Department of Energy (DOE)
Office of Science (SC)

FY 2025 Continuation of Solicitation for the Office of Science Financial Assistance Program

Notice of Funding Opportunity (NOFO) Number:
DE-FOA-0003432

NOFO Type: Initial
CFDA Number: 81.049

NOFO Issue Date:	September 30, 2024
Submission Deadline for Pre-Applications:	A Pre-Application is optional/encouraged. Pre-Applications may be required for consideration by certain review panels.
Submission Deadline for Applications:	This NOFO will remain open until September 30, 2025, or until replaced by a successor NOFO. Applications may be submitted any time during that period. Individual topics in this NOFO may have scheduled review panels. Applications may be submitted before the deadline, but applications submitted after the panel's acceptance date may be held until the next review panel.

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I. Basic Information

U.S. Department of Energy (DOE)
Office of Science (SC)

Executive Summary

The Office of Science (SC) of the Department of Energy (DOE) hereby announces its continuing interest in receiving applications for support of work in the following program areas: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, Isotope R&D and Production, and Accelerator R&D and Production. On September 3, 1992, DOE published in the Federal Register the Office of Energy Research Financial Assistance Program (now called the Office of Science Financial Assistance Program), 10 CFR 605, as a Final Rule, which contained a solicitation for this program. Information about submission of applications, eligibility, limitations, evaluation and selection processes and other policies and procedures are specified in 10 CFR 605.

This NOFO is our annual open solicitation that covers all research areas in SC and is open throughout the Fiscal Year. Any research within SC's Congressionally authorized mission may be proposed under this NOFO.

This NOFO will remain open until September 30, 2025, 11:59 PM Eastern Time, or until it is succeeded by another issuance, whichever occurs first. This NOFO succeeds DE-FOA-0003177, which was published September 29, 2023.

Funding Details

Expected total available funding	Approximately $500,000,000 in current and future fiscal year funds.
Expected number of awards	Historically, 200 to 350 new awards have been made in response to the NOFO each year.
Expected dollar amount of individual awards	Historically, awards from $5,000 to $5,000,000 have been made in response to the NOFO each year.
Expected award project period	Awards are expected to be made for a project period of six months to five years as befitting the project, with the most common project period being three years in duration

Key Facts

NOFO Title	FY 2025 Continuation of Solicitation for the Office of Science Financial Assistance Program
NOFO Number	DE-FOA-0003432
Announcement Type	Initial
Assistance Listing	81.049

Statutory Authority	The programmatic authorizing statute is: Section 646 of Public Law 95-91, U.S. Department of Energy Organization Act Section 901, et seq. of Public Law 109-58, Energy Policy Act of 2005
Governing Regulations	Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, codified at 2 CFR 200 U.S. Department of Energy Financial Assistance Rules, codified at 2 CFR 910 U.S. Department of Energy, Office of Science Financial Assistance Program Rule, codified at 10 CFR 605 U.S. Department of Energy, Technology Investment Agreements, codified at 10 CFR 603

Key Dates

Key dates are printed on the cover of this NOFO.

Agency Contact Information

Grants.gov Customer Support	800-518-4726 (toll-free) support@Grants.gov
PAMS Customer Support	855-818-1846 (toll-free) 301-903-9610 sc.pams-helpdesk@science.doe.gov
Technical/Scientific Program Contact	Questions regarding the program technical requirements must be directed to the point of contact listed for each program area within this NOFO.
Administrative Contact (e.g., questions about budgets and eligibility)	sc.opencall@science.doe.gov

Informational Webinar / Office Hours

SC plans to hold an informational webinar about this NOFO on Tuesday, October 1, 2024, at 2:00 pm ET as part of our monthly office hours. Registration information, the webinar recording (initial introduction only), and all slides will be posted at https://science.osti.gov/officehours.

Recommendation

SC encourages you to register in all systems as soon as possible. You are also encouraged to submit pre-applications and applications well before the deadline.

II. Eligibility

A. Eligible Applicants

All types of applicants are eligible to apply, except nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

Federally affiliated[1] entities must adhere to the eligibility standards below:

1. DOE/NNSA National Laboratories

DOE/NNSA National Laboratories are not eligible to submit applications under this NOFO but may be proposed as subrecipients under another organization's application. If recommended for funding as a proposed subrecipient, the value of the proposed subaward will be removed from the prime applicant's award and will be provided to the laboratory through the DOE Field Work Proposal System and work will be conducted under the laboratory's contract with DOE. No administrative provisions of this NOFO will apply to the laboratory or any laboratory subcontractor. Additional instructions for securing authorization from the cognizant Contracting Officer are found in Section IX of this NOFO.

2. Non-DOE/NNSA FFRDCs

Non-DOE/NNSA FFRDCs are eligible to submit applications (either as a lead organization or as a team member in a multi-institutional team) under this NOFO and may be proposed as subrecipients under another organization's application. If recommended for funding as a lead applicant or a team member, funding will be provided through an interagency agreement Award to the FFRDC's sponsoring Federal Agency. If recommended for funding as a proposed subrecipient, the value of the proposed subaward may be removed from the prime applicant's award and may be provided through an interagency agreement to the FFRDC's sponsoring Federal Agency. Additional instructions for securing authorization from the cognizant Contracting Officer are found in Section IX of this NOFO.

3. Other Federal Agencies

Other Federal Agencies are eligible to submit applications (either as a lead organization or as a team member in a multi-institutional team) under this NOFO and may be proposed as subrecipients under another organization's application. If recommended for funding as a lead applicant or a team member, funding will be provided through an interagency agreement. If recommended for funding as a proposed subrecipient, the value of the proposed subaward may be removed from the prime applicant's award and may be provided through an interagency agreement. Additional instructions for providing statutory authorization are found in Section IX of this NOFO.

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[1] Institutions that are not DOE/NNSA National Laboratories, a non-DOE/NNSA FFRDC, or another Federal agency are not Federally affiliated, even if they receive Federal funds or perform work under a Federal award or contract.

Notes for applicants of all types:

- Individual applicants are unlikely to possess the skills, abilities, and resources to successfully accomplish the objectives of this NOFO. Individual applicants are encouraged to address this concern in their applications and to demonstrate how they will accomplish the objectives of this NOFO.
- Non-domestic applicants are advised that successful applications from non-domestic applicants include a detailed demonstration of how the applicant possesses skills, resources, and abilities that do not exist among potential domestic applicants.

This NOFO does not support an applicant's commercial activity. This NOFO seeks to support basic research to advance understanding rather than to address commercial opportunities. Applications that propose research related to current commercial activity or current customer needs may be declined without merit review. All for-profit applicants must include a description, not to exceed 200 words, of how their proposed work will advance scientific understanding of a basic and fundamental nature as an appendix to the project narrative.

B. COST SHARING

Cost sharing for basic and fundamental research is not required pursuant to an exclusion from the requirements of Section 988 of the Energy Policy Act of 2005.

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 will not be considered as a factor during merit review or award selection.

C. ELIGIBLE INDIVIDUALS

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 an application. Individuals from underrepresented groups and institutions as well as individuals with disabilities are always encouraged to apply.

III. Program Description

A. Purpose

The DOE SC program hereby announces its continuing interest in receiving applications for support of work in the following program areas: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, Isotope R&D and Production, and Accelerator R&D and Production. This NOFO is our annual open solicitation that covers all research areas in SC and is open throughout the Fiscal Year. Any research within SC's Congressionally authorized mission may be proposed under this NOFO.

SUPPLEMENTARY INFORMATION

The SC mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic and national security of the United States. SC is the Nation's largest Federal sponsor of basic research in the physical sciences and the lead Federal agency supporting fundamental scientific research for our Nation's energy future.

SC accomplishes its mission and advances national goals by supporting:

- The frontiers of science—exploring nature's mysteries from the study of fundamental subatomic particles, atoms, and molecules that are the building blocks of the materials of our universe and everything in it to the DNA, proteins, and cells that are the building blocks of life. Each of the programs in SC supports research probing the most fundamental disciplinary questions.

- The 21st Century tools of science—providing the Nation's researchers with 28 state-of-the-art national scientific user facilities - the most advanced tools of modern science - propelling the U.S. to the forefront of science, technology development and deployment through innovation.

- Science for energy and the environment—paving the knowledge foundation to spur discoveries and innovations for advancing the Department's mission in energy and environment. SC supports a wide range of funding modalities from single principal investigators to large team-based activities to engage in fundamental research on energy production, conversion, storage, transmission, and use, and on our understanding of the earth systems.

SC manages its research portfolio through eight scientific program offices. The following program descriptions, websites, and technical contacts are offered to provide more in-depth information on scientific and technical areas of interest to SC:

1. Advanced Scientific Computing Research (ASCR)
(a) Applied Mathematics

(b) Computer Science
(c) Computational Partnerships
(d) Advanced Computing Technologies

2. Basic Energy Sciences (BES)
(a) Materials Chemistry
(b) Biomolecular Materials
(c) Synthesis and Processing Science
(d) Experimental Condensed Matter Physics
(e) Theoretical Condensed Matter Physics
(f) Physical Behavior of Materials
(g) Mechanical Behavior and Radiation Effects
(h) Quantum Information Science in Materials Sciences and Engineering
(i) X-ray Scattering
(j) Neutron Scattering
(k) Electron and Scanning Probe Microscopies
(l) Atomic, Molecular, and Optical Sciences
(m) Gas Phase Chemical Physics
(n) Computational and Theoretical Chemistry
(o) Condensed Phase and Interfacial Molecular Science
(p) Quantum Information Science Research in Chemical Sciences, Geosciences, and Biosciences
(q) Catalysis Science
(r) Separation Science
(s) Heavy Element Chemistry
(t) Geosciences
(u) Solar Photochemistry
(v) Photosynthetic Systems
(w) Physical Biosciences
(x) BES Accelerator and Detector Research

3. Biological and Environmental Research (BER)
(a) Biological Systems Science
(b) Earth and Environmental Systems Sciences

4. Fusion Energy Sciences (FES)
(a) Theory & Simulation
(b) Artificial Intelligence and Machine Learning for Fusion & Plasma Science
(c) Fusion Materials and Internal Components
(d) Emergent Plasma Concepts: Tokamak Research
(e) Emergent Plasma Concepts: Spherical Tokamak Research
(f) Emergent Plasma Concepts: Superconducting and Compact Stellarator Research
(g) Emergent Plasma Concepts: Inertial Fusion Energy
(h) Emergent Plasma Concepts: Measurement Innovation
(i) Closing the Fusion Cycle: Fusion Nuclear Science
(j) Closing the Fusion Cycle: Enabling Research and Development

(k) Plasma Science and Technology – General Plasma Science
(l) Plasma Science and Technology – High Energy Density Physics
(m) Plasma Science and Technology – Microelectronics Research
(n) Plasma Science and Technology – Quantum Information Science
(o) Public-Private Partnerships

5. High Energy Physics (HEP)
(a) Experimental Research at the Energy Frontier in High Energy Physics
(b) Experimental Research at the Intensity Frontier in High Energy Physics
(c) Experimental Research at the Cosmic Frontier in High Energy Physics
(d) Theoretical Research in High Energy Physics
(e) Accelerator Science and Technology Research and Development in High Energy Physics
(f) Instrumentation and Detector Research and Development in High Energy Physics
(g) Computational Research in High Energy Physics
(h) Quantum Information Science for High Energy Physics Research

6. Nuclear Physics (NP)
(a) Medium Energy Nuclear Physics
(b) Heavy Ion Nuclear Physics
(c) Nuclear Structure and Nuclear Astrophysics
(d) Fundamental Symmetries
(e) Nuclear Theory
(f) Nuclear Data
(g) Nuclear Physics Computing
(h) Advanced Technology R&D for Accelerators and Applications
(i) NP Quantum Information Science
(j) EIC-related Generic Detector Research and Development

7. Isotope R&D and Production (DOE IP)
(a) Targetry and Isotope Production Research
(b) Nuclear and Radiochemical Separation, Purification and Radiochemical Synthesis
(c) Biological Tracers, Imaging, and Therapeutics
(d) Isotopic Enrichment Technology

8. Accelerator R&D and Production (ARDAP)

1. Advanced Scientific Computing Research (ASCR)
Program Website: https://science.osti.gov/ascr

The mission of the Advanced Scientific Computing Research (ASCR) program is to advance applied mathematics and computer science; deliver the most sophisticated computational scientific applications in partnership with disciplinary science; advance computing and networking capabilities; and develop future generations of computing hardware and software tools for science and engineering in partnership with the research community, including U.S. industry. The strategy to accomplish this has two thrusts: developing and maintaining world-class computing and network facilities for science; and advancing research in applied

mathematics, computer science and advanced networking.

ASCR supports cross-disciplinary research in which other domains of scientific inquiry may provide the data to provide use-cases for computer scientists and applied mathematicians to devise generalized methods, models, algorithms and tools. ASCR's interest in these fields is not to solve the specific problems in other scientific domains but to use those challenges to advance the state of the art and increase knowledge in its fields of research.

The priority areas for ASCR include the following:

- Develop generalizable mathematical models, methods and algorithms to accurately describe and predict the behavior of complex systems involving processes that span vastly different time and/or length scales.
- Advance key areas of computer science that:
  - Enable the design and development of energy-efficient extreme-scale computing systems and their effective use in the path to scientific discoveries; and
  - Transform extreme scale data from experiments and simulations into scientific insight.
- Advance key areas of computational science and discovery that support the missions of SC through mutually beneficial partnerships.
- Develop and deliver forefront computational, networking and collaboration tools and facilities that enable scientists worldwide to work together to extend the frontiers of science.

The computing resources and high-speed networks required to meet SC needs exceed the state-of- the-art by a significant margin. Furthermore, the system software, algorithms, software tools and libraries, programming models and the distributed software environments needed to accelerate scientific discovery through modeling and simulation are often beyond the realm of commercial interest. To establish and maintain DOE's modeling and simulation leadership in scientific areas that are important to its mission, ASCR operates leadership computing facilities, a high-performance production computing center, research prototypes, and a high-speed network, implementing a broad base research portfolio in applied mathematics, computer and network sciences, and computational science to solve complex problems on computational resources at the exascale and beyond. Further information on ASCR facilities can be found at: https://science.osti.gov/ascr/Facilities.

The ASCR subprograms and their objectives follow:

(a) Applied Mathematics

This subprogram supports basic research leading to fundamental mathematical advances and computational breakthroughs across DOE and SC missions. Important areas of basic research include: (1) novel deterministic or randomized numerical methods for the scalable solution of large-scale, linear and nonlinear systems of equations, including those solution methods that take into consideration the possibilities brought about by future high performance computing (HPC) architectures; (2) optimization techniques and next-generation solvers; (3) numerical methods for

modeling multiscale, multi-physics, or multi-component continuous or discrete systems that span a wide range of time and length scales; (4) methods of simulation and analysis of systems that account for the uncertainties of the systems, or are inherently stochastic or uncertain; (5) innovative approaches for analyzing, extracting insight from, or reducing large-scale data sets; and (6) foundational research in scientific machine learning and artificial intelligence (AI) as a cross-cutting area of interest for enabling greater adaptivity, automation, and predictive capabilities in scientific computing.

Notice of Submission Requirements for the Panel Review on the topic of Randomized Algorithms for Combinatorial Scientific Computing. This topic area is highlighted in Section 3.3 of the ASCR report "Randomized Algorithms for Scientific Computing", https://doi.org/10.2172/1807223. ASCR expects to convene a merit-review panel in February 2025 for applications submitted on randomized algorithms for combinatorial scientific computing. To be considered by the panel, a pre-application must be submitted by November 14, 2024. A pre-application submission may involve researchers from a single or multiple eligible institutions. Each pre-application will be reviewed for responsiveness and competitiveness of the proposed research. ASCR expects to provide pre-application encouragement and discouragement decisions by December 13, 2024. To be reviewed by the panel, applications associated with encouraged pre-applications must be submitted by January 16, 2025. The award ceiling is $1,000,000 per year in total across all institutions for a three-year award. ASCR expects to make at most three awards.

Areas that are out of scope include:

- Topics not covered in the list of Applied Mathematics topics above, except with the specific encouragement of an Applied Mathematics program manager in response to an emailed concept paper;
- Research and applications not motivated and justified in the context of current and future SC user facilities, especially those supported by ASCR (i.e., Argonne Leadership Computing Facility [ALCF], Oak Ridge Leadership Computing Facility [OLCF], and National Energy Research Scientific Computing Center [NERSC]): https://science.osti.gov/ascr/Facilities;
- Application-specific research. The Applied Mathematics program seeks research focused on innovative and novel mathematics, not on existing mathematical techniques applied to new applications. Innovative and novel mathematics appropriate for ASCR are typically generalizable to multiple applications, and successful applications often demonstrate such generalizability in the context of two or more applications; and
- Approaches that are not efficient and scalable for problems of increasingly high dimensionality and computational complexity and that do not take advantage of current and emerging high-performance computing architectures or ecosystems.

Submission of preliminary research descriptions (e.g., pre-applications, concept papers) is strongly encouraged. They will be reviewed for responsiveness of the proposed work to the research topics. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice. You must send an email to a subprogram contact for information regarding format and content.

Subprogram Contacts:

- William Spotz, William.Spotz@science.doe.gov and
- Steven Lee, Steven.Lee@science.doe.gov

Website: https://science.osti.gov/ascr/Research/Applied-Mathematics

(b) Computer Science

The Computer Science research program supports research that enables computing and networking at extreme scales and the understanding of extreme scale, or complex data from both simulations and experiments. It aims to make high performance scientific computers and networks highly productive and efficient to solve scientific challenges while attempting to reduce domain science application complexity as much as possible. The computer science program does this in the context of sharp increases in the heterogeneity and complexity of computing systems; the need to integrate simulation, data analysis, and other tasks seamlessly and intelligently into coherent and usable workflows; and the challenges posed by highly novel computing platforms, such as neuromorphic and quantum systems.

Priority interests for the program include the following. Applications are not restricted to a single topic and may span several topics.

