .xlsx) files.

For your convenience, a template is available at https://science.osti.gov/grants/Policy-and-Guidance/Agreement-Forms. If using the template:

- Do not add tabs to the spreadsheet
- Do not merge the existing tabs
- Do not remove headers
- Fill out the requested headers on both tabs with the same information
- Ensure that given and family names are presented in the correct columns

7. How to Prepare Current and Pending Support

> **WARNING**: These instructions have been significantly revised to require disclosure of a variety of potential conflicts of interest or commitment, including participation in foreign government-sponsored talent recruitment programs.

Current and Pending support is intended to allow the identification of potential duplication, overcommitment, potential conflicts of interest or commitment, and all other sources of support. The PI and each senior/key person at the prime applicant and any proposed subaward must provide a list of all sponsored activities, awards, and appointments, whether paid or unpaid; provided as a gift with terms or conditions or provided as a gift without terms or conditions; full-time, part-time, or voluntary; faculty, visiting, adjunct, or honorary; cash or in-kind; foreign or domestic; governmental or private-sector; directly supporting the individual's research or indirectly supporting the individual by supporting students, research staff, space, equipment, or other research expenses. All foreign government-sponsored talent recruitment programs must be identified in current and pending support.

SC requires the use of the format approved by the National Science Foundation (NSF), which may be generated by the Science Experts Network Curriculum Vitae (SciENcv), a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/, and is also available at https://www.nsf.gov/bfa/dias/policy/nsfapprovedformats/cps.pdf. If an interagency common format for current and pending support has been promulgated, that format must be used in a proposal. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats.

For every activity, list the following items:

- The sponsor of the activity or the source of funding.
- The award or other identifying number.

- The title of the award or activity. If the title of the award or activity is not descriptive, add a brief description of the research being performed that would identify any overlaps or synergies with the proposed research.
- The total cost or value of the award or activity, including direct and indirect costs. For pending proposals, provide the total amount of requested funding.
- The award period (start date – end date).
- The person-months of effort per year being dedicated to the award or activity.

If required to identify overlap, duplication of effort, or synergistic efforts, append a description of the other award or activity to the current and pending support.

Requested information may be appended to current and pending support, whether produced from a fillable PDF or in SciENcv.

SC strongly recommends the use of SciENcv to reduce administrative burden by allowing the use of digital persistent identifiers, including the Open Researcher and Contributer ID (ORCiD).

Details of any obligations, contractual or otherwise, to any program, entity, or organization sponsored by a foreign government must be provided on request to either the applicant institution or DOE.

7. How to Prepare a Data Management Plan

In general, a DMP should address the following requirements:

1. DMPs should describe whether and how data generated in the course of the proposed research will be shared and preserved. If the plan is not to share and/or preserve certain data, then the plan must explain the basis of the decision (for example, cost/benefit considerations, other parameters of feasibility, scientific appropriateness, or limitations discussed in #4). At a minimum, DMPs must describe how data sharing and preservation will enable validation of results, or how results could be validated if data are not shared or preserved.
2. DMPs should provide a plan for making all research data displayed in publications resulting from the proposed research open, machine-readable, and digitally accessible to the public 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 to the public in accordance with the principles stated in the Office of Science Statement on Digital Data Management (https://science.osti.gov/funding-opportunities/digital-data-management. 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.
3. DMPs should consult and reference available information about data management resources to be used in the course of the proposed research. In particular, DMPs that explicitly or implicitly commit 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 Office of Science 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

Office of Science facilities can be found at https://science.osti.gov/user-facilities/.

4. DMPs 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 applicable laws, and regulations. There is no requirement to share proprietary data.

DMPs will be reviewed as part of the overall SC research proposal merit review process. Applicants are encouraged to consult the SC website for further information and suggestions for how to structure a DMP: https://science.osti.gov/funding-opportunities/digital-data-management

8. How to Prepare a Budget and Justification

The following advice will improve the accuracy of your budget request:

- Funds requested for personnel (senior, key, and other) must be justified as the product of their effort on the project and their institutional base salary.
- Funds requested for fringe benefits must be calculated as the product of the requested salary and, if present, the negotiated fringe benefit rate contained in an institution's negotiated indirect cost rate agreement.
- Funds requested for indirect costs must be calculated using the correct indirect cost base and the negotiated indirect cost rate.
- You are encouraged to include the rate agreement used in preparing a budget as a part of the budget justification.
- Do not prepare a budget justification using the expired DOE form F4260.1.