- **Data analysis and visualization:**
  SC-supported researchers and facilities are generating large, complex, multi-modal data at unprecedented rates. There is a need for advanced visualizations and visual analytics tools for making sense of these data and making operational decisions. This program solicits research to develop techniques for deriving and visualizing insights from large scale and/or complex simulation, experimental, or observational data or combinations of these as relevant to SC and DOE priority applications: visual analysis of high-dimensional data at scale, data from multiple sources and of varying types, attributes such as uncertainty, and data in the context of domain-specific knowledge; and visual analytic approaches to understanding artificial intelligence/machine learning outcomes or the state and behavior of a supercomputing system at scale. Also of interest are machine learning or AI techniques for data analysis that are scalable, energy-efficient, explainable, or involve knowledge extraction. Possible topics are highlighted in the "Report for the ASCR Workshop on Visualization for Scientific Discovery, Decision-Making, and Communication", https://doi.org/10.2172/1845709.

- **Continuum Computing:**
  Scientific computing will increasingly incorporate a number of different tasks that need to be managed along with the main simulation or experimental tasks—for example, ensemble analysis, data-driven science, artificial intelligence, machine learning, surrogate modeling, and graph analytics. Many of these tasks will need to be executed concurrently with simulations and experiments sharing the same computing resources.

  Continuum-computing capabilities can enable scientific discovery from a broad range of data sources—i.e. HPC simulations, experiments, scientific instruments, and sensor networks—over a wide scale of computing platforms: leadership-class HPC, clusters, clouds, workstations, and devices at the edge. Continuum-computing capabilities can also manage

large data volumes from computations and experiments to minimize data movement, save storage space, and boost resource efficiency—often while simultaneously increasing scientific precision.

This program solicits research to advance continuum-computing capabilities to run on a variety of computing platforms and at different length and time scales; to be automated and controllable; to be more interoperable and composable; and to use provenance and metadata for transparent results. This program also solicits co-designed research activities for continuum computing as well as new management and coordination algorithms.

- **Storage Systems and I/O:**

The success of the DOE computational, experimental, and observational sciences is inextricably tied to the usability, performance, and reliability of emerging storage systems and input/output (SSIO) technologies. Emerging technologies include storage and networking devices, including those providing computational capabilities. SSIO technologies involve the organization, movement, placement, and efficient retrieval of data to enhance computation and discovery. This includes innovative interfaces and management methods that allow for flexible, high-performance access to large data sets, potentially federated across different kinds of memory, edge devices, and repositories, capturing and management relevant usage statistics, provenance, and other metadata. This program solicits research to improve SSIO capabilities that enable science understandability and reproducibility; accelerate scientific discovery; enhance SSIO usability, performance, and resilience; and improve efficiency and integrity of data movement and storage. One particular focus of this program is to improve pipelines for analysis-centric, data intensive workflows on HPC systems, and that use large-scale storage. This program also solicits techniques and tools for advancing findable, accessible, interoperable reusable (FAIR) data practices of management, archiving, curation, and/or reuse, of data generated by experimental, observational, and simulation relevant to SC mission areas. Additional areas of interest include combining of data streaming and cloud storage uses for SC infrastructure as well as visualization needs at the edge for SC experimental facilities. Possible topics are highlighted in the "Report for the ASCR Workshop on the Management and Storage of Scientific Data", https://doi.org/10.2172/1845707.

- **Programming Models, Environments, and Portability:**

Innovative programming models for developing applications on next-generation platforms, exploiting unprecedented parallelism, heterogeneity of memory systems (e.g. non-uniform memory access [NUMA], non-coherent shared memory, high-bandwidth memory [HBM]), scratchpads, and heterogeneity of processing (e.g., graphics processing units [GPUs], field-programmable gate arrays [FPGAs], coarse-grained reconfigurable architectures [CGRAs], other types of accelerators, big-small cores, processing in memory, and near memory, etc.), with particular emphasis on making it easier to program at scale. Basic research on programming tools, for all phases of the software-development cycle, are relevant, including but not limited to, design, implementation, verification, optimization, and integration. Particularly welcome are methods that infuse artificial intelligence/machine learning into the programming environment.

Work on programming models, environments, and portability is often informed by considerations stemming from the collaborative nature of the modern scientific enterprise. See the report, "Basic Research Needs in The Science of Scientific Software Development and Use: Investment in Software is Investment in Science", https://doi.org/10.2172/1846009.

- **Operating and Runtime Systems:**

System software that provides intelligent, adaptive resource management and support for highly-parallel software and workflow-management systems, and that facilitates effective and efficient use of heterogeneous computing technologies, including diverse execution models, processors, accelerators, memory, and storage systems. Target workloads include modeling and simulation, data analysis, and the processing of large-scale, streaming data from experiments.

- **Performance Portability and Co-design:**

Methods that support performance portability, which provides the ability to efficiently use diverse kinds of hardware platforms with minimal changes to the application source code, and/or hardware/software co-design, which is a method for designing and/or adapting both hardware and software design as part of a holistic process. These methods include automated and semi-automated refinements from high-level specification of an application and/or hardware design to low-level code, optimized when compiled and/or, for software, at runtime, to different HPC platforms. The focus is on enabling performance portability of, and/or the design of future hardware for, applications developed for extreme-scale computing and beyond. Possible topics are highlighted in, "Reimagining Codesign for Advanced Scientific Computing: Report for the ASCR Workshop on Reimagining Codesign", https://doi.org/10.2172/1822199.

- **Distributed Scheduling and Resource Management:**

As scientific-computing resources are being called upon to support a wide variety of workloads, including those that tightly integrate large-scale and ensemble simulation and data-analysis workflows with experimental data collection and control, the algorithms and implementations matching computational requirements to resources need to scale to handle more tasks, more resources, and more-widely-distributed resources. Specifically sought are methods for decentralized, resilient, secure resource management, scheduling, and coupled data transfer across widely distributed computing facilities; and modeling of such distributed systems.

- **Network-Offloaded Acceleration for Distributed/Parallel Computing:**

Programmable and computation-enabled network interfaces present the opportunity to exploit computational power closer to the network to complement the capabilities of CPUs, GPUs, and other computational components. Note that the programmable network interfaces include both edge accelerators as well as devices in core interconnects in parallel platforms or transport planes in distributed settings. Application behavioral information may be exploited, both in terms of dynamic learning as well as mathematically predefined primitives such as distributed reductions and other offloaded synchronization operations. New methods, algorithms, software, and interfaces are needed to effectively exploit asynchronous and autonomous capabilities of network hardware beyond traditional data-transfer functionalities.

Of interest are new conceptual approaches, algorithmic support, application programming interfaces, and use cases in HPC scientific applications.

- **Computer Science Fundamentals Accounting for Thermodynamics and Energy:**

Unprecedented levels of modern computation, including areas such as artificial intelligence and machine learning (AI/ML) training, have now made computation a very large consumer of energy in the Nation and the world. Much of modern computer science, and the understanding it provides regarding the fundamental properties of algorithms, does not account for the underlying thermodynamic and information-theoretic reality of computation. As "Beyond Moore" devices are explored along with their corresponding ultra-efficient computer architectures, and the programming paradigms appropriate for these new computing technologies, a better understanding is needed of both potential ultra-efficient computer architectures and the energy-aware properties of algorithms executed on them. Ultra-efficient computer architectures include, but are not limited to, those based on reversible and asymptotically-adiabatic approaches. Investigations combining thermodynamics and information theory, computer architecture, reversible computing and algorithmic properties are sought to advance our ability to design new, energy-efficient approaches to scientific computation.

- **Memory-Aware Systems:**

Advances in memory technologies are creating new opportunities and challenges where it is unclear how to best introduce or abstract memory awareness and composition. Memory is evolving in highly asymmetric and distributed directions, with new industry standards greatly expanding memory sharing and capacities to much larger sizes, largely in backward-compatible system architectures. Research is needed to uncover new possibilities for solving larger scientific-computing problems with such highly asymmetric and distributed memory architectures. Innovations in algorithms, software interfaces, programming languages and models are needed to also effectively exploit new processing-in-memory architectures that are emerging as a paradigm for scientific computing. Memory safety needs to be revisited in fundamental research on programming languages, runtimes, and operating systems, considering the multi-developer and shared nature of modern scientific programming eco-systems. The smoothening of the spectrum from volatile to non-volatile memories needs to be investigated for revisiting out-of-core algorithms to expand the limits of scientific computing. On-the-fly compression and decompression needs investigation for increasing the problem sizes without detriment to performance. The intersection of machine learning (ML) with memory systems opens the potential for new solutions, including smarter ML-informed cache prefetching and replacement policies potentially customizable for specific scientific applications via signatures and other mechanisms.

- **Quantum Computing**

Research to develop modules of end-to-end software toolchains aimed to program and control quantum computing systems at scale. Possible topics include quantum computing areas as presented in "Report for the ASCR Workshop on Basic Research Needs in Quantum Computing and Networking," https://doi.org/10.2172/2001045.

Notice of Submission Requirements for the Panel Review on topics at the intersection of quantum thermodynamics and computing, including aspects of energy-efficient quantum computation. ASCR expects to convene a merit-review panel in February 2025 for applications submitted in this area. To be considered by the panel, a pre-application must be submitted by November 14, 2024. Each pre-application will be reviewed for responsiveness and competitiveness of the proposed research. ASCR expects to provide encouragement and discouragement decisions by December 4, 2024. To be reviewed by the panel, applications associated with encouraged pre-applications must be submitted by January 7, 2025. The award ceiling is $500,000 in total for a two-year award. ASCR expects to make at most three awards.

- **Quantum Networking**

This topic involves innovative research in quantum networking concepts, systems, and protocols by which quantum networking applies in scientific discovery, including, but not limited to, distribution of quantum information from sensors, quantum networking in support of interconnected or scalable quantum computing systems, and blind/cloud quantum computing. Networking can span heterogeneous systems or homogeneous systems (such as all-photonic) and parallel quantum processing (in co-located or local-area settings) and distributed quantum communications (at metropolitan or wide-area scales). Possible topics include quantum networking areas as presented in "Report for the ASCR Workshop on Basic Research Needs in Quantum Computing and Networking," https://doi.org/10.2172/2001045.

This program also supports:

- **Participation in International Standardization:**

Scientific computing relies on robust adoption of Voluntary Consensus Standards[2] (VCSs) that are applicable to state-of-the-art computing technologies. Notably, most applications running at the ASCR user facilities depend on some combination of standardized programming languages and application programming interfaces (APIs), and DOE contributes to many of them, including, but not limited to, the Message Passing Interface (MPI), C, C++, Fortran, OpenMP, and SYCL. Moreover, standardization is an important enabler of knowledge transfer from research to industry. Similarly, the characterization of computing hardware relies on benchmarks established through a VCS process, and these benchmarks drive industry decisions affecting what capabilities ASCR user facilities can provide. Such benchmarks include, but are not limited to, SPEC CPU/ACCEL and MLPerf. VCSs and benchmarks relevant to data, artificial intelligence and machine learning, quantum computing, software, and hardware interfaces are all in scope.

[2] Voluntary Consensus Standards are "Standards [that] are developed through a process that is open to participation by representatives of all interested parties, transparent, consensus-based, and subject to due process. These might be developed by governmental organization or private sector groups such as the American Society for Testing and Materials (ASTM) or the International Organization for Standardization (ISO)." See https://www.directives.doe.gov/terms_definitions/voluntary-consensus-standard; for additional discussion, see Office of Management and Budget Circular Number A-119, https://www.nist.gov/system/files/revised_circular_a-119_as_of_01-22-2016.pdf.

The development of standards relies on robust participation from a broad spectrum of Stakeholders, and the program supports maintaining and broadening participation in standards development. Standards development benefits from the participation of laboratory and university researchers in addition to experts from businesses of all sizes. Funding may support training on standards development and leadership, travel to relevant meetings, the hosting of relevant meetings, the development of applications for, and associated prototypes of, new standardized functionalities, and any Standards Development Activity[3]. Particularly welcome are activities supporting US leadership in standards development and activities including a specific focus on broadening participation from experts from traditionally underrepresented groups, academic institutions, small businesses, and others who may face higher participation barriers.

- **Activities Supporting Career Development, and Broadening Participation, in Computer-Science Research:**
Computer-science research depends on a healthy, diverse community of computer-science researchers. Professional networking, mentorship, and associated training activities targeting students and early-career researchers support the health and diversity of the research community. Particularly welcome are activities including a specific focus on outreach to members of groups that are underrepresented in computer-science research.

Topics that are out of scope for Computer Science include:

- Topics not covered in the list of Computer Science Priority Interests, above, except with the specific encouragement of a Computer Science program manager in response to an emailed concept paper;
- Research with primary emphasis on resilient solvers, and/or new development of machine probabilistic methods and their mathematical formalism;
- Research aimed at advancing computer-supported collaboration, social computing, and generalized research in human-computer interaction;
- Discipline-specific data analytics and informatics without a clear articulation of how the research will generalize to other disciplines and/or advance computer-science capabilities;
- Research focused on the World Wide Web, the dark web, and/or data about it;
- Research that is primarily to advance cloud computing, hand-held, portable, desktop, and/or embedded computing that is not applicable to ASCR-supported computational and data science environments;
- Research and applications not motivated and justified in the context of current and future SC user facilities, especially those supported by ASCR (i.e., Argonne Leadership Computing Facility or ALCF, Oak Ridge Leadership Computing Facility or OLCF, and National Energy Research Scientific Computing Center or NERSC): https://science.osti.gov/ascr/Facilities;
- Development of new candidate physical qubit systems and improvements to physical qubits; and

[3] Standards Development Activity is defined in 15 USC § 4301(a)(7). See https://www.govinfo.gov/app/details/USCODE-2015-title15/USCODE-2015-title15-chap69-sec4301/summary

- Quantum key distribution, quantum cryptography and cryptanalysis.

Submission of preliminary research descriptions (e.g., pre-applications, concept papers) is strongly encouraged. They will be reviewed for responsiveness of the proposed work to the research topics. You must send an email to a subprogram contact for information regarding format and content.

Subprogram Contacts:

- Margaret R. Lentz, Margaret.lentz@science.doe.gov: Data analysis and visualization
- Hal Finkel, Hal.Finkel@science.doe.gov: Storage Systems and I/O (SSIO); programming models, environments, and portability; operating and runtime systems; performance portability and co-design; distributed scheduling and resource management
- Hal Finkel, Hal.Finkel@science.doe.gov, and Margaret Lentz, Margaret.Lentz@science.doe,gov: Continuum computing, participation in international standardization and activities supporting career development, and broadening participation, in computer-science research
- Kalyan Perumalla, Kalyan.Perumalla@science.doe.gov: Network-Offloaded Acceleration for Distributed/Parallel Computing, Computer Science Fundamentals Accounting for Thermodynamics and Energy, Memory-Aware Systems
- Marco Fornari, Marco.Fornari@science.doe.gov, Kalyan Perumalla, Kalyan.Perumalla@science.doe.gov: Quantum Computing
- Kalyan Perumalla, Kalyan.Perumalla@science.doe.gov, Marco Fornari, Marco.Fornari@science.doe.gov: Quantum Networking

Website: https://science.osti.gov/ascr/Research/Computer-Science; https://science.osti.gov/ascr/Community-Resources/Program-Documents

(c) Computational Partnerships

This activity primarily supports the Scientific Discovery through Advanced Computing (SciDAC), program, which is a recognized leader for the employment of HPC for scientific discovery. Established in 2001, SciDAC involves ASCR partnerships with the other SC programs, other DOE program offices, and other federal agencies in strategic areas with a goal to dramatically accelerate progress in scientific computing through strong collaborations between discipline scientists, applied mathematicians, and computer scientists. For examples of current SciDAC partnerships, refer to the website https://www.scidac.gov.

Applications to SciDAC that involve software products should demonstrate the need for the software being developed in one or more scientific communities and should address both the dissemination of the software and the strategy for the software's long-term sustainability after the end of the proposed activities.

Other partnerships between discipline scientists, applied mathematicians, and computer scientists are also supported.

Subprogram Contacts:

- Kalyan Perumalla, Kalyan.Perumalla@science.doe.gov, SciDAC Institutes
- Steven Lee, Steven.Lee@science.doe.gov, SciDAC Institutes
- Lali Chatterjee, Lali.Chatterjee@science.doe.gov, SciDAC Institutes and Partnerships
- David Rabson, david.rabson@science.doe.gov, SciDAC Institutes and Partnerships, other partnerships
- Marco Fornari, marco.fornari@science.doe.gov, Computational Partnerships with Basic Energy Sciences

Website: https://science.osti.gov/ascr/Research/scidac

(d) Advanced Computing Technologies

This activity supports the Research and Evaluation of Prototypes (REP), including in quantum computing and networking. The REP activity addresses the challenges of next generation computing systems. By actively partnering with the research community, including industry and Federal agencies, on the development of technologies that enable next-generation machines, ASCR ensures that commercially available architectures serve the needs of the scientific community. The REP activity also prepares researchers to effectively use future generation of scientific computers, including novel technologies, and seeks to reduce risk for future major procurements.

Additionally, this subprogram provides graduate research training for the next generation of scientists as well as activities supporting career development, and broadening participation, in high-end computational science.

Research topics currently of interest for Advanced Computing Technologies (ACT) include:

- Research focused on information processing and computation systems for emerging computing technologies (including quantum computing and networking technologies) which aim to enable testbed use, including hardware architectures, accelerators, development of programming environments, languages, libraries, compilers, simulators and other modeling tools, and research and development on their algorithms for physical simulation and capability assessment.
- Neuromorphic computing: Specific to HPC-enabled modeling and simulation of computing architecture at extreme scales for generalizable applications of the proposed approach and for the prototyping and fabrication of advanced neuromorphic computing architectures.
- Microelectronics for scientific computing, including innovative methods for processor synthesis, placement, architectures, and algorithms. Especially of interest are multi-disciplinary co-design projects where each scientific discipline informs and engages the other to achieve orders of magnitude improvements in system-level performance.
- The maintenance and improvement of the software ecosystem, including that developed through the Exascale Computing Project (ECP), which provides shared software packages, novel evaluation systems, and applications relevant to the science and engineering requirements of DOE, in order that the full potential of the current and future computing systems deployed by DOE can be continuously realized.

Proposed research in quantum computing should focus on applications of quantum computing relevant to SC and on devices that are already available or that become available during the term of the award rather than large-scale, high-fidelity, fault-tolerant machines.

Topics that are out of scope include:

- Research that does not address the specific ACT topics described above;
- Development of new candidate qubit systems or improvements to physical qubits;
- Cryptography and cryptanalysis; and
- Projects that are duplicative of, or competitive with, industry efforts.

Submission of preliminary research descriptions (e.g., preapplications, concept papers) is strongly encouraged. They will be reviewed for responsiveness of the proposed work to the research topics. Send an email to a subprogram contact for information regarding format and content.

Subprogram Contacts:

- Robinson Pino, Robinson.Pino@science.doe.gov, neuromorphic and heterogeneous computing architectures
- Robinson Pino, Robinson.Pino@science.doe.gov and David Rabson, David.Rabson@science.doe.gov, microelectronics
- Kalyan Perumalla, Kalyan.Perumalla@science.doe.gov and Marco Fornari, Marco.Fornari@science.doe.gov, quantum computing research and evaluation prototypes
- Hal Finkel, Hal.Finkel@science.doe.gov; William Spotz, William.Spotz@science.doe.gov; David Rabson, David.Rabson@science.doe.gov; Robinson Pino, Robinson.Pino@science.doe.gov, maintenance and improvement of the software ecosystem
- Christine Chalk, Christine.Chalk@science.doe.gov, Graduate research training and broadening participation

Website: https://science.osti.gov/ascr/

2. Basic Energy Sciences (BES)
Program Website: https://science.osti.gov/bes/

The mission of the Basic Energy Sciences (BES) program is to support fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels. BES research provides scientific foundations for DOE missions in energy, environment, and national security. The portfolio supports fundamental research in materials sciences, chemistry, geosciences, and biosciences. The BES website listed above includes more detailed information such as descriptions of program areas, workshop reports that address future directions, and Principal Investigator (PI) meeting summaries.

The following web pages are listed for convenience:

- BES Workshop Reports: http://science.osti.gov/bes/community-resources/reports/
- Materials Sciences and Engineering Division PI Meetings:

http://science.osti.gov/bes/mse/principal-investigators-meetings/
- Chemical Sciences, Geosciences, and Biosciences Division PI Meetings: http://science.osti.gov/bes/csgb/principal-investigators-meetings/
- Scientific User Facilities Division web page: http://science.osti.gov/bes/suf/

Proposed research must be responsive to a supported topic in one of the core research areas listed in this document. Overarching research priorities relevant to multiple core research areas are described in the bulleted list below.

- **Fundamental Science to Enable Clean Energy**: Research to provide understanding and scientific foundations for clean energy.
- **Critical Materials/Minerals**: Research to understand the fundamental properties of rare earth and platinum group elements to improve separation and extraction processes and to enable discovery and design of alternates to critical materials that will reduce or eliminate their need.
- **Fundamental Science to Transform Processing and Fabrication**: Research to understand fundamental chemical and materials processes for circular, clean, and scalable synthesis, processing, and fabrication; to advance transformational operando characterization and multiscale models and tools; and to co-design materials and processes.
- **Artificial Intelligence and Machine Learning (AI/ML)**: Research to advance data science and AI/ML to accelerate fundamental research for the discovery of new chemical mechanisms and material systems with exceptional properties and function, and to apply these techniques for effective user facility operations and interpretation of massive data sets.

Notes For Applicants:
- Applications submitted to BES through this NOFO typically have Project Narratives that are 15 – 20 pages long. If applicants feel that additional pages are needed for the Project Narrative, prior to submission they should discuss the requested increase with the relevant subprogram contact listed in this NOFO.
- Prior to submission, applicants are encouraged to contact program managers (subprogram contacts, listed below) to discuss research ideas. While white papers/pre-applications are encouraged, they are not required.
- BES and SC Office Hours provide an opportunity to learn about BES and SC programs and to ask questions. To sign up for future virtual office hours or find recordings and slides from past events, visit https://science.osti.gov/bes/officehours.
- Resources about PIER plans are available at https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans.
- Resources about Data Management Plans are available at https://science.osti.gov/funding-opportunities/digital-data-management.

The BES divisions, program areas, and their objectives follow:

Materials Sciences and Engineering
Division Website: https://science.osti.gov/bes/mse

The Materials Sciences and Engineering (MSE) Division supports fundamental experimental, theoretical, and computational research to provide the knowledge base for the discovery and design of new materials with novel structures, functions, and properties. This knowledge serves as a basis for the development of new materials for energy and national priorities. The MSE research portfolio consists of the research program areas listed below.

(a) Materials Chemistry

This program supports hypothesis-driven research on materials with a focus on the role of chemical reactivity, chemical transformation, and chemical dynamics on the material composition, structure, function, and lifetime across the range of length scales from atomic to mesoscopic. Discovery of the mechanistic detail for chemical synthesis, transformations and dynamics of materials, fundamental understanding of structure-property relationships of functional materials, and utilization of chemistry to control interfacial properties and interactions between materials are common themes.

Major scientific areas of interest include: (1) Fundamental aspects of chemical synthesis, including covalent and non-covalent assembly of materials from molecular-scale building blocks and macromolecular-to-macromolecular transformations; (2) Synthesis and characterization of new classes of materials including hierarchical materials or other innovative assemblies of matter with novel functionality; (3) Exploitation of extreme and/or non-equilibrium conditions leading to new materials discovery; (4) Control of interphase chemistry and morphology; (5) Fundamental electrochemistry and related charge transport in materials; (6) Chemical dynamics and transformations of functional materials in operational environments; and (7) Development of new tools and techniques for the elucidation of chemical processes in materials, particularly *in situ* or *operando* studies of materials in energy-relevant environments.

Specific topics of interest are aligned with recent BES roundtable and workshop reports and include fundamental understanding of the chemical interactions of materials with hydrogen or carbon dioxide, novel approaches to the chemical conversion of polymers, fundamental investigations of rare earth compounds and other critical materials leading to earth-abundant alternatives, discovery of materials with spin-selective electronic functionality, and new approaches to materials discovery using data-driven science such as AI/ML.

Research will not be supported if it is primarily aimed at optimization of properties of materials for specific applications, optimization of synthetic methods (including non-science-based scale-up research), device fabrication and testing, or synthesis of small molecules. Applications focused on the elucidation of mechanisms of catalytic reactions, particularly with single-site or single-atom catalysts, will not be supported.

Subprogram Contact:
- Christopher Chervin, christopher.chervin@science.doe.gov
- Craig Henderson, craig.henderson@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Materials-Chemistry

(b) Biomolecular Materials

This program supports fundamental materials science research for discovery, design and synthesis of functional materials and complex structures based on principles and concepts of biology. Biology provides a blueprint for organizing and manipulating matter, energy, entropy, and information across multiple length scales to build material systems that display complex yet well-coordinated collective behavior. The major programmatic direction is on the science-driven creation of materials and multiscale systems that exhibit well-coordinated functionality and information content approaching that of biological materials but capable of functioning under extreme, non-biological environments. This research activity seeks innovative fundamental science approaches for co-design and scalable synthesis of materials that coherently and actively manage multiple complex and simultaneous functions and tolerate abuse through autonomous repair and regrowth. New synthetic approaches and unconventional assembly pathways are sought to accelerate discovery of materials. An area of emphasis will be activities to understand and control assembly mechanisms to seamlessly integrate capabilities developed for one length scale across multiple length scales as the material is constructed. Included is development of predictive models and AI/ML for data-driven science that accelerate materials discovery and support fundamental science to direct clean, energy efficient scalable synthesis with real-time adaptive control.

Major scientific areas of interest are: self, directed, and dissipative assembly to form resilient materials with self-regulating capabilities such as reconfiguration of morphology and function, autonomous self-healing and growth, control of active matter, and non-equilibrium information and signaling processing; management of precise functional group positioning and component interactions across multiple time and length scales; and design and creation of next-generation materials that incorporate low-energy mechanisms for programmable selectivity and active management of energy and fluid transport.

The program will not support projects that lack a clear focus on fundamental materials science or are aimed at optimization of materials properties for any applications, device fabrication, sensor development, tissue engineering, understanding of underlying biological synthetic or assembly processes, biological research, or biomedical research.

Subprogram Contact:
- Aura Gimm, aura.gimm@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Biomolecular-Materials

(c) Synthesis and Processing Science

This program supports research to understand the physical phenomena and unifying principles that underpin materials synthesis and processing across multiple length scales. Some of these

phenomena include diffusion, nucleation, and phase transitions and the role imperfections and interfaces play in the emergence of materials functionality. The emphasis is on hypothesis-based research that enables discovery of new materials, from quantum to bulk dimensionalities, with targeted composition, structure, and function. New crystal growth methods, thin-film deposition techniques, and post-processing techniques are needed to create complex materials, including new states of matter or discoveries under non-equilibrium conditions and through (multi-) scale and external interactions. The program also is interesting in understanding complex synthesis and processing relationships, for example time-temperature-transformation diagrams (TTT), transition state surfaces, or the effect of substrate (stress/strain) or precursor (kinetic energy/structure) states on film growth.

The program emphasizes innovative research to understand materials growth kinetics and mechanisms, especially as they relate to the science of advanced low-carbon fabrication processes, organic and inorganic film deposition with controlled defects, and the organization of multifaceted mesoscopic hierarchical assemblies. Topics targeted for increased emphasis are emerging areas of research that examine (1) fundamental processes to reduce energy consumption for physical deposition processes, (2) meta-stable intermediates for phase and composition transformations, (3) the role of localized external fields in directing growth processes, and (4) the direct conversion of natural minerals or end-of-life materials into new functional alternatives. Applications are sought that focus on creative coupling of physical synthesis, processing techniques, and solution-based chemistry with computational/theory approaches, including AI/ML and automated synthesis for data-driven science. Additionally, projects emphasizing the development of real-time diagnostic tools and characterization techniques to understand the fundamental science of nucleation and structure/composition for atomic level control, and computational approaches bridging multiple timescales are encouraged.

Projects aimed at controlling synthesis to direct optimization or engineering of properties will be de-emphasized. In addition, research will not be supported that focuses primarily on device fabrication, device development, or any optimization based on known processing or synthesis principles.

Subprogram Contact:
- James Dorman, james.dorman@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Synthesis-and-Processing-Science

(d) Experimental Condensed Matter Physics

This program supports research that will advance our fundamental understanding of the quantum physics governing the electronic structure of complex materials and will allow us to achieve new materials functionalities through the coherent manipulation and control of collective excitations and quasiparticles in solids. Research supported by the program focuses on systems whose behavior derives from correlation effects as manifested in superconducting, semiconducting, magnetic, ferroelectric, thermoelectric, and optical properties. The goal is to understand microscopic collective behavior emerging from nontrivial band topology, low dimensionality, and interplay of charge, spin, valley, and orbital degrees of freedom. The Experimental Condensed Matter Physics program supports design, synthesis, and characterization of new

material systems whose electronic properties derive from quantum effects and cannot be described by semiclassical paradigms. Also supported is the development of new experimental techniques for characterizing the electronic states and properties of materials of interest, with emphasis on non-equilibrium phenomena and characterizations in situ, in operando, or under extreme conditions.

The incorporation of computational tools and scientific machine learning algorithms is encouraged to the extent that these methods can significantly expedite experimental predictions and validations. Scientific machine learning frameworks should be designed to enhance the proposed experimental workflows beyond traditional data analysis. These methods should be fully integrated within the research tasks, domain-aware, interpretable, and robust. Examples of scientific machine learning approaches that align with experimental condensed matter physics goals are: 1) efficiently extracting critical and strategic information from large, complex data-sets; 2) enabling real-time capabilities to acquire and analyze large data volumes and steer data collection for in-the-loop experiments; 3) extracting knowledge from published data and contributing to data repositories to aid materials design and discovery; and 4) supporting high-throughput combinatorial synthesis and characterization.

Targeted materials systems and phenomena should aim at advancing our scientific understanding of emergent states of matter enabling new clean energy technologies, quantum technologies, and next-generation, energy-efficient microelectronics. This program also supports research to reduce or eliminate critical materials and minerals while maintaining functionality in a wide range of clean technologies for the production, storage, distribution, and conversion of energy.

Growth areas for the program include emergent quantum phenomena in topological materials, e.g., topological superconductors and Dirac/Weyl semimetals. Of particular interest are quantum phenomena associated with flat bands, strong spin orbit coupling, fractional and chiral states, spin liquids and frustrated magnetism, phononic/magnonic interactions, and moiré effects in van der Waals bonded heterostructures. Additional areas of interest include the study of interactions at the interfaces of heterostructures comprising organic and inorganic quantum materials, resulting in functionalities that are not accessible to inorganic materials alone.

Research focused on studies of materials' microstructure to enhance materials' performance, either structural or electronic, is not supported by this program. Areas of decreasing emphasis include heavy fermion (non-topological) superconductivity and 2D electron and hole gases in conventional semiconductors. The program will not consider applications on cold atom physics, conventional superconductivity, bulk semiconductor physics (e.g., Si, GaAs), device development, materials property optimization, and/or incremental optimization of known phenomena.

Subprogram Contacts:

- Claudia Cantoni, Claudia.Cantoni@science.doe.gov
- Tim Mewes, Tim.Mewes@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Experimental-Condensed-Matter-Physics

(e) Theoretical Condensed Matter Physics

This program supports fundamental research in quantum physics by advancing our fundamental understanding of quantum materials and out-of-equilibrium quantum systems, driving materials discovery and design, and leading to novel materials theory related to DOE missions.

Major scientific themes include electron correlations, quantum phases of matter, topological states of matter, quantum magnetism, superconductivity, multiferroic or ferroelectric materials, and excited states phenomena. Research spans from analytical to computational approaches with a strong emphasis on theory, methods, and technique development, as well as prediction and interpretation of novel quantum phenomena.

Growth areas focus on (a) quantum dynamics in matter, including driven and many-body quantum dynamics; (b) novel and emergent materials behavior addressing quantum phenomena; (c) materials exploiting quantum interactions, for example photon/phonon/magnon/electron interactions; (d) discovery and design of functional materials, that for example reduce or eliminate the need of critical materials/minerals, or revolutionize memory, data storage, and/or power conversion; and (e) development and use of advanced theoretical and computational methods, including computational design of quantum materials with atomic precision, and innovative physics-guided AI approaches to accelerate fundamental research.

Areas of decreasing emphasis include quantum phase transitions, fractional quantum Hall effect, wide bandgap and conventional semiconductors, and high-throughput calculations. Soft matter, polymers, glasses, granular materials, cold atoms, classical transport, classical molecular dynamics, and optimization of physical properties are not priorities.

Subprogram Contacts:

- Matthias Graf, matthias.graf@science.doe.gov
- Claudia Mewes, claudia.mewes@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Theoretical-Condensed-Matter-Physics

(f) Physical Behavior of Materials

This program supports basic research to advance understanding of fundamental processes that take place in materials and in response to external stimuli, such as temperature, electromagnetic fields, chemical dopants and disorder, the proximity effects of surfaces and interfaces, and strain. The program emphasizes research on the structure-property relationships to physical behavior of materials, such as the relationship of atomic structure and crystal defects leading to semiconducting, superconducting, and magnetic properties, including novel diffusion and transport phenomena. The research should seek to understand how materials generate, transmit, and store energy. A detailed understanding of how a material's behavior can be influenced by the surroundings is critical to the understanding of photon generation and harvesting; spin, charge and heat transport; and novel magnetic and magnetocaloric materials.

The areas targeted for increased emphasis include fundamental materials research to support future microelectronics, spintronics and light-matter interactions in the fields of excitonics, and plasmonics.

Areas targeted for decreased emphasis in this program include conventional semiconductor physics, and research focused on theory and modeling of defects in crystals and their influence on the structural properties of materials (topics covered by the Mechanical Behavior and Radiation Effects program).

Subprogram Contact:
- Refik Kortan, refik.kortan@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Physical-Behavior-of-Materials

(g) Mechanical Behavior and Radiation Effects

This program supports basic research to understand defects in materials and their effects on the properties such as strength, structure, deformation, and failure. Defect formation, growth, migration, and propagation are examined by coordinated experimental and modeling efforts over a wide range of spatial and temporal scales as well as a range of environments and stimuli. Topics include deformation of nanostructured materials, fundamentals of radiation damage, corrosion/stress-corrosion cracking in conjunction with radiation or stress, and research that would lead to microstructural design for tailored strength, radiation response, formability, and fracture resistance in energy-relevant materials. In addition to traditional structural materials, this program will also support research to understand fundamental deformation and failure mechanisms of other materials used in energy systems (e.g., polymers, membranes, coating materials, electrodes). Within these areas, research on topics such as driven systems, new materials and non-linear cooperative phenomena (multiple inputs, e.g. radiation + stress + corrosion) are of interest. There will be an increased emphasis in the program on research to understand defect evolution in materials in radiation environments. Applicants focusing on radiation effects are encouraged to consider the priority research directions and priority research opportunities in the reports from the 2017 Basic Research Needs Workshop for Nuclear Energy and the 2022 Roundtable on Foundational Science to Accelerate Nuclear Energy Innovation. Of particular interest to this program overall are applications that take advantage of advanced synthesis methods to create tailored structures that better isolate mechanisms, high-performance computing and data science techniques, and advanced characterization techniques such as neutron or x-ray scattering. These fundamental science efforts should be related to DOE's mission areas, and may also impact advanced fabrication and AI/ML.

Research will not be supported if it is primarily aimed at optimization of properties of materials for specific applications or focused on developing simple structure-property correlations. Applications emphasizing high-strain-rate deformation, high-dose radiation, or mechanics of materials (rather than materials science) will not be considered responsive.

Subprogram Contact:

- John Vetrano, john.vetrano@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Mechanical-Behavior-and-Radiation-Effects

(h) Quantum Information Science in Materials Sciences and Engineering

This program supports research in Materials Sciences and Engineering (MSE) to advance fundamental understanding of quantum phenomena in support of crosscutting MSE Division research areas (Materials Discovery, Design, and Synthesis; Condensed Matter and Materials Physics; Scattering and Instrumentation Sciences) within the Office of Basic Energy Sciences (BES).