Budget Fields

Section A Senior/Key Person	For each Senior/Key Person, enter the requested information. List personnel, base salary, the number of months that person will be allocated to the project, requested salary, fringe benefits, and the total funds requested for each person. The requested salary must be the product of the base salary and the effort. Include a written narrative in the budget justification that justifies the need for requested personnel. Within the justification, explain the fringe benefit rate used if it is not the standard faculty rate.
Section B Other Personnel	List personnel, the number of months that person will be allocated to the project, requested salary fringe benefits, and the total funds requested for each person. Include a written narrative in the budget justification that fully justifies the need for requested personnel. Within the justification, provide the number of positions being filled in each category of other personnel.
Section C Equipment	For the purpose of this budget, equipment is designated as an item of property that has an acquisition cost of $5,000 or more and an expected service life of more than one year, unless a different threshold is specified in a negotiated Facilities and Administrative Cost Rate. (Note that this designation applies for proposal budgeting only and differs

	from the DOE definition of capital equipment.) List **each** item of equipment separately and justify each in the budget justification section. Do not aggregate items of equipment. Allowable items ordinarily will be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose office equipment is not eligible for support unless primarily or exclusively used in the actual conduct of scientific research.
Section D Travel	For purposes of this section only, travel to Canada or to Mexico is considered domestic travel. In the budget justification, list each trip's destination, dates, estimated costs including transportation and subsistence, number of staff traveling, the purpose of the travel, and how it relates to the project. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). To qualify for support, attendance at meetings or conferences must enhance the investigator's capability to perform the research, plan extensions of it, or disseminate its results. Domestic travel is to be justified separately from foreign travel. Within the budget justification, detail the number of personnel planning to travel and the estimated per-traveler cost for each trip.
Section E Participant/Trainee Support Costs	If applicable, submit training support costs. Educational projects that intend to support trainees (precollege, college, graduate and post graduate) must list each trainee cost that includes stipend levels and amounts, cost of tuition for each trainee, cost of any travel (provide the same information as needed under the regular travel category), and costs for any related training expenses. Participant costs are those costs associated with conferences, workshops, symposia or institutes and breakout items should indicate the number of participants, cost for each participant, purpose of the conference, dates and places of meetings and any related administrative expenses. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis).
Section F Other Direct Costs	• **Materials and Supplies:** Enter total funds requested for materials and supplies in the appropriate fields. In the budget justification, indicate general categories such as glassware, and chemicals, including an amount for each category (items not identified under "Equipment"). Categories less than $1,000 are not required to be itemized. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). • **Publication Costs:** Enter the total publication funds requested. The proposal budget may request funds for the costs of documenting, preparing, publishing or otherwise making available to others the findings and products of the work conducted under the award. In the budget justification, include supporting information. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar

	items, or some other basis). • **Consultant Services:** Enter total funds requested for all consultant services. In the budget justification, identify each consultant, the services he/she will perform, total number of days, travel costs, and total estimated costs. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). • **ADP/Computer Services:** Enter total funds requested for ADP/Computer Services. The cost of computer services, including computer-based retrieval of scientific, technical and education information may be requested. In the budget justification, include the established computer service rates at the proposing organization if applicable. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). • **Subawards/Consortium/Contractual Costs:** Enter total costs for all subawards/consortium organizations and other contractual costs proposed for the project. In the budget justification, justify the details. • **Equipment or Facility Rental/User Fees:** Enter total funds requested for Equipment or Facility Rental/User Fees. In the budget justification, identify each rental/user fee and justify. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). • **Alterations and Renovations:** Enter total funds requested for Alterations and Renovations. In the budget justification, itemize by category and justify the costs of alterations and renovations, including repairs, painting, removal or installation of partitions, shielding, or air conditioning. Where applicable, provide the square footage and costs. • **Other:** Add text to describe any other Direct Costs not requested above. Enter costs associated with "Other" item(s). Use the budget justification to further itemize and justify.
Section G Direct Costs	This represents Total Direct Costs (Sections A through F). PAMS will automatically calculate this.
Section H Other Indirect Costs	Enter the Indirect Cost information, including the rates and bases being used, for each field. Only four general categories of indirect costs are allowed/requested on this form, so please consolidate if needed. Include the cognizant Federal agency and contact information if using a negotiated rate agreement. Within the budget justification, explain the use of multiple rates, if multiple rates are used.
Section I Total Direct and Indirect Costs	This is the total of Sections G and H. PAMS will automatically calculate this.

9. How to Register in PAMS

You must register in PAMS to submit a pre-proposal, letter of intent, or DOE national laboratory proposal.

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

Notifications sent from the PAMS system will come from the PAMS email address <PAMS.Autoreply@science.doe.gov>. Please make sure your email server/software allows delivery of emails from the PAMS email address to yours.

Registering to PAMS is a two-step process; once you create an individual account, you must associate yourself with ("register to") your institution. Detailed steps are listed below.

CREATE PAMS ACCOUNT:

To register, click the "Create New PAMS Account" link on the website https://pamspublic.science.energy.gov/.

- Click the "No, I have never had an account" link and then the "Create Account" button.
- You will be prompted to enter your name and email address, create a username and password, and select a security question and answer. Once you have done this, click the "Save and Continue" button.
- On the next page, enter the required information (at least one phone number and your mailing address) and any optional information you wish to provide (e.g., FAX number, website, mailstop code, additional email addresses or phone numbers, Division/Department). Click the "Create Account" button.
- Read the user agreement and click the "Accept" button to indicate that you understand your responsibilities and agree to comply with the rules of behavior for PAMS.
- PAMS will take you to the "Having Trouble Logging In?" page. (If you have been an SC merit reviewer or if you have previously submitted a proposal, you may already be linked to an institution in PAMS. If this happens, you will be taken to the PAMS home page.)