This program encompasses topics described in the Basic Energy Sciences Roundtable: Opportunities for Basic Research for Next-Generation Quantum Systems and Basic Energy Sciences Roundtable on Opportunities for Quantum Computing in Chemical and Materials Sciences reports. The program also supports characterization of QIS-relevant materials, and the use or development of cutting-edge techniques to measure fundamental quantum phenomena, with the goal of advancing understanding.

Applications must propose fundamental research with potential transformative impact. Applications must address one or more of the eight Priority Research Opportunities identified in the two BES Roundtable Reports mentioned above. Additionally, applications must propose science that is aligned with one or more of MSE Division research areas, as described in this NOFO. This program will not fund applications that are solely based on engineering, manufacturing of prototypes/devices, or optimization of hardware.

Subprogram Contact:

- Athena Sefat, athena.sefat@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Quantum-Information-Sciences

(i) X-Ray Scattering

This program supports basic research on the fundamental interactions of photons with matter to achieve an understanding of atomic, electronic, and magnetic structures and excitations and their relationships to materials properties, including the dynamics of quantum phenomena. The main emphasis is on x-ray scattering, spectroscopy, and imaging research, primarily at major BES-supported user facilities. Instrumentation development and experimental research in ultrafast materials science, across the full electromagnetic spectrum, is an integral part of the portfolio. This includes research aimed at manipulating and detecting ultrafast transient physical phenomena in materials, especially at excitation levels consistent with quantum phenomena and controlled energy conversion and transport.

Advances in x-ray scattering and ultrafast sciences will continue to be driven by scientific opportunities presented by improved source performance and optimized instrumentation, especially with the advent of improved synchrotron coherence and free electron laser sources.

The x-ray scattering activity will expand current capabilities at the DOE facilities by providing support for independent external researchers who motivate and lead new instrumentation and technique development at those facilities. For example, research is sought that will take advantage of unprecedented levels of coherent brightness and of controlled timing structures at upgraded light source facilities.

New investments in ultrafast science will emphasize development of novel ultrafast techniques and focus on research that uses radiation sources associated with BES facilities and beamlines. New pump schemes to manipulate dynamic states of quantum materials will be supported, especially those which can be adapted to x-ray free-electron laser and ultrafast electron diffraction probe environments. Additionally, new approaches to improve the collection, processing and analysis of large data sets obtained with high repetition-rate pulsed sources or with fast multi-mega-pixel detector arrays are encouraged under the cross-cutting emerging domain of Data Sciences.

Novel X-ray techniques are sought that enable detailed investigations of the fundamental dynamic mechanisms of energy conversion systems and their active material components. This involves the interaction of complexity at atomic to mesoscopic length scales and requires the development of multimodal experimental techniques that examine the same active sample positions, in place and under operational boundary conditions. Of particular emphasis for new energy saving quantum computation is the in-place study of the evolution of quantum properties and phase transitions at the shortest relevant time scales.

The program will not support research considered "mature use" of existing x-ray or ultrafast techniques. Typically, the emphasis on new techniques enables new access to inhomogeneous and dynamic systems and therefore the program will de-emphasize steady-state research of bulk and equilibrium systems.

Subprogram Contact:
- Lane Wilson, lane.wilson@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/X-Ray-Scattering

(j) Neutron Scattering

This program supports hypothesis-driven research to understand atomic, molecular, electronics and magnetic structures and excitations, and their relationships to macroscopic properties, including, mechanical, thermal, electronic, magnetic, and topological. Neutron scattering, spectroscopy, and imaging research performed primarily at DOE neutron facilities should be central to pursuit of the research. Transformative research involving hard and/or soft matter will be considered.

The scientific research should leverage advances in neutron scattering driven by improved source performance, instrumentation, and advanced data acquisition and analysis approaches. The neutron scattering activity will expand current capabilities at DOE neutron facilities by providing support for research that motivates and leads new instrumentation and technique developments. Research is sought to identify fundamental mechanisms governing the response of materials to

out-of-equilibrium (including operando) conditions as achieved through correlation of neutron detection with driven changes of sample environment, and concepts to analyze such measurements. New approaches to improve the collection and analysis of large data sets in raw form obtained with high repetition-rate pulsed sources or pulsed sample environment or fast multi-mega-pixel detector arrays are encouraged.
Scientific research supported by this activity should enable growth of the neutron scattering community, such as through engagement of postdocs and students and efforts to make data widely accessible.

The program will not support research considered mature or routine use of neutron scattering techniques. Typically, the emphasis on new techniques enables new access to inhomogeneous and dynamic systems and therefore the program will de-emphasize research of bulk systems in quiescent conditions, or research resulting in incremental advances of understanding of materials.

Subprogram Contact:
- Michael Fitzsimmons, Michael.Fitzsimmons@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Neutron-Scattering

(k) Electron and Scanning Probe Microscopies

This program supports basic research in materials sciences using advanced electron and scanning probe microscopy and related spectroscopy techniques to understand the atomic, electronic, and magnetic structures and properties of materials. This activity also supports the development of new instrumentation concepts and quantitative techniques to advance materials characterizations. Supported advancements include ultrafast electron diffraction and imaging techniques. The goal is to develop a fundamental understanding of materials, including quantum phenomena, through advanced microscopy, spectroscopy, and the associated theoretical tools.

This activity emphasizes innovative research using electron and scanning probe microscopy techniques for groundbreaking science. These include understanding and controlling nano- or meso-scale inhomogeneity and investigations of the interplay among the quantum observables (e.g., charge, spin) that produce unique properties. Research topics include imaging the functionality of materials and investigation of electronic structure, spin dynamics, magnetism, phase transitions; transport properties from atomistic to mesoscopic length scales; and data science methods in microscopy and data analysis including machine learning and artificial intelligence. Progress in materials research requires development of innovative techniques and probes that harness quantum behavior in their characterization schema, as well as the utilization of imaging and spectroscopic techniques for the understanding and control of material or defect formation and properties at the atomic or nanometer scales. Advanced *in situ* analysis capabilities for the study of time-dependent phenomena, including dynamics of quantum materials using ultrafast techniques, is also an area of interest in the program.

The program will not support research considered to be “mature use” of microscopy techniques or device development. Electron and scanning probe efforts, including technique development, that is proposed without associated scientific goals or is motivated primarily by support of other

funded research will not be considered. Research focused on conventional superconductivity will be de-emphasized.

Subprogram Contact:
- Jane Zhu, jane.zhu@science.doe.gov

Website: https://science.osti.gov/bes/mse/Research-Areas/Electron-and-Scanning-Probe-Microscopies

Chemical Sciences, Geosciences, and Biosciences
Division Website: https://science.osti.gov/bes/csgb/

The Chemical Sciences, Geosciences, and Biosciences (CSGB) Division supports experimental, theoretical, and computational research to provide fundamental understanding of chemical transformations and energy flow in systems relevant to DOE missions.

Five synergistic, fundamental research themes are at the intersection of multiple CSGB research focus areas: *Ultrafast Chemistry* develops and applies approaches to probe the dynamics of electrons that control chemical bonding and reactivity, to understand energy flow and elucidate structural dynamics in chemical transformations. *Chemistry at Complex Interfaces* addresses the challenge of uncovering emergent chemical phenomena at dynamic interfaces with structural and functional heterogeneity. *Charge Transport and Reactivity* elucidates the contributions of charge dynamics to energy flow and its coupling to reactions. *Reaction Pathways in Diverse Environments* discovers the influence of nonequilibrium, heterogeneous, nanoscale environments on complex reaction mechanisms. *Chemistry in Aqueous Environments* addresses the unique properties of water in extreme environments and the role aqueous systems play in energy and chemical conversions.

(l) Atomic, Molecular, and Optical Sciences

This program is focused on fundamental, hypothesis-driven research in ultrafast chemical sciences. The program supports basic experimental and theoretical research aimed at understanding the structural and dynamical properties of atomic and molecular systems. The research targets fundamental interactions of photons and electrons with atomic and molecular systems to characterize and control their behavior. The program aims to develop accurate quantum mechanical descriptions of ultrafast dynamical processes, such as charge migration and transfer, chemical bond breaking and forming, and interactions in strong fields, where electron-electron and electron-nuclei correlations are important. Topics of interest include the development and use of novel, ultrafast probes of matter; the interactions of molecules with intense electromagnetic fields; and the control of quantum phenomena in molecular systems.

The Atomic, Molecular, and Optical Sciences (AMOS) activity will continue to support science that advances DOE mission priorities, including research that contributes to the development of a fundamental understanding of excitation dynamics and charge transfer relevant to the initial steps in clean solar energy conversion. The AMOS program will continue to have a prominent role at BES facilities in understanding and controlling the interaction of intense, ultrafast x-ray pulses with matter. Key targets for greater investment include attosecond science, ultrafast x-ray

science, and ultrafast electron diffraction from molecular systems. Although the program has supported compelling research in atomic systems, an emphasis will be placed on research that elucidates ultrafast dynamics in molecular systems of increasing complexity. Closely related experimental and theoretical efforts are encouraged. The AMOS program will consider applications on fundamental research aimed towards understanding and control of quantum phenomena in molecular systems. Projects involving technical development of sources or instrumentation must include a well-integrated scientific research focus.

The program emphasizes ultrafast, strong-field, short-wavelength science, and studies of correlated dynamics in molecules. Examples include ultrafast x-ray science at the Linac Coherent Light Source (LCLS-II) and the use of high-harmonic generation or its variants for probing ultrafast dynamics. Applications of these light sources include ultrafast imaging of chemical reactions, inner-shell photoionization of atoms and molecules, and probing and controlling non-adiabatic dynamics. The program encourages research exploiting next-generation capabilities of x-ray free electron lasers and modern data science approaches to provide new insights to electronic and molecular dynamics occurring on the attosecond-to-femtosecond time scale and to reveal key intermediate states in chemical reactions. Coherent control of nonlinear optical processes and tailoring of quantum mechanical wave functions with lasers will continue to be of interest, particularly in molecular systems. The program will continue to support the use of experimental and theoretical tools to advance the understanding of low-energy electron-molecule interactions in the gas and condensed phases.

The AMOS program **is not** accepting applications in the areas of plasma physics, nanoscience, and science of ultracold systems.

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(m) Gas Phase Chemical Physics

This program supports research on fundamental gas-phase chemical processes that provide understanding and scientific foundations for clean energy and transformative manufacturing Research in this program explores chemical reactivity, kinetics, and dynamics in the gas phase at the level of electrons, atoms, molecules, and nanoparticles. A continuing goal of this program is to understand energy flow and reaction mechanisms in complex, nonequilibrium, gas-phase environments. A new crosscutting theme for the GPCP program concerns systems chemistry, in which complex molecular behavior emerges from ensembles of molecules or large reaction networks in the gas phase. The GPCP program seeks to understand, model, and ultimately control this emergent molecular complexity. Of particular interest are reactions included in gas phase and/or gas/surface chemical reaction networks. In such reaction networks emergent behavior manifests as a significant and possibly precipitous change in chemical reaction rates, branching ratios, particle growth, and/or product energy distributions with changes in conditions,

e.g., temperature, pressure, ion concentration (plasma) and elementary reactions included in the reaction network.

The major focus of research in this area is in five thrust areas (*Light-Matter Interactions, Chemical Reactivity, Gas-Particle Interconversion*, *Gas-Surface Chemical Physics* and *Ultrafast Imaging/Spectroscopy*).

- *Light-Matter Interactions* includes research in the development and application of novel tools, such as molecular spectroscopy, for probing the nuclear and electronic structure of gas-phase molecules to enable chemical and physical analysis of heterogeneous and dynamic gas-phase environments and to understand the dynamic behavior of isolated molecules, such as energy flow (e.g., relaxation of excited states), nuclear rearrangements, and quantum phenomena. Applications are encouraged that develop automated methods based on AI/ML methods to facilitate the analysis of complex molecular spectra or seek to improve the understanding of quantum phenomena.
- *Chemical Reactivity* comprises research in chemical kinetics and mechanisms, chemical dynamics, collisional energy transfer, and construction of, and calculations on, molecular potential energy surfaces to develop fundamental insight into energy flow and chemical reactions important in clean energy and transformative manufacturing processes. Applications are encouraged that develop AI/ML methods for the construction of potential energy surfaces and optimization of chemical kinetic mechanisms.
- *Gas-Particle Interconversion* comprises research on the chemistry of small gas-phase particles, including their interactions with gas-phase molecules and dynamic evolution to understand the molecular mechanisms of formation, growth, and transformation (such as evaporation, phase transition, and reactive processing) of small particles.
- *Gas-Surface Chemical Physics* retains a strong emphasis on molecular-scale investigations of gas-phase chemical processes with the goal of gaining a better understanding of the cooperative effects of coupling gas-phase chemistry with surface chemistry. Applications are encouraged that explore the cooperative effects of gas-surface coupling for systems relevant to clean energy or transformative manufacturing.
- *Ultrafast Imaging/Spectroscopy* includes studies of the short timescale phenomena underlying photochemical and photophysical processes, such as photodissociation, isomerization, and nonadiabatic dynamics. Applications are encouraged that develop AI/ML methods for analyzing ultrafast images/spectra or to provide insight into chemical systems associated with clean energy or transformative manufacturing.

Other areas of recent increased emphasis include:

- benchmarking theoretical calculations via quantum state resolved experimental measurements of state-to-state chemical dynamics at conditions where quantum effects are significant,
- understanding and controlling upcycling chemical reaction mechanisms that transform polycyclic aromatic hydrocarbons (PAHs) and/or consume CO_2 into high value products, and

- understanding and controlling electron-driven chemistry, especially the chemistry of low temperature plasmas.

The Gas Phase Chemical Physics program does **not** support research in non-reacting fluid dynamics (transport phenomena including computational fluid dynamics); reacting and non-reacting turbulent flow and the impact of transport of chemical reactions; spray dynamics; data-sharing software development; end-use combustion device development; and characterization or optimization of end-use combustion devices.

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(n) Computational and Theoretical Chemistry

This program supports fundamental research for the sustained development and integration[4] of new and existing theoretical and massively parallel computational approaches for the deterministic, accurate and efficient prediction of chemical processes and mechanisms relevant to the DOE missions. Part of the focus is on simulation of dynamical processes that are so complex that efficient computational implementation must be accomplished in concert with development of new theories and algorithms. Efforts must be tightly integrated and provide theories and computational approaches to advance the fundamental science of at least one of the overarching research priorities for FY 2025 as listed at the start of the BES program description section (above). Applications may include the development or improvement of modular computational tools that enhance interpretation and analysis of advanced experimental measurements, including those acquired at DOE user facilities, or efforts aimed at enhancing the accuracy, precision, applicability and scalability of quantum-mechanical simulation methods. Also included are development of spatial and temporal multiscale methodologies that allow for time-dependent simulations of coherent and dissipative processes as well as rare events. Development of novel theories and simulation capabilities for theory-guided control of externally driven electronic and spin-dependent processes in real environments is encouraged.

The Computational and Theoretical Chemistry (CTC) focus for FY 2025 is on the innovation of predictive mechanistic theories and practical, systematically improvable and hierarchical methods for describing and simulating dynamical processes occurring in complex molecular ensembles and environments. Topics of interest within this focus include the development and integration of correlated and/or stochastic quantum chemical and quantum dynamical approaches for the accurate simulation and prescriptive design of (i) systems-level behaviors and other emergent functionalities and phenomena for manipulating information and energy transduction, with specific emphasis on dynamical chemical systems that exploit coordinated effects of chirality, topology, and magnetoelectric interactions to achieve novel functionalities, (ii) non-biological autocatalytic cooperative reaction networks and mechanisms, such as those leading to directed molecular assembly and/or replication processes, or (iii) correlated multi-

[4] A Perspective on Sustainable Computational Chemistry Software Development and Integration, R. Di Felice et al., J. Chem. Theory Comput. 2023, 19, 7056. https://DOI.org/10.1021/acs.jctc.3c00419.

electron and/or multi-photon governed chemical transformation and energy transduction processes in field-driven complex open quantum systems, including those that may require non-Hermitian or non-memoryless dynamical approaches to describe their behavior.

CTC does **not** support projects based exclusively on (i) the "mature use" of presently available implementations of computational and theoretical chemistry methods and/or approaches, or (ii) the development of phenomenological models and empirical parameterization of models. AI/ML focused efforts in CTC must develop algorithms and methods to advance the current state-of-the-art in exascale or quantum hardware-based simulations of chemical systems and processes for fundamental knowledge discovery. Applications to CTC focused on the development of density functional approximations or machine-learned potentials are not encouraged. Methods for, or applications to, systems that do not explicitly consider rearrangements of quantum-mechanical degrees of freedom are not supported.

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(o) Condensed Phase and Interfacial Molecular Science

This program emphasizes basic research at the boundary of chemistry and physics, pursuing a molecular-level understanding of chemical and physical processes in liquids and at interfaces. With its foundation in chemical physics, the impact of this crosscutting program is far reaching, providing understanding and scientific foundations underpinning a variety of areas of importance to the DOE, including energy, chemical synthesis and manufacturing, and microelectronics. The Condensed Phase and Interfacial Molecular Science (CPIMS) program also supports efforts related to research priorities such as Artificial Intelligence and Machine Learning that can form the basis for new approaches to understanding science questions of interest to the CPIMS program.

Experimental and theoretical investigations in the gas phase, condensed phase, and at interfaces aim at elucidating the molecular-scale chemical and physical properties and interactions that govern chemical reactivity, solute/solvent structure, and transport. Studies of reaction dynamics at well-characterized surfaces and clusters lead to the development of theories on the molecular origins of surface-mediated catalysis and heterogeneous chemistry. Studies of model condensed-phase systems target first-principles understanding of molecular reactivity and dynamical processes in solution and at interfaces. The transition from molecular-scale chemistry to collective phenomena in complex systems is also of interest, allowing knowledge gained at the molecular level to be exploited through the dynamics and kinetics of collective interactions. In this manner, the desired evolution is toward predictive capabilities that span the microscopic to nanoscale domains, enabling the understanding of molecular-scale interactions as well as their role in complex, collective behavior at larger scales. A molecular level understanding of complex molecular systems is sought, capturing the essence of chemical behavior, knowledge of the main molecular-level driving forces behind the behavior, and discovery of universal principles that can be applied more widely.

The CPIMS program seeks increased emphasis in Systems Chemistry, for which energy is provided to dissipative systems at the molecular level, seeking to understand how interacting molecular networks can lead to emergent reactive behavior. Examples include reaction-diffusion systems, positional information, compartmentalized reaction networks, substrate-induced reactive systems, chemical replication, and the chemical dynamics of nonequilibrium catalysis. The CPIMS program seeks increasing emphasis on chemistry at the boundaries of condensed matter physics, including where unexpected emergent behavior has been identified. Examples of recent CPIMS-supported projects in this area include a study of how chemical reactions might be supported at the surface of topological materials, another studying the impact of Moiré effects on electrochemistry, and another that explores use of the theories of topological physics to change the way chemical reactions are understood and manipulated.

The CPIMS program does **not** fund research in mechanics or dynamics of bulk fluids, technological applications, or device development.

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(p) Quantum Information Science Research in Chemical Sciences, Geosciences, and Biosciences

This program supports fundamental research at the intersection of chemistry, quantum physics, and information theories to provide a foundational understanding of quantum information control in complex molecular systems. Efforts in this area build the necessary scientific basis to develop chemical design principles for the next-generation quantum technologies in computing, communication, and sensing.

The core QIS research program aligns with the priority research opportunities described in two community Roundtable reports organized by BES (Opportunities for Basic Research for Next-Generation Quantum Systems and Opportunities for Quantum Computing in Chemical and Materials Sciences). Applicants may also find useful discussions in the recent National Academy of Sciences report, Advancing Chemistry and Quantum Information Science.

Among applicable topics of research are fundamental studies of:

- Entanglement as an important metric of quantum information content, including its quantification, control, and utilization in molecular systems.
- The effects of the environment from the perspective of quantum information scrambling in open quantum systems and within the context of quantum thermodynamics, studying how quantum entanglement influences thermodynamic behavior.
- Dynamical approaches to quantum state stabilization in molecular systems using techniques such as periodic driving fields, controlled measurements, and dissipative processes.

Quantum computing is an important application of quantum technology. The QIS program adopts a strategic, long-term perspective on quantum computing as a systems-based approach to map complex quantum processes onto simpler equivalent representations composed of discrete or analog quantum simulators. The key focus areas for Fiscal Year 2025 include the development of new complexity reduction approaches for quantum simulator representations of processes relevant to open quantum systems, the exploration of computational approaches using measurement-based quantum simulators and quantum cellular automata, and theoretical studies of surrogate quantum simulator models to gain fundamental insights into emergent collective phenomena in large-scale chemical systems.

Applications must demonstrate relevance to scientific problems in the CSGB domain sciences. Applications that emphasize materials science, engineering, device optimization, or the design/construction of quantum computers will be deemed non-responsive and may be declined without review.

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(q) Catalysis Science

This program supports basic research pursuing novel catalyst design and molecular-level control of chemical transformations relevant to the sustainable conversion of energy resources. Emphasis is on the understanding of reaction mechanisms, enabling precise identification and manipulation of catalytic active sites, their environments, and reaction conditions for optimized efficiency and selectivity. Elucidation of *catalytic reaction mechanisms in diverse chemical environments* and *the structure-reactivity relationships of solid and molecular catalysts* comprises a central component of the program.

A long-term objective is to promote the convergence of heterogeneous, homogeneous, electro-, and bio-catalysis as a means to discover novel inorganic, organic, and hybrid catalysts that are atom and energy efficient for selective fuel and chemical production. The current landscape emphasizes the adoption of sustainable solutions and is largely driven by the shift to renewable and more abundant feedstocks. Therefore, emerging activities are encouraged in catalysis science underpinning catalytic transformations from sustainable carbon sources that achieve low greenhouse gas emissions, such as carbon-neutral hydrogen production and utilization, deconstruction or functionalization of macromolecules, catalysis by Earth-abundant metals, and electro-driven processes. Specific focus areas are described below:

- Advanced concepts concerning catalyst design, including topics related to atomically precise synthesis, enabling, for instance: multi-functionality, confinement within porous materials, site cooperativity, nano- and single-atom stabilized structures, and manipulation of weak interactions.
- Substituting or coupling thermal energy sources with less-energy intensive ones, such as electrical, mechanochemical, or electromagnetic sources leading to sustainable chemical

processes, such as low-temperature electrosynthesis, integrated separation-catalytic processes, or carbon-neutral transformations.

- Strategies that explore catalysts and mechanisms associated with direct catalytic transformations in multicomponent mixtures, multiple reactions, integrated processes, and circular processing, including selective breakdown or functionalization of synthetic or natural polymers.
- Catalysis mediated by earth-abundant metals or investigations related to transformations targeting the reduction or elimination of the use of platinum group and other critical elements.
- Examination of the dynamics of catalyst and electronic structures occurring during catalytic cycles and deactivation via the development of novel spectroscopic techniques and structural probes for *in situ/operando* characterization of catalytic processes. This also includes strategies to induce changes in catalytic structure and activity via response to stimuli.
- Integrated theory-experiment and predictive theoretical catalysis supported by data-intensive and AI/Machine Learning approaches for mechanism identification, catalyst discovery and development, and benchmarking of catalytic properties.

This program does **not** support: (1) the study of transformations for pharmaceutical applications; (2) non-catalytic stoichiometric reactions; (3) whole cell or organismal catalysis; (4) studies where the primary focus is photochemistry or photophysics; and (5) studies primarily focused on process or reactor design and optimization.

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(r) Separation Science

This program supports hypothesis-based experimental and computational research that addresses fundamental questions focused on discovering, understanding, predicting, and controlling de-mixing transitions, with the goal of enabling chemical separation paradigms that may become the basis for solutions to current and long-term energy challenges. These include decarbonization towards a net-zero scenario, availability of critical elements to support clean energy infrastructure, and avoidance or mitigation of associated environmental impacts. Practical needs include, for example, fundamental knowledge gaps related to the efficient capture of CO_2 directly from air or oceans; expanded supply and recycling of critical elements such as rare earths, lithium, cobalt, nickel, platinum group metals, or other critical metals; and separation of radioactive elements. Basic research in these areas relies on understanding chemical and physical properties at multiple length and time scales, quantum through macroscopic properties, and molecular interactions and energy exchanges that determine the efficiency and sustainability of chemical separations.

The program particularly supports emerging fundamental scientific areas within separation science that are molecularly focused and in a nascent stage. Selected topics of interest include:

- discovering, understanding, and predicting paradigms for removal of dilute constituents from a mixture, including but not limited to (a) reactive separations, (b) intermolecular interactions leading to formation of a new phase, and (c) emergent phenomena that result from correlation and amplification of individual atomic or molecular processes, such as aggregation and their effects on kinetic or transport properties;
- elucidating factors that cause a separation system to approach mass transfer limitations;
- understanding non-thermal and other sustainable mechanisms that have the potential to drive efficient and selective energy-relevant separations, such as magnetic, mechanic, electromagnetic, magneto-reactive, bio-inspired, and other novel means to affect transport kinetics and bonding;
- elucidating how separation parameters and processes such as high selectivity, capacity, and throughput are impacted by complex and/or interconnected system properties;
- understanding temporal changes in separation systems such as activation, degradation, self-repair, or solvation;
- enabling new strategies for critical materials recovery from natural and unconventional feedstocks;
- advancing the scientific basis for the separation and utilization of rare isotopes or the recovery of heavy elements from nuclear waste;
- developing scalable approaches to carbon oxides removal from low-concentration sources such as air and water.

The topics listed above may include, for example, membranes, framework materials (such as metal-organic framework materials), zeolites, ionic liquids, and molecular complexes. Issues of selectivity, capacity, throughput, durability, and energy input are important for most separations, and should be of concern in separation science research, although they may not be the singular focus. Use of AI/ML and data science to support hypothesis-driven separation science research questions are encouraged when appropriate.

This activity does **not** support engineering design, optimization, or scale-up; development of narrowly defined devices or processes; established desalination approaches; microfluidics technology; or sensors.

Research opportunities identified in recent reports from the National Academies of Sciences, Engineering, and Medicine and the Basic Energy Sciences Advisory Committee (BESAC) serve as references for some of the basic science topics outlined above: *A Research Agenda for Transforming Separation Science* and *Foundational Science for Carbon Dioxide Removal Technologies*. Applicants may also look to the DOE Earthshots Initiative and the *National Academies' report on Carbon Utilization Infrastructure, Markets, and Research and Development* for inspiration, as they contain multiple chemical separation challenges that this program will help tackle over the next decades.

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(s) Heavy Element Chemistry

This program supports actinide and transactinide fundamental chemical research that underpins the DOE missions in energy, environment, and national security with an emphasis on the chemical and physical properties of the transuranic elements. Research performed in this program is essential to a clean-energy future, such as but not limited to, the fundamental research supporting carbon-free nuclear energy. The unique molecular bonding of these elements is explored using experiment and theory to elucidate electronic and molecular structure, reaction thermodynamics, as well as quantum phenomena. Emphasis is placed on the chemical and physical properties of the transuranic elements to determine their bonding and reactivity, the fundamental transactinide chemical properties, and the overarching goal of resolving the *f*-electron challenge. The *f*-electron challenge refers to the inadequacy of current electronic structure methods to accurately describe the behavior of *f*-electrons, in particular strong correlation, spin-orbit coupling, multiplet complexity, and associated relativistic effects. Aligned with current BES priorities, is the inclusion of machine learning, artificial intelligence, and the exploitation of the unique electronic properties of the *f*-elements for quantum phenomena (e.g., actinide qubits or the synthesis and investigation of strongly correlated multidimensional lattices). Theoretical applications are considered that integrate closely with experimental research or otherwise demonstrate impact outside the theory community. While the Heavy Element Chemistry (HEC) program does not support code development as an objective, it can be a tangential effort while in pursuit of HEC-aligned goals. Development or improvement of computational tools is better aligned with the BES Computational and Theoretical Chemistry program, which is described in section (n). Theoretical and experimental investigations of the superheavy elements where relativistic chemical effect dominate and the half-lives are short, are a challenging test of theoretical and chemical techniques; these applications are highly encouraged.

The role of 5*f* electrons in bond formation remains the fundamental topic in actinide chemistry and is an overarching emphasis for this program. Theory and experiment show that 5*f* orbitals participate significantly in molecular actinide compounds. Resolving the role of the *f*-electrons is one of the three grand challenges identified in the *Basic Research Needs for Advanced Nuclear Energy Systems (ANES)* report of the Basic Energy Sciences Workshop (2006) and echoed in the report from the Basic Energy Sciences Advisory Committee: *Science for Energy Technology: Strengthening the Link between Basic Research and Industry* (2010). Applicants should also look at the priority research directions and opportunities discussed in the reports from the 2017 *Basic Research Needs for Future Nuclear Energy* workshop and the July 2022 *Foundational Science to Accelerate Nuclear Energy Innovation* roundtable (to be posted at https://science.osti.gov/bes/Community-Resources/Reports when available).

Catalytic reactivity involving actinides, if not better aligned with the BES Catalysis Science program described in section (q), is of interest to this program if the project yields insight into *f*-

electron behavior particularly if the focus is on the exotic catalytic and redox behavior exhibited by actinides in extreme environments, such as the legacy nuclear waste tanks or molten salts.

Based on programmatic priorities, the HEC program does **not** fund research on: the processes affecting the transport of subsurface contaminants, the form and mobility of contaminants including wasteforms, projects focused on the use of heavy-element surrogates, projects aimed at optimization of materials properties including radiation damage, high-pressure research on neptunium or plutonium, device fabrication, data science efforts without chemical experimentation, or biological systems; these are all more appropriately supported through other DOE programs. The HEC program will consider applications to understand how the unique electronic structure of rare earth elements, including the role of *f*-electrons, determines the physical and chemical properties of molecules and materials, with the goal of accelerating their design to reduce or eliminate the use of critical elements. Research that is focused primarily on separations and does not address the unique properties of the heavy elements is better aligned with the BES Separation Science program, which is described in section (r). Research that is focused primarily on radiation chemistry (chemistry initiated from excited states) is better aligned with the BES Solar Photochemistry program, which is described in section (u). Applications should be hypothesis-based.

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(t) Geosciences

This program supports basic experimental, theoretical, and computational research in geochemistry and geophysics that have clear connections to energy or recovery of critical elements. Geochemical research emphasizes fundamental understanding of the reaction mechanisms and rates associated with geochemical processes, focusing on molecular-mesoscale aspects of minerals and interfaces and on the molecular origins of critical element distributions and their influence on migration/separation/fractionation pathways in the earth, ranging from weathering environments to magmatic/hydrothermal systems. Geophysical research focuses on new approaches to understand subsurface processes that characterize the evolution of fractures in the upper crust, particularly when associated with enhanced geothermal systems, CO_2 mineralization, and gas storage.

Applicants should look at the geosciences-aligned priority research directions and opportunities discussed in the BES workshop and roundtable reports as well as the National Academies of Sciences, Engineering, and Medicine. The reports that contain particularly topical geosciences topics include *Carbon Utilization Infrastructure, Markets, and Research and Development* (2024), *Foundational Science for Carbon Dioxide Removal Technologies* (2022), *Basic Research Needs for Energy and Water* (2017), and *Controlling Subsurface Fractures and Fluid Flow: A Basic Research Agenda* (2015).

The inclusion of machine learning, artificial intelligence, and computational methods are particularly desirable. While it is necessary that the work have a well-defined connection to clean

energy or critical elements applications, priority in BES Geosciences funding is given to research that has strong potential for breakthrough science. Examples include (but are not necessarily limited to): Direct air capture & mineralization and geologic storage of carbon dioxide; hydrogen storage; earth-abundant minerals for energy conversion to electricity and fuels; and fundamental properties and occurrences of critical elements to enhance understanding & prediction of resource distributions and to improve separation and extraction processes from naturally occurring host phases. Applicants must make a strong case for (i) the relevance of the work to DOE's energy mission or critical materials/minerals and (ii) the fundamental mechanistic nature of the work (i.e., why the work belongs in Basic Energy Sciences). Modeling-focused applications that do not clearly indicate direct engagement with novel and compelling data sets will also be discouraged. Based on programmatic priorities, this program does not fund applied research: the processes affecting the transport of subsurface contaminants, device fabrication, or biological systems; these are all more appropriately supported through other DOE programs. Applications should be hypothesis-based.

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(u) Solar Photochemistry

This program supports fundamental, molecular-level research on solar energy capture and conversion in the condensed phase and at interfaces. Photochemical approaches may ultimately form the basis of new clean energy technologies that generate electricity or energy-rich chemicals from sunlight. Advances in these areas will require a thorough understanding of elementary processes such as light absorption, charge separation, and charge transport within a number of chemical systems, including those with significant nanostructured composition.

Supported research areas include organic and inorganic photochemistry, light-driven electron and energy transfer in condensed phase and interfacial molecular systems, electrocatalysis and photocatalysis of solar fuels reactions, semiconductor photoelectrochemistry, light-driven generation or manipulation of quantum phenomena in molecular systems, and artificial assemblies that mimic natural photosynthetic systems. An enhanced theory and modeling effort is needed to improve current understanding of many photochemical phenomena.

To enable the light-driven production of fuels and other energy-rich chemicals, knowledge of photoinduced charge transfer needs to be closely coupled with the conversion of abundant, renewable feedstocks like H_2O, CO_2, or N_2. Fundamental research to enable robust photochemical water oxidation continues to be a particularly challenging and important area of research. Basic science that could underpin light-driven cascade approaches to generate fuels or energy-rich chemicals from CO_2 and/or N_2 is a topic of increasing emphasis. More generally, considerable challenges remain in understanding degradation mechanisms to enhance photochemical durability, designing catalytic microenvironments that promote selective production of energy-rich solar fuels, exploiting direct coupling of light-driven phenomena and chemical processes to enhance performance, and tailoring interactions of complex phenomena to achieve integrated multicomponent assemblies for solar fuels production.

An additional regime of interest is the chemistry initiated through creation of excited states with ionizing radiation, as can be produced through electron pulse radiolysis, to investigate reaction dynamics, structure, and energetics of short-lived transient intermediates in the condensed phase, solutions, and interfaces.

The Solar Photochemistry program does support systems-level investigations, but it does **not** fund applied research on device development or optimization.

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(v) Photosynthetic Systems

This program supports basic research on the capture and conversion of solar energy to chemical energy in the photosynthetic systems of plants, algae, and photosynthetic microbes. Topics of study include, but are not limited to, light harvesting, proton and electron transport, reduction of carbon dioxide to form organic compounds, and the self-assembly and self-repair of photosynthetic proteins, complexes and membranes. Examples of specific topics under these headings include capture of CO_2 by carboxylase enzymes and bicarbonate transporters, light-driven production of H_2 by hydrogenase enzymes, long-lived quantum coherent energy transfers in photosystems, and oxidation of water for generation of reduced carbon compounds, including solar fuels. The broad goal of the program is to foster greater knowledge of the diverse photosynthetic systems found in nature. These offer a natural library of self-assembling biochemical systems that conduct unusually efficient transfers and conversions of energy from one form to another. Understanding of these biochemical processes can guide the development of clean energy technologies.

All submitted applications must clearly state how the knowledge gained from the proposed research is relevant to greater mechanistic understanding of the capture and conversion of solar energy to chemical energy in the photosynthetic systems of plants, algae, and photosynthetic bacteria. Photosynthetic Systems does **not** fund: 1) development or optimization of energy devices or processes; 2) development or optimization of microbial strains or plant varieties for biofuel or biomass production; 3) phenotype analyses that do not test specific hypotheses relevant to the program; 4) genomic, transcriptomic, or proteomic data acquisition that does not test specific hypotheses relevant to the program; and 5) projects that are primarily computational in nature.