REGISTER YOUR INSTITUTION:

1. Click the link labeled "Option 2: I know my institution and I am here to register to the institution." (Note: If you previously created a PAMS account but did not register to an institution at that time, you must click the Institutions tab and click the "Register to Institution" link.)
2. PAMS will take you to the "Register to Institution" page.
3. Type a word or phrase from your institution name in the field labeled, "Institution Name like," choose the radio button next to the item that best describes your role in the system, and click the "Search" button. A "like" search in PAMS returns results that contain the word or phrase you enter; you do not need to enter the exact name of the institution, but you should enter a word or phrase contained within the institution name. (If your institution has a frequently used acronym, such as ANL for Argonne National Laboratory or UCLA for the

Regents of the University of California, Los Angeles, you may find it easiest to search for the acronym under "Institution Name like." Many institutions with acronyms are listed in PAMS with their acronyms in parentheses after their names.)

4. Find your institution in the list that is returned by the search and click the "Actions" link in the Options column next to the institution name to obtain a dropdown list. Select "Add me to this institution" from the dropdown. PAMS will take you to the "Institutions – List" page.
5. If you do not see your institution in the initial search results, you can search again by clicking the "Cancel" button, clicking the Option 2 link, and repeating the search.
6. If, after searching, you think your institution is not currently in the database, click the "Cannot Find My Institution" button and enter the requested institution information into PAMS. Click the "Create Institution" button. PAMS will add the institution to the system, associate your profile with the new institution, and return you to the "Institutions – List" page when you are finished.

For help with PAMS, click the "External User Guide" link on the PAMS website, **https://pamspublic.science.energy.gov/**. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, email: **sc.pams-helpdesk@science.doe.gov**. All submission and inquiries about this Announcement should reference the number printed on the cover page.

10. How to View Proposals in PAMS

Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the proposal.

Upon submission, the proposal will appear under My Proposals for the PI and the Submitter with a Proposal Status of "Submitted to DOE."

B. POLICY PROVISIONS

1. Availability of Funds

Funds are not presently available for this award. The Government's obligation under this award is contingent upon the availability of appropriated funds from which payment for award purposes can be made. No legal liability on the part of the Government for any payment may arise until funds are made available to the Contracting Officer for this award and until the awardee receives notice of such availability, to be confirmed in writing by the Contracting Officer.

2. 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 other than the Contracting Officer, either explicit or implied, is invalid.

3. Environmental, Safety and Health (ES&H) Performance of Work at DOE Facilities

With respect to the performance of any portion of the work under this award which is performed at a DOE-owned or controlled site, the recipient agrees to comply with all state and Federal ES&H regulations, and with all other ES&H requirements of the operator of such site.

Prior to the performance on any work at a DOE-Owned or controlled site, the recipient shall contact the site facility manager for information on DOE and site specific ES&H requirements.

The recipient shall apply this provision to all subawardees at any tier.

4. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, 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. The applicant, by submitting its proposal, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign a conflict of interest and a certificate of confidentiality prior to reviewing a proposal. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

5. Federal, State, and Local Requirements

With respect to the performance of any portion of the work under this award, the recipient agrees to comply with all applicable local, state, and Federal ES&H regulations. The recipient shall apply this provision to all sub awardees at any tier.

6. Funding Restrictions

Funding for all awards and future budget periods are contingent upon the availability of funds appropriated by Congress and the availability of future-year budget authority.

7. Government Right to Reject or Negotiate

DOE reserves the right, without qualification, to reject any or all proposals received in response to this DOE National Laboratory Announcement and to select any proposal, in whole or in part, as a basis for negotiation and/or award.

8. Modification

Notices of any modifications to this DOE National Laboratory Announcement will be posted on the Grants and Contracts website (http://science.osti.gov/grants/).

9. Proprietary Proposal Information

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in a proposal only when such information is necessary to convey an understanding of the proposed project. The use and

disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of any document included in the proposal that contains such proprietary information and specifies the pages of the document which are to be restricted:

"The data contained in pages _____ of this document have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this proposal, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the government's right to use or disclose data obtained without restriction from any source, including the applicant."

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

"The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation."

10. Publications

Researchers are expected to publish or otherwise make publicly available the results of the work conducted under any authorization resulting from this Announcement. Publications and other methods of public communication describing any work based on or developed under an authorization resulting from this Announcement must contain an acknowledgment of SC support. The format for such acknowledgments is provided at https://science.osti.gov/funding-opportunities/acknowledgements/. The author's copy of any peer-reviewed manuscript accepted for funding must be announced to DOE's Office of Scientific and Technical Information (OSTI) and made publicly available in accordance with the instructions contained in the Reporting Requirements Checklist incorporated in all Assistance Agreements.