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(w) Physical Biosciences

This program supports basic research into the chemistry, biochemistry, biophysics, and molecular biology that underpin biological energy capture, conversion, and storage. Primary focus areas of the program include:

- structure/function, mechanism, and electrochemical properties of complex multielectron enzyme reactions (especially those involved in the interconversion of CO_2/CH_4, N_2/NH_3, and H^+/H_2)
- complex metallocofactors and active sites biosynthesis
- cofactor redox tuning by ligand coordination and local chemistry that controls overpotential, manages electron transfer, and enables catalysis using earth-abundant metals
- the role of structure, conformational change, and allostery in gating electron flow over long distances
- electron bifurcation and catalytic bias in enzymes
- control factors and critical components, such as proton and electron tunneling and other quantum phenomena, in enzyme systems that direct and regulate electron flow on larger spatial and temporal scales through energy-relevant metabolic pathways
- basic research on the biosynthesis and structure of electron stores in energy rich biological compounds and materials (e.g., plant cell walls, lipids, terpenes, etc.)
- studies that provide insight into the assembly and maintenance of biological energy transduction systems, and research to understand the roles played by ion gradients in storing energy and driving transport processes.

Funded projects typically combine biochemistry, biophysics, molecular biology, computational chemistry, and other approaches to understand the structure, function, and mechanism of enzymes, enzyme systems, and energy-relevant biological reactions that control energy flow in natural systems. Combined approaches that support a broad interdisciplinary understanding of these processes and identify unique principles that can provide foundational knowledge for clean energy and critical materials research efforts are encouraged. These processes and unique structure-function relationships can provide a basis for the design and synthesis of highly selective and efficient bioinspired catalysts and allow control of the flow of electrons in biological systems to achieve desired metabolic outcomes.

All submitted applications must clearly state how the knowledge gained from the proposed research will further our fundamental understanding of the ways plants, algae, and non-medical microbes capture, convert, and/or store energy. Projects should ideally be hypothesis-driven. Physical Biosciences does **not** fund research in: 1) animal systems; 2) prokaryotic systems related to human/animal health or disease; 3) development or optimization of energy devices or processes; 4) development or optimization of microbial strains or plant varieties for biofuel/biomass production; 5) cell wall breakdown or deconstruction; 6) transcriptional or translational regulatory mechanisms or processes; 7) environmental remediation or identification of environmental hazards; 8) genomic or other “omic” data acquisition that does not test specific hypotheses relevant to the program; and 9) projects that are primarily computational in nature.

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Website: https://science.osti.gov/bes/csgb/Research-Areas/Physical-Biosciences

Scientific User Facilities
Division Website: https://science.osti.gov/bes/suf/

The Scientific User Facilities Division supports the research and development, planning, construction, and operation of scientific user facilities for a vast range of science using x-ray, neutron, and electron beam scattering as fundamental probes of matter. The Division supports research to improve today's facilities and lay the foundation for next generation facilities.

(x) BES Accelerator and Detector Research

This program supports research that advances the instruments, techniques, and capabilities of the existing and/or future scientific user facilities. Research is supported that aims at developing techniques that will strongly benefit the next generation of accelerator-based particle sources including improved diagnostics. Research includes studies of creation, manipulation, and transport of ultrahigh brightness beams and modeling of beam dynamics.

Specific topics of interest are aligned with the recent BES Basic Research Needs Workshop on Accelerator-based Instrumentation and include:

- research to understand the fundamentals of beam generation and parameters' behavior near or at their theoretical limits;
- research to explore scientific mechanisms that limit system performance and utilization;
- mechanisms to tailor and control beams with unprecedented precision and speed to probe complexity in matter;
- detectors concepts with higher computational capabilities per pixel, improved readout rates, radiation hardness, and better energy and temporal resolution;
- high atomic weight sensors to expand the range of experiments possible at synchrotrons and allow operando probes of diverse materials;
- co-design of optics and detector leading to efficient optics that couple photons for complex detector systems (e.g., cryogenic detectors with limited collections areas);
- ultrafast beam instrumentation capable of accurate measurement of femto- and atto-second bunch lengths;
- tight control of beam losses, and detectors designed for advanced neutron imaging with very high throughput for high-intensity H– currents; and
- advances in probabilistic digital twins that incorporate errors present in physical systems and real-time integration to predict outcomes of specific experiments (with real-time parameter optimization) and facility operations.

Research emphasizing device fabrication will be discouraged.

Subprogram Contact:
- Eliane Lessner, eliane.lessner@science.doe.gov

Website: https://science.osti.gov/bes/suf/accelerator-and-detector-research/

3. Biological and Environmental Research (BER)
Program Website: https://science.osti.gov/ber

The mission of the Biological and Environmental Research (BER) program is to support transformative science and scientific user facilities to achieve a predictive understanding of complex biological, Earth, and environmental systems for clean energy and climate innovation.

The BER subprograms and their objectives follow:

(a) Biological Systems Science

Research is focused on using DOE's unique resources and facilities to achieve a predictive systems-level understanding of complex biological processes to advance DOE missions in energy and the environment. By integrating genome science with advanced AI/ML computational and experimental approaches, the subprogram seeks to gain a predictive understanding of living systems, from microbes and microbial communities to plants and ecosystems. This foundational knowledge enables the design and reengineering of microbes, plants, and microbiomes underpinning a broad clean energy and bioeconomy portfolio, including improved biofuels, bioproducts and biomaterials produced from renewable resources, improved carbon management and storage capabilities, and improved understanding of the biological cycling and transformation of carbon, nutrients, and materials in the environment.

The major research objectives are to:

1. Determine the molecular and regulatory mechanisms governing genotype to phenotype translation needed to predictively understand genome-scale functional properties of microbes, plants, and microbiomes relevant to BER's research efforts; develop experimental "-omics" capabilities and enabling technologies needed to achieve a dynamic, systems-level understanding of cellular and microbiome functions; and develop the knowledgebase, computational infrastructure, and modeling capabilities to advance predictive understanding and design of biological systems for a variety of bioenergy, environmental and engineering biology applications underpinning a broader, more carbon-neutral and globally competitive U.S. bioeconomy.
2. Develop the advanced characterization, measurement and imaging technologies (classical and quantum science-based) to visualize the spatial and temporal relationships of key metabolic processes governing phenotypic expression in plants and microbes, information crucial for developing an understanding of the impact of various environmental and/or biosystems design impacts on whole cell or community function.

Subprogram Contact:
- Robert (Todd) Anderson, todd.anderson@science.doe.gov

Website: https://science.osti.gov/ber/Research/bssd

(b) Earth and Environmental Systems Sciences

The Earth and Environmental Systems Sciences subprogram supports fundamental science and research capabilities that enable major scientific developments and enhanced predictability involving Earth system-relevant atmospheric, terrestrial, cryospheric, marine, and human system process and modeling research in support of DOE's mission goals for transformative science for energy and national security. This includes experimental and modeling research on components such as clouds, aerosols, precipitation, and turbulence interactions; experimental and modeling research involving terrestrial biogeochemistry, hydrology, ecology, coastal, and urban systems; modeling of marine systems; evaluation of component interdependencies under a variety of forcing conditions; quantification of vulnerability and resilience of the full suite of energy and related infrastructures as well as disadvantaged communities to extreme events; and novel uncertainty quantification methodologies, including the use of AI/ML as appropriate.

The major research objectives are to:

1. Understand the physics, chemistry, and dynamics governing clouds, aerosols, and precipitation interactions, with a goal to advance the predictive understanding of the Earth system;
2. Improve the understanding and representation of physical and hydro-biogeochemical processes that govern terrestrial surface and subsurface ecosystems, that in turn can be represented in system models to improve confidence in the models and their projections; and
3. Develop, evaluate and analyze complex models of Earth and environmental systems that include a dynamic human component, in order to understand trends, variability, change, and patterns of extremes and impacts, including improved understanding of system component interactions and co-evolution of the systems.

Subprogram Contact:

- Gerald (Gary) Geernaert, Gerald.Geernaert@science.doe.gov

Website: https://science.osti.gov/ber/Research/eessd

4. Fusion Energy Sciences (FES)

Program Website: https://science.osti.gov/fes/

The mission of the Fusion Energy Sciences (FES) program is to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. This is accomplished through the study of plasma, the fourth state of matter, and how it interacts with its surroundings. Section 2008 of the Energy Act of 2020 (42 U.S.C. § 18645) expanded the scientific mission of FES to support "the development of a competitive fusion power industry in the U.S."

To achieve its mission, an alignment in the FES program toward the Long-Range Plan (LRP) Fusion Materials and Technology (FM&T) gaps is being implemented, which connects the three science drivers: Sustain a Burning Plasma, Engineer for Extreme Conditions, and Harness Fusion Energy. FES research is guided by the LRP "Powering the Future: Fusion and

Plasmas" developed by the Fusion Energy Sciences Advisory Committee (FESAC): https://science.osti.gov/-/media/fes/fesac/pdf/2020/202012/FESAC_Report_2020_Powering_the_Future.pdf

FES invests in flexible U.S. experimental facilities of various scales, international partnerships leveraging U.S. expertise, large-scale numerical simulations based on experimentally validated theoretical models, development of advanced fusion-relevant materials, enabling R&D, future blanket concepts and tritium fuel cycle, research in inertial confinement fusion, and innovation in measurement techniques.

In addition, FES supports partnerships with the private fusion sector to accelerate the development of commercial fusion energy by combining efforts to resolve common scientific and technological challenges and enable commercially relevant fusion pilot plant designs.

In addition to its fusion energy mission, FES also supports discovery plasma science and technology, which is focused on research at the frontiers of basic and low temperature plasma science and high-energy-density laboratory plasmas.

Finally, FES invests in several crosscutting initiatives, such as artificial intelligence and machine learning (AI/ML), microelectronics, and quantum information science (QIS), that have practical applications and the potential to accelerate progress in several mission areas.

Applications to this NOFO should be aligned with one of the six Technology and Science Drivers identified in the LRP. Applications in fusion energy should also be aligned with the U.S. Fusion Science & Technology (FS&T) roadmap which is currently under development. Applications enabling bridges between foundational science and early-stage technology development, including the needs of the fusion private sector, and addressing priorities of the Fusion Innovation Research Engine (FIRE) Collaboratives are encouraged.

FES also encourages early career development for research scientists and engineers beyond the SC Early Career Research Program (ECRP), mainly to support early career researchers that are in non-tenure track positions and, therefore, ineligible for the ECRP. If you are eligible for the ECRP, FES encourages you to apply to that program. If you are ineligible because you are considered a non-tenure track researcher, FES encourages you to contact the designated subprogram contact of the program area that your research most closely aligns with.

FES may sponsor conferences, workshops, summer schools, and seminars. If you are interested in FES support, please contact the designated subprogram contact for the program area that your event most closely aligns with and follow the due dates in Section V.

Fusion energy and plasma science and technology depend on diverse community of exceptional researchers. Professional networking, mentorship, and associated training activities targeting students and early-career researchers support the health and diversity of the research community. Particularly welcome are activities including a specific focus on outreach to members of groups that are underrepresented in fusion energy science or plasma science and technology.

Submission of preliminary research descriptions (e.g., preapplications or white papers) is strongly encouraged to ensure alignment with program goals. They will be reviewed for responsiveness of the proposed work to the research topics. Prior to submission, it is highly encouraged to contact the relevant subprogram contact listed under each topical area below for format, content, and submission timelines. Applications submitted after the second quarter of the Fiscal Year (FY) may not be able to be considered for an award during the current FY.

Additional resources include:

- A series of community engagement workshops (https://science.osti.gov/fes/Community-Resources/Workshop-Reports)
- The Administration's Bold Decadal Vision for Commercial Fusion Energy (BDV)
- The DOE Fusion Energy Strategy 2024
- The FES Building Bridges vision for fusion energy science
- National Academies reports such as:
  - the 2018 report on a Strategic Plan for U.S. Burning Plasma Research
  - the 2018 report on Opportunities in Intense Ultrafast Lasers
  - the 2020 Decadal Assessment of Plasma Science report
  - the 2021 report on Bringing Fusion to the U.S. Grid

Specific information about FES program areas is as follows:

(a) Theory & Simulation

This program area focuses on advancing the scientific understanding of the fundamental physical processes governing the behavior of magnetically confined plasmas.

Specific areas of interest include:

- Macroscopic stability and dynamics of fusion plasmas, with a strong focus on the prediction, avoidance, control, and mitigation of deleterious or performance-limiting instabilities such as plasma disruptions;
- Understanding and control of the multiscale, collisional and turbulent physical mechanisms responsible for the loss of heat, momentum, and particles from the confining region;
- Interaction of externally launched radiofrequency waves designed to heat the plasma and drive current, with the background plasma and surrounding structures;
- Nonlinear interaction between background plasma, various instabilities, and energetic particle populations, including the alpha particles generated by the fusion reactions, and its impact on the confinement of these particles and the overall plasma performance;
- The effect of multiscale and multiphysics processes at the plasma boundary on the plasma performance and on the interaction and interface of the hot plasma boundary with the material walls and divertor configurations; and
- Predictive modeling of fusion pilot plant concepts including plasma performance, component engineering, and optimization techniques.

The efforts supported by this program provide the foundations for whole-facility modeling of fusion systems and range from analytical work to the development and application of advanced

simulation codes capable of exploiting the potential of current and emerging high-performance computing systems. Modeling and Simulation efforts are not limited to tokamak concepts; work that focuses on stellarator and other alternate MFE concepts is eligible for support.

Subprogram Contact:
- Michael Halfmoon, Michael.Halfmoon@science.doe.gov

Website: https://science.osti.gov/fes/Research

(b) Artificial Intelligence and Machine Learning for Fusion & Plasma Science

This program supports the application of AI/ML techniques in partnership with data and computational scientists. Supported activities span the full range of other FES program areas. Activities include the development of fusion data resources and frameworks. Novel algorithms that leverage the wealth of experimental and HPC simulation data are eligible for support. See also the Report of the workshop on Advancing Fusion with Machine Learning.

Subprogram Contact:
- Michael Halfmoon, michael.halfmoon@science.doe.gov

Website: https://science.osti.gov/fes/Research

(c) Fusion Materials and Internal Components

The development of materials suitable for a power-producing fusion device is prerequisite for the eventual success of fusion power. Every component, from the innermost chamber walls to the outer framework, demands materials that can endure and perform in demanding conditions including extremes of heat, particle exposure, and neutron fluxes. The fusion materials and internal components program area is devoted to advancing materials, developing physical and numerical material models, and realizing essential material tools necessary to achieve fusion power. The program area is dedicated to research that results in:

- Suitable materials for plasma-facing components (PFCs) in a fusion pilot plant (FPP)
- Suitable materials for structural components in an FPP
- Adequate modeling support for component and structural design of an FPP which accurately represents material behavior in the fusion environment
- The effective utilization of, or development of new, research facilities aimed at fulfilling the above
- Adequate materials codes that can be used to assess the suitability of various materials and components in an FPP
- Suitable functional materials (e.g. diagnostics, shielding, magnets, etc.) for an FPP (via collaboration with the relevant research communities)

Therefore, this subprogram supports applications in the following areas. Please note, some research topics are considered cross-cutting and are coupled to the fusion nuclear science program. Please indicate in your application if the topic is cross-cutting, or contact the subprogram contact for more information.

- *Plasma Material Interactions and Plasma Facing Components (PFC)*: The innermost wall of a fusion device, known as the plasma-facing component (PFC), is exposed to the high-energy plasma and a high neutron flux. Plasma-material interactions can cause erosion, sputtering, and material migration. Research in this area aims to advance materials that can withstand and perform within the extreme heat, particle fluxes, irradiation effects, and erosion conditions that these components are subject to.
- *Structural Materials for Fusion:* Structural materials refer to those materials used in the overall construction of the fusion device, such as the vacuum vessel, blanket structure, and other supporting components. These materials must be able to withstand the structural loads, radiation, and heat while maintaining their desired material properties. Advanced structural steels, advanced alloys, and engineered composites are areas of interest for research.
- *Fundamental Modeling and Materials Behavior:* Advances in materials modeling play a crucial role in predicting how materials will behave under fusion reactor conditions. Computational tools allow researchers to simulate material responses to high temperatures, radiation, and stress, aiding in material selection and design optimization.
- *Functional Materials:* These are materials that impact the functionality of various fusion components beyond their structural integrity. For instance, materials used for sensors and heat transfer enhancement fall under this category.
- *Advanced and Additive Manufacturing:* Novel manufacturing techniques, including additive manufacturing, offer the potential to create components with enhanced material characteristics and complex geometries that might be challenging to achieve through traditional manufacturing methods. This area includes researching near-net-shape additive manufacturing and exploring ways to improve component performance and cost compared to conventional manufacturing techniques.

Subprogram Contact:
- John Echols, john.echols@science.doe.gov

Website: https://science.osti.gov/fes/Research

Emergent Plasma Concepts

This program is aligned with the FESAC LRP science driver Sustain a Burning Plasma to "build the science and technology required to confine and sustain a burning plasma." This program consists of diverse plasma confinement concepts such as toroidal-based systems and linear plasma concepts such as field-reverse configuration, axisymmetric mirrors, and plasma pinches. The goal is that as approaches such as tokamaks and other configurations reach more mature designs and are translated to industry, FES will support new innovative concepts that emerge. This element includes the growing IFE activities and other innovative IFE approaches. The FESAC LRP stated that investments should be balanced over time towards emerging approaches as a mitigation strategy towards accelerated paths in realizing fusion energy. This activity also emphasizes the remaining key physics gaps in both toroidal and linear-based plasma concepts. For example, some topics include predicting the dynamic behavior of burning plasmas, alpha-particle heating, self-sustaining pathways, steady-state scenarios, enhanced performance, stability and control in burning plasma scenarios, predicting transient behavior, understanding

turbulence and instabilities, and addressing core-edge coupling and its relationship with sustainable confinement conditions in a burning plasma environment.

(d) Tokamak Research

The Tokamak Research area addresses gaps in the physics basis for the conventional tokamak approach to magnetic confinement fusion. The program includes research and facility operations on the DIII-D National Fusion Facility in San Diego, CA, small-scale tokamak research conducted on university-scale devices, and research on international tokamak facilities accessible to U.S. staff under international bilateral agreements and multi-lateral frameworks.

This area supports foundational science, early-stage technology development, and capability development in the following priority areas:

1) Sustaining Burning Plasmas, which includes managing plasma transport and instabilities from energetic particles, enhancing plasma confinement, accessing and maintaining burning plasma conditions, and optimizing plasma heating and current drive strategies.
2) Exhaust Handling, which includes understanding the physics of tokamak divertors, managing plasma exhaust, controlling particle inventories, and integrating plasma core and edge scenarios.
3) Control of Damaging Transients and Instabilities, which includes mitigating tokamak disruptions, avoiding and preventing off-normal events, and controlling instabilities (e.g., edge localized modes, resistive wall modes, tearing modes, etc.).
4) Plasma Material Interactions, which includes controlling the plasma edge, testing the survivability of materials, effects from impurities on materials and plasma performance, and wall conditioning for long pulse operation.
5) Technology development for tokamak-specific diagnostics, actuator development, engineering support, and tokamak system monitoring.
6) Enabling and Crosscutting Activities includes theory and model validation, inference of plasma states, and plasma control integration and simulation.
7) Other activities essential for the operation and exploitation of tokamak facilities not covered in other FES program areas.

This program area covers research in support of ITER, and activities previously supported in the following FES programs:

(a) Burning Plasma Science: Foundations—Advanced Tokamak
(b) Burning Plasma Science: Long Pulse—Tokamak

In FY 2025, this solicitation will be used to accept supplemental applications, and applications not covered by other funding opportunity announcements.

Subprogram Contact:
- Matthew Lanctot, Matthew.Lanctot@science.doe.gov

Website: https://science.osti.gov/fes/Research

(e) Spherical Tokamak Research

The Spherical Tokamak Research program involves both foundational scientific research on low aspect ratio plasmas and the development of enabling technologies to support this confinement concept. An improved understanding of the spherical tokamak magnetic confinement configuration is needed to establish the physics basis for next-step spherical tokamak facilities, to broaden the scientific understanding of plasma confinement for burning plasmas, and to support the Bold Decadal Vision for commercial fusion energy. Operation at higher magnetic field, reduced collisionality, and with controllable fully-non-inductive current-drive are necessary next steps for assessing the spherical tokamak as a potentially cost-effective path to fusion energy.

A variety of important research topics that broadly support the foundational science for burning plasmas are uniquely possible through the study of spherical tokamak plasmas. Specifically, spherical tokamaks have demonstrated much higher normalized plasma pressure than conventional aspect ratio tokamaks. Also, spherical tokamaks provide access to unique plasma turbulence, energetic particle instabilities, and edge plasma regimes.

Applications addressing high impact studies involving low recycling walls, or non-inductive plasma startup may also be considered.

Subprogram Contact:
- Josh King, Josh.King@science.doe.gov

Website: https://science.osti.gov/fes/Research

(f) Superconducting and Compact Stellarator Research

This program area supports stellarator research, The stellarator is a confinement concept that offers the promise of steady-state confinement without plasma current driven transient events. The three-dimensional (3D) shaping of the plasma in a stellarator provides a broader range in design flexibility than is achievable in a 2D system. This program element supports research conducted on U.S. stellarators and research conducted by U.S. teams on international facilities.

Subprogram Contact:
- Josh King, Josh.King@science.doe.gov

Website: https://science.osti.gov/fes/Research

(g) Inertial Fusion Energy

The Inertial Fusion Energy (IFE) program is dedicated to advancing the foundational science and technology essential for developing IFE as a viable energy source. Key research areas of interest are outlined in the IFE Basic Research Needs Workshop Report. Additionally, the FES program has established three IFE Science and Technology hubs, which focus on both scientific

advancement and the stewardship of the IFE ecosystem. We encourage applications that utilize this ecosystem. Areas of interest include, but are not limited to:

- Target Physics: involves improving energy transfer with broad laser bandwidth, demonstrating energy coupling for fast ignition (FI), advancing theoretical and computational models of laser-plasma instabilities, and investigating the physical processes that restrict fuel compression in low-adiabat implosions.

- Driver Technologies: includes developing conceptual designs for IFE driver system-level architecture, reducing the cost of diode pumps in diode-pumped solid-state laser (DPSSL) technologies, and improving the reliability of high-power switching and capacitor energy storage systems.

- Target Injection and Engagement includes developing an IFE target injector capable of reaching necessary velocities without compromising the target or its fuel layer, and demonstrating accurate, real-time engagement of IFE targets with a driver beam.

Applicants are strongly encouraged to contact the subprogram contact before submitting an application.

Subprogram Contact:
- Kramer Akli, Kramer.Akli@science.doe.gov

Website: https://science.osti.gov/fes/Research

(h) Measurement Innovation

The Measurement Innovation activity supports the development of world-leading transformative and innovative diagnostic techniques and their application to plasmas. The Measurement Innovation program is looking for applications to develop diagnostics with the high spatial, spectral, and temporal resolution necessary to validate plasma physics models used to predict the behavior of plasmas in all the areas of the fusion program, including burning plasmas and eventual fusion pilot plants. Advanced diagnostic capabilities successfully developed through this activity will then be positioned to migrate to domestic and international plasma facilities.

Subprogram Contact:
- Curt Bolton, Curt.Bolton@science.doe.gov

Website: https://science.osti.gov/fes/Research

(i) Closing the Fusion Cycle: Fusion Nuclear Science

Applications for the FES Fusion Nuclear Science (FNS) research activities in the four areas below may be submitted to this NOFO. The FNS program will conduct yearly comparative merit reviews for both new and renewal applications. Submission of preliminary research descriptions (e.g., pre-applications) is strongly encouraged to ensure alignment with program goals. They will be reviewed for responsiveness of the proposed work to the research topics. Prior to submission it is highly encouraged to contact the subprogram contact for format and content.

Applications in response to this NOFO may also propose activities in support of FNS research, which include, but are not limited to supplemental support for research activities, conferences, or exploratory (seed) research. These applications are not part of the comparative review process and may receive lower programmatic priority unless exceptions are warranted based on program needs. Below is guidance for FY 2025 and FY 2026.

- *FY 2025 FNS Comparative Review:* FNS expects to convene merit review panels in February 2025 for research areas listed below. Research applications, as described below, that are aligned with one or more of those research areas and are received before December 1, 2024, will be considered for merit review by those panels. Applicants are strongly encouraged to submit pre-applications prior to November 1, 2024.
- *FY 2026 FNS Comparative Review:* FNS expects to convene merit review panels in November 2025 for research areas listed below. Research applications, as described above, that are aligned with one or more of those research areas and are received before September 5, 2025, will be considered for merit review by those panels. Applicants are strongly encouraged to submit pre-applications prior to August 1, 2025.

Additional information about the FNS research areas is described below. All applicants should pay particular attention to the following when preparing applications to be submitted to this NOFO:

- External peer reviewers will be explicitly requested to evaluate the applicant's proposed work in relation to the priorities established in FESAC LRP and forthcoming FESAC reports.
- FES recognizes the ever-increasing integrated nature of fusion energy technology research. Research that is considered cross-cutting with another program area but primarily sits within one of the research areas listed below must indicate that it is cross-cutting research and identify the other program area(s) the research crosses into.
- Applications which pose an undue burden on merit reviewers may be declined without review: Applications submitted to FNS from a single institution must not contain project narratives more than 10 pages; Applications submitted to FNS from multi-institutional teams must not contain project narratives more than 20 pages.
- In addition to the points listed in Section IV, FNS also offers the following suggestions for the organization of the Project Narrative:
    - Demonstrate the following relevance to the new FES mission and strategic vision; How is research foundational to fusion science and technology; How would the results inform the fusion science and technology community; How will programs train the next generation of researchers; How will resulting data and metadata be managed based on community standards in preparation for a fusion database; *Only for renewals*: how are you reorienting your existing program to better support the fusion science and technology vision.
    - Timetable of Activities: Timeline for all major activities including aims and objectives.
- Previously declined applications that have not been substantially revised considering merit reviewer comments may be declined without additional merit review and will not be considered for funding.

Additional requirements for multi-institution applications follow below. Investigators who are proposing a focused, single-institution research effort may skip to the FNS program areas below.

Applications in response to this NOFO may consist of teams of investigators from multiple institutions to submit applications in accordance with the mechanisms for Multi-Institutional Teams described in this NOFO. Such teams may be appropriate when the involvement of multiple institutions permits the formation of larger teams that can address a greater scope of scientific inquiry or significant research thrust, but, unless specifically encouraged in the research area descriptions below, such applications are likely to be assigned a lower programmatic priority and excluded from the merit review panels.

Additionally, this subprogram provides graduate research training for the next generation of researchers as well as activities supporting career development, and broadening participation, in foundational engineering science and technology.

The FNS research portfolio focuses on understanding and addressing the challenges associated with the nuclear aspects of fusion energy systems. This includes studying the behavior of blanket functional materials under high neutron fluxes, developing tritium breeding technologies, and advancing fusion nuclear components like blankets and first-wall structures. The portfolio aims to bridge the gap between plasma physics and the engineering requirements of fusion energy systems ensuring that the nuclear components of future fusion systems are safe, reliable, and efficient. Foundational science within the FNS portfolio focuses on understanding fundamental processes and developing new technologies that are not yet ready for commercial application but are essential for overcoming long-term challenges in fusion energy. Areas of interest to the Foundational FNS program:

Blanket Systems:

- *Functional Materials:* Develop materials that optimize tritium breeding, heat transfer, and compatibility with breeding environments.
- *Coolant Interaction Studies:* Investigate the interactions between breeding materials and coolants to ensure efficient heat removal and minimal corrosion or degradation.

Fuel Cycle Systems:

- *Tritium Permeation and Retention:* Research on materials and technologies to control tritium permeation and retention within fuel cycle systems.
- *Isotope Separation Technologies:* Develop advanced materials and processes for efficient isotope separation and recycling within the fusion fuel cycle.
- *Tritium Breeding and Handling:* Research on tritium management, including breeding and safe handling, while ensuring minimal permeation and environmental impact.

Advanced Components:

- *Liquid Metal Plasma-Facing Materials:* Research on the use of liquid metals for plasma-facing components, focusing on materials that can withstand high thermal and particle fluxes while maintaining plasma compatibility. Additionally, address engineering challenges such as erosion, material replenishment, thermal management, and system integration.
- *Thermal Management Strategies:* Develop materials and technologies to manage heat loads expected in a fusion energy system, including innovative cooling solutions.

Foundational Crosscutting Research

- *Activation Studies:* Understand material activation under neutron exposure and develop strategies to minimize radiological waste. *(Nuclear Data and Fusion Materials)*
- *Radiation Transport:* Develop advanced radiation transport models to predict neutron behavior and their effects on materials within fusion reactors. *(Nuclear Data and Fusion Materials)*
- *Waste Reduction Technologies:* Research into deactivation techniques and materials recycling processes.
- *Safety Analysis:* Foundational research into the safety of nuclear components, including failure modes and accident scenarios, to ensure the safe operation of fusion reactors.

Areas that are considered out of scope include: Research focused on structural materials, solid plasma-facing components, or technologies already demonstrated in public or commercial facilities (Technology Readiness Level [TRL] 5+). The program prioritizes early-stage, high-impact research that advances foundational knowledge and addresses long-term challenges, rather than applied engineering solutions or iterative improvements to existing models and data.

Subprogram Contact:

- Guinevere Shaw, Guinevere.shaw@science.doe.gov

Website: https://science.osti.gov/fes/Research

(j) Closing the Fusion Cycle: Enabling Research and Development

Applications for Enabling R&D (ERD) activities in the three areas below may be submitted to this NOFO. Submission of preliminary research descriptions (e.g., pre-applications) is strongly encouraged to ensure alignment with program goals. They will be reviewed for responsiveness of the proposed work to the research topics. Prior to submission it is highly encouraged to contact the subprogram contact for format and content.

Applications in response to this NOFO may also propose activities in support of ERD research, which include, but are not limited to supplemental support for research activities, conferences, or exploratory (seed) research.

FES recognizes the ever-increasing integrated nature of fusion energy research. Research that is considered cross-cutting with another program area but primarily sits within one of the research areas listed below must indicate that it is cross-cutting research and identify the other program area(s) the research crosses into.

Additionally, this subprogram provides graduate research training for the next generation of researchers as well as activities supporting career development, and broadening participation, in foundational engineering science and technology.

The ERD program establishes the scientific and technological foundation necessary for the development of essential components across a wide range of concepts that will eventually be integrated into a fusion energy system. This program addresses cross-cutting challenges, such as materials, simulations, and diagnostics, critical for the foundational basis of a fusion component.

Enabling R&D supports early-stage, high-impact research, excluding component design, development, demonstration, or deployment. Areas of research within scope are as follows:

- *Functional Materials:* Studies of materials essential to the component, particularly those interacting with harsh fusion environments, such as plasma exposure or high neutron fluxes, without providing structural support. This area emphasizes enhancing the reliability, availability, maintainability, and inspectability (RAMI) of fusion components, ensuring materials can withstand extreme reactor conditions while supporting consistent operation and easy maintenance. This includes high-functionality materials for key components such as superconducting magnets, optics, and radiation-hardened electronics.
- *Component Compatibility:* Study the interactions between different components to ensure their compatibility and performance when integrated into fusion systems.
- *Real-Time Monitoring Technologies:* Develop foundational technologies for real-time monitoring of fusion components, particularly in high-radiation environments, to enhance the reliability and safety of fusion components.

Research focused on structural materials, solid plasma-facing components, or technologies already demonstrated in public or commercial facilities (TRL 5+) is out of scope. The program prioritizes early-stage, high-impact research that advances foundational knowledge and addresses long-term challenges, rather than applied engineering solutions or iterative improvements to existing models and data.

Subprogram Contact:

- Guinevere Shaw, Guinevere.Shaw@science.doe.gov

Website: https://science.osti.gov/fes/Research

(k) Plasma Science and Technology—General Plasma Science

The General Plasma Science (GPS) program supports research at the frontiers of basic and low temperature plasma science. This program aims to develop accurate theoretical descriptions of the complex behavior of the plasma state, to push it into new regimes that expand our concept of what constitutes a plasma, to design experiments and diagnostics to explore these states, and to validate theoretical models. GPS topical areas are broad and include but are not limited to: understanding the onset of magnetic reconnection and trigger mechanisms for explosive instabilities in nature (solar flares, geomagnetic storms) and in the laboratory; plasma dynamo processes by which magnetic fields are generated in the laboratory and nature; mechanisms by which energy is transferred between fields, flows, and particles; how coherent structures are created through the self-fields of the plasma and its interactions with waves; coupling of dusty plasma with strong magnetic fields; plasma chemistry and processes related to interaction of plasma with surfaces, materials, or biomaterials. For more information, see science drivers in the CPP Report: A Community Plan for Fusion Energy and Discover Plasma Sciences, 2019-2020.

Applicants are strongly encouraged to contact the subprogram contact before submitting an application.

Subprogram Contact:
- Nirmol Podder, Nirmol.Podder@science.doe.gov

Website: https://science.osti.gov/fes/Research

(l) Plasma Science and Technology—High Energy Density Physics

The High Energy Density Physics (HEDP) program seeks to understand how matter behaves under extreme conditions of temperature and pressure. In this domain, energy density is typically defined as being above 1 Mbar (100 GPa or approximately 1 million atmospheres), which is comparable to the energy density of a chemical bond, such as in a water molecule. HEDP conditions are crucial for studying processes such as the formation and destruction of stars and for controlling thermonuclear fusion in laboratory settings.

Areas of interest include but are not limited to high-temperature physics, which examines the behavior of materials at extreme temperatures; plasma physics, focusing on the dynamics and properties of plasmas under intense energy conditions; and shock physics, which explores the generation and effects of shock waves in various substances. Additionally, a key area encompasses relativistic plasmas, which aim to understand the behavior of matter and energy under extreme conditions where particles move at speeds close to the speed of light, leading to significant relativistic effects and complex interactions.

Applicants are strongly encouraged to contact the subprogram contact before submitting an application.

Subprogram Contact:
- Kramer Akli, Kramer.Akli@science.doe.gov

Website: https://science.osti.gov/fes/Research

(m) Plasma Science and Technology—Microelectronics Research

Plasmas are essential to the manufacture of devices in the semiconductor industry, from the creation of extreme ultraviolet photons used in the most advanced lithography to thin film etching, deposition, and surface modifications. It is estimated that 40-45% of all process steps needed to manufacture semiconductor devices use low temperature plasmas (LTPs) in one form or another. LTPs have been an enabling technology in the multi-decade progression of the shrinking of device dimensions, often referred to as Moore's Law. New challenges in circuit and device design, novel materials, and increasing demands to achieve environmentally benign processing technologies are pushing the boundaries of what is possible today in plasma technology. Microelectronics research areas are focused on plasma science for microelectronics and plasma-enabled nanofabrication. These include but are not limited to: (i) Plasma assisted processes enabling sustainable device manufacturing at extreme scales; (ii) Optimization and control of plasma-surface interactions down to the atomic scale to enable materials and device structures; (iii) Development of integrated modeling and validation capability to enable next generation semiconductor plasma processing; and, (iv) Generation and control of radiation, radiation transport, and materials interactions in semiconductor processing systems for lithography, plasma etching and deposition applications.

For more information, see the report of the recent FES sponsored microelectronics workshop entitled "Plasma Science for Microelectronics Nanofabrication." Applicants are strongly encouraged to contact the subprogram contact before submitting an application.

Subprogram Contact:
- Nirmol Podder, Nirmol.Podder@science.doe.gov

Website: https://science.osti.gov/fes/Research

(n) Plasma Science and Technology—Quantum Information Science

The Fusion Energy Sciences Quantum Information Science (QIS) program is organized into two main thrusts: "Quantum for Fusion" and "Fusion for Quantum." The "Quantum for Fusion" thrust focuses on how QIS can impact fusion energy and plasma science, including developing quantum algorithms for plasma physics problems, leveraging quantum simulation for fusion research, and using quantum sensing to enhance diagnostics for fusion plasmas. Conversely, the "Fusion for Quantum" thrust explores how advances in fusion science can benefit QIS by using high-energy density laboratory plasmas to create novel quantum materials, adapting relativistic plasma techniques for quantum communication, and applying plasma science tools to improve quantum system simulation and control.

A 2018 roundtable identified six priority research opportunities (PROs) in these areas. The report details these opportunities and emphasizes the potential for QIS to revolutionize both fusion science and quantum technologies. Applications that advance these priority research opportunities are encouraged.

Applicants are strongly encouraged to contact the subprogram contact before submitting an application.

Subprogram Contact:
- Kramer Akli, Kramer.Akli@science.doe.gov

Website: https://science.osti.gov/fes/Research

(o) Public-Private Partnerships

Public-private partnerships (PPPs) enable greater resources to be applied to help achieve technical goals and accelerate commercialization timelines. The rapidly growing private fusion sector is informed and enabled by decades of publicly supported research in fusion. Through PPPs, research can be pursued in a way that is relevant to the private sector and amenable to commercialization. Within the PPP space, multiple avenues exist for the public and private sector to cooperate on research of mutual interest. All activities in this space are contingent on future appropriations.

Applicants must contact the relevant subprogram contact listed below before submitting an application under the PPP program.

Innovation Network for Fusion Energy (INFUSE)
The Innovation Network for Fusion Energy (INFUSE) program supports research partnerships with the emerging fusion private sector, with the goal of accelerating the development of fusion energy in the U.S. Applications under this topic are welcome from university or research institution-based scientists, seeking to collaborate with industrial partners in the INFUSE program. This topic seeks to advance our scientific understanding of fusion-related phenomena by fostering collaborations involving the expertise and unique resources available at DOE national laboratories and U.S. universities.

Partnership awards made under the INFUSE program follow a unique application process, for which more information is available at the INFUSE webpage: https://infuse.ornl.gov/.

Subprogram Contact:
- Colleen Nehl, Colleen.Nehl@science.doe.gov

Website: https://science.osti.gov/fes/Research

Milestone-Based Fusion Development Program
The Milestone Program aims to accelerate progress toward the development of commercial fusion energy by establishing partnerships with the private sector. It represents a first step toward the implementation of the Administration's BDV for commercial fusion energy. Key goals of this program in the near term include the achievement of preliminary designs and technology roadmaps for a fusion pilot plant and enabling significant performance improvements of fusion pilot plant concepts. DOE may award Other Transactions (OT) agreements via Technology Investment Agreements (TIAs) under this topic. DOE implements its OT authority through awarding and administering TIAs (governed by 10 CFR 603). TIAs are assistance instruments used to increase the involvement of commercial entities in DOE's research, development, and demonstration programs. DOE has greater flexibility in tailoring the terms and conditions of a TIA.

Subprogram Contact:
- Colleen Nehl, Colleen.Nehl@science.doe.gov

Website: https://science.osti.gov/fes/Research

Private Facilities Research Program
As private fusion facilities begin operation, there are opportunities for publicly funded researchers to conduct open scientific studies on privately constructed facilities for the mutual benefit of all parties. Uniquely, the Private Facilities Research (PFR) program aims to advance fusion and plasma science and technology by delivering peer-reviewed journal article publications and conference presentations using data acquired from world-leading private experimental facilities.

Subprogram Contact:
- Josh King, Josh.King@science.doe.gov

Website: https://science.osti.gov/fes/Research

5. High Energy Physics (HEP)
Program Website: https://science.osti.gov/hep

The mission of the High Energy Physics (HEP) program is to understand how the universe works at its most fundamental level by discovering the elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time.

The scientific objectives and priorities for the field recommended by the High Energy Physics Advisory Panel (HEPAP) are detailed in its recent long-range strategic plan, developed by the Particle Physics Project Prioritization Panel (P5) and available at: https://science.osti.gov/-/media/hep/hepap/pdf/Reports/2024/2023_P5_Report_Single_Pages.pdf.

The HEP program is divided into four core research programs covering three experimental scientific frontiers and theory:

- *The Energy Frontier*, where powerful accelerators are used to create new particles, reveal their interactions, and investigate fundamental forces using highly sensitive experimental detectors;
- *The Intensity Frontier*, where intense particle beams and highly sensitive detectors are used to pursue alternate pathways to investigate fundamental forces and particle interactions by studying events that occur rarely in nature, and to provide precision measurements of these phenomena;
- *The Cosmic Frontier*, where data from the universe are used to probe fundamental physics questions and offer new insight about the nature of dark matter, cosmic acceleration in the forms of dark energy and inflation in the early universe, neutrino properties, and other phenomena; and
- *Theoretical Particle Physics*, where the vision and mathematical framework for understanding and extending the knowledge of particles, forces, space-time, and the universe are developed.

Together, these interrelated and complementary discovery research areas offer the opportunity to answer some of the most basic questions about the world around us. Also integral to the mission of HEP are the following four technology research areas that enable new scientific opportunities by developing the necessary tools and methods for discoveries:

- *Accelerator Science and Technology R&D*, where the technologies and basic science needed to design, build, and operate the accelerator facilities essential for making new discoveries are developed;
- *Instrumentation and Detector R&D,* where the basic science and technologies needed to design and build the High Energy Physics instrumentation essential for making new discoveries are developed;
- *AI/ML and Computational High Energy Physics,* where computational tools, data management and analytics, and simulation techniques are developed for advancing the HEP mission; this program also supports research that uses AI/ML to advance the HEP mission, use of HEP datasets and theory to learn about fundamental AI/ML techniques,

and development of the HEP AI/ML ecosystem to broaden participation in HEP AI/ML research; and

- *Quantum Information Science for High Energy Physics Research,* an interdisciplinary research area where innovative solutions for scientific discovery techniques leveraging the unique capabilities of quantum information science and technology (e.g., in sensing, computing, and theoretical advances) are developed through partnerships with the wider quantum information science community to advance the HEP science drivers, as identified by P5, the program mission of HEP, and the SC quantum information science initiative.

While fully distinct and non-overlapping, the research topics supported by HEP and Nuclear Physics (NP) may be of interest for the unique capabilities of research groups in either SC program. To ensure that "transitional" applications for groups exploring new research directions can be accommodated fairly, for a limited period not to exceed one award term, and subject as always to appropriate peer review, HEP and NP will allow for the possibility of support in their own portfolios for groups engaged in such crossover research.

Applications for support of HEP research activities in any of the eight areas identified above may be submitted to this NOFO. HEP expects to convene comparative merit review panels on a yearly basis, as described below, for both New and Renewal applications devoted to these research activities. Eligible applications that are not subjected to this comparative review process will be sent for peer-review but will likely be assigned a lower programmatic priority than those that are, with any exceptions considered on a case-by-case basis to address program priorities. **Prior to any submission to this NOFO, applicants are strongly encouraged to contact the relevant HEP subprogram contact listed below to develop applications that properly address program goals.**

Applications in response to this NOFO may also propose activities *in support of* HEP research, which include, but are not limited to: supplemental support for research activities, conferences, experimental operations, conceptual research and development (R&D), or design or fabrication *directed towards a specific (pre)project* within the HEP scientific program, but such applications will *not* be considered by comparative merit review panels.

Applications submitted for the annual HEP comparative review process:

1. FY 2026 HEP Comparative Review: HEP expects to convene merit review panels in November 2025 for research areas **(a)** through **(g)** below. Research applications, as described above, that are aligned with one or more of those research areas and are received **no later than** September 4, 2025, will be considered for merit review by those panels. Applicants are strongly encouraged to submit pre-applications no later than July 31, 2025.

Additional information about the HEP research areas described above, and in areas **(a)** through **(h)** below, may be found at https://science.osti.gov/hep/research/. *All applicants* should pay particular attention to the following when preparing applications to be submitted to this NOFO:

1. External peer reviewers will be explicitly requested to evaluate the applicant's proposed work in relation to the priorities established in the P5 strategic plan for HEP.
2. Applications for support of *generic particle detector R&D* efforts should be directed to the Detector Research and Development research area described below. However, applicants proposing physics studies and pre-conceptual R&D efforts *directed towards a specific experiment* within an experimental frontier should submit their application to the relevant HEP scientific frontier research subprogram specified below.
3. Applications which pose an undue burden on merit reviewers may be declined without review:
    a. Applications in HEP from a **single institution** must not contain project narratives in excess of 9 pages per senior/key person.
    b. Applications in HEP from **multi-institutional teams** must not contain project narratives in excess of 9 pages per senior/key person or a total of 30 pages, whichever is less.
4. In addition to the points listed in Section IV, HEP also offers these suggestions for the organization of the Project Narrative:
    a. **Research using Artificial Intelligence (AI) or Machine Learning (ML), if applicable:** If applications or development of AI/ML techniques are a part of your research effort, call attention to them so that it can be properly reviewed. Consider adding a dedicated section to your narrative to describe the research group's efforts in AI/ML and their importance to completing the proposed research, explaining the associated AI/ML methods used and their impact to advance the group's scientific results; highlight particular results which are expected to be significantly improved or enabled by the use of AI/ML methods. Identify the personnel and effort level (e.g., students, postdoctoral researchers, etc.) carrying out AI/ML activities in the proposed research plan. Additional supporting information (if needed) may be included in Appendix 6: Other Attachment.
    b. **Proposed Resources:** Identify the resources needed to meet the objectives of the proposed project and accomplish the research goals. Requests for support of any resources in the budgets submitted with the application should be consistent with the scope of research efforts identified in the narrative. Reviewers will be asked to consider if the proposed budgets are reasonable and appropriate to carry out the proposed work and adequately estimated and justified.
    c. **Timetable of Activities:** Timeline for all major activities including aims and objectives.
5. Previously declined applications that have not been substantially revised in light of merit reviewer comments may be declined without additional merit review and will not be considered for funding.

Additional requirements for multi-task or multi-institution applications follow below. Investigators who are proposing a single-task, single-institution research effort may skip to the **HEP Research Subprograms** descriptions below.

Multi-Task Applications

HEP allows applications from single institutions that span multiple research areas described in this NOFO, including applications that span multiple HEP subprograms or research thrusts.

These separate research areas are called “tasks” within the application and should be separately delineated. Specifically, applications in response to this NOFO may propose multiple research tasks, addressing a) two or more HEP research subprograms (e.g., the Energy Frontier and Theoretical Particle Physics) and/or b) different research thrusts (specific experiments, experimental or technology R&D campaigns, or other significant collaborations) within a particular HEP research subprogram (e.g., LSST and LZ/LUX in the Cosmic Frontier).

Eash task should constitute a distinct, non-overlapping subsection of the application narrative. Each task should be associated with one or more of the listed senior/key personnel. Reviewers will be requested to comment on each of the proposed activities and their impact.

If proposing a multi-task application:

- Ensure that the application describes an overall integrated and synergistic research effort. Do not propose unconnected discrete research efforts.
- Organize the narrative portion of the application by task.
- Provide a common narrative**:** any narrative material that is common to all research tasks or thrusts should be included in a single separate section within the narrative.
    - This section should address the integration and the synergies of the different research activities (as appropriate) and describe the management of the overall research effort. Reviewers will have access to the complete application and will be asked to comment on the adequacies of such synergies and institutional support and/or infrastructure as appropriate to the application.
- Provide both a summary budget and a budget for each task, using the Research and Related Subaward Budget Attachment(s) Form to provide multiple task budgets by identifying the task budget type as being for a “project.”
- Provide a supplementary page to the DOE title page, including:
    1. List all research task(s) by name with each Co-Investigator (Co-I) for the respective research on the same line.
    2. Indicate the Lead PI who will serve as the point of contact and coordinator for the combined application.
    3. Include a table modeled on the following chart providing summary budget information for each research task. Provide the total costs (Direct and Indirect) in the budget request in each funding year for each subprogram or thrust as well as the totals for all rows and columns.
    4. If necessary, appropriately add rows for additional Co-I(s) and research tasks.
    5. Applicants should appropriately modify the table below for the correct number of years where a budget is being requested in their application.

Name and Yearly Budget for Applications with Multiple Research Tasks						
	Name	**Research Task**	**Year 1 Budget ($)**	**Year 2 Budget ($)**	**Year 3 Budget ($)**	**Total Budget ($)**
Lead PI						
Co-I #1						
Co-I #2						

Co-I #1 Co-I #2 Co-I #3 Co-I #4						
TOTAL	—	—	***Total Year 1***	***Total Year 2***	***Total Year 3***	***Total Y1-Y3***

Example Summary Budget Table (for Applications with Multiple HEP Tasks)

6. If any senior/key person requests support from two or more HEP research tasks (including two or more tasks in the same research subprogram), provide information on the estimated distribution of research effort (FTE) for them in a table (example below) in the subprogram/task budget justification. Applicants should appropriately modify the table for their proposed efforts.

Yearly FTE Estimates for Senior/Key Personnel with Multiple HEP Tasks						
Name	**Application Project Period**					
	Budget Period 1		**Budget Period 2**		**Budget Period 3**	
	Name of Task 1	Name of Task 2	Name of Task 1	Name of Task 2	Name of Task 1	Name of Task 2
	FTE	**FTE**	**FTE**	**FTE**	**FTE**	**FTE**
Senior/Key Person A	0	100%	25%	75%	50%	50%
Senior/Key Person B	50%	50%	25%	75%	0%	100%

Example Effort Table (for Applications with Multiple HEP Tasks)

Multi-Institutional Teams

Applications in response to this NOFO may consist of teams of investigators from multiple institutions to submit applications in accordance with the mechanisms for "Multi-Institutional Teams" described at the end of this section. Such teams may be appropriate when the involvement of multiple institutions permits the formation of larger teams that can address a greater scope of scientific inquiry or significant research thrust, but, unless specifically encouraged in the research area descriptions below, such applications are likely to be assigned a lower programmatic priority and excluded from the merit review panels.

Applications from multi-institutional teams should not be part of a multi-task application from the lead institution.

HEP Research Subprograms

(a) Experimental Research at the Energy Frontier in High Energy Physics

This research area seeks to support studies of fundamental particles and their interactions using

particle beam collisions at the highest possible energies and/or luminosities. This is accomplished through direct detection of new phenomena or through sensitive measurements of processes that probe the Standard Model and new physics beyond it. In particular, applications are sought for physics research utilizing data being collected at the Large Hadron Collider (LHC) by the ATLAS (A Toroidal LHC Apparatus) and CMS (Compact Muon Solenoid) experiments. This research area also provides graduate and postdoctoral research training for the next generation of scientists, and equipment and computational support for physics research activities. Applications addressing physics studies and pre-conceptual R&D directed towards specific future proposed Energy Frontier collider experiments are also accepted but will be assigned a lower priority for support than those that are considered under the nationally coordinated consortia or organizations that have been recently formed for a targeted future collider. Support for heavy-ion physics research is not provided under this research area.

Subprogram Contact:
- Abid Patwa, abid.patwa@science.doe.gov

Website: https://science.osti.gov/hep/research

(b) Experimental Research at the Intensity Frontier in High Energy Physics

This research area seeks to support precision studies that are sensitive to new physical processes at very high-energy scales, beyond what can be directly probed with energy frontier colliders, and that often require intense particle beams. This research area includes studies of the fundamental properties of neutrinos produced by a variety of sources, including accelerators and nuclear reactors; studies of rare processes or precision measurements probing new physics processes as described above with either high intensity stored beams or beams incident on fixed targets; and studies of high intensity electron-positron collisions. In addition, this research area includes searches for proton decay. Graduate and postdoctoral research training for the next generation of scientists, and equipment and computational support for physics research activities are also provided. Applications addressing physics studies and pre-conceptual R&D directed towards specific future Intensity Frontier experiments are also accepted. Support for the Large Hadron Collider beauty experiment (LHCb) research or studies of neutrinoless double beta decay is not provided under this research area.

Some research areas in this subprogram are closely related to but distinct from research areas pursued in the Nuclear Physics program. See note above concerning “transitional” applications to support cross-cutting research on NP and/or HEP topic areas.

Subprogram Contact:
- Brian Beckford, Brian.Beckford@science.doe.gov

Website: https://science.osti.gov/hep/research

(c) Experimental Research at the Cosmic Frontier in High Energy Physics

This research area seeks to support precision studies using observations of the cosmos and naturally occurring cosmic particles to understand the properties of fundamental particles and fields. Priorities include the study of cosmic acceleration by studying the nature of dark energy,

planning the next-generation ground-based cosmic microwave background experiment to explore the inflationary epoch, and using direct-detection experiments to search for dark matter particles. Many of the experiments in the program also place constraints on neutrino masses. Measurements using high-energy cosmic rays, gamma rays and other phenomena are included, but at a lower priority. Applications are sought for physics research efforts in support of current experiments in the Cosmic Frontier, as well as physics studies and pre-conceptual planning directed towards specific future experiments being considered for the program. This research area also provides graduate and postdoctoral research training for the next generation of scientists, and equipment and computational support for physics research activities.

Research efforts aimed at developing techniques or understanding experimental data within the context of theoretical models that are expressly for or as part of an experimental research collaboration are included in this area. General theoretical or computational research applications not specifically carried out as part of a particular Cosmic Frontier experimental collaboration should be directed to the Theoretical Research in High Energy Physics subprogram. Studies of gravitational physics (other than for cosmic acceleration), classical astrophysics phenomena, fundamental symmetries, or planning for future cosmic ray or gamma ray experiments are not included in this research area.

Subprogram Contacts:
- Manuel Bautista (Dark Matter), manuel.bautista@science.doe.gov
- Bryan J. Field (Cosmology and Dark Energy), bryan.field@science.doe.gov
- Kathleen (Kathy) Turner, kathy.turner@science.doe.gov

Website: https://science.osti.gov/hep/research

(d) Theoretical Research in High Energy Physics

This research area seeks to support theoretical activities that provide the vision and the mathematical framework for understanding and extending our knowledge of particles, forces, space-time, and the universe. Theoretical research is essential to support current experiments at the Energy, Intensity and Cosmic Frontiers, to identify new directions for High Energy Physics and to provide a deeper understanding of nature. Topics studied in theoretical high energy physics research include but are not limited to: phenomenological studies that seek to interpret experimental data, suggest searches for new physics at existing facilities and develop a research program for future facilities; precision calculations of experimental observables to test our current theories at the level of quantum corrections; the development of new models of physical interactions to describe unexplained phenomena or to unify seemingly distinct concepts; progress in quantum field theory, quantum gravity and other possible frameworks to develop a deeper understanding of nature; quantum information science to extend the reach of HEP theory; and the development of analytical and numerical computational techniques to facilitate studies in these areas. This research area also provides graduate and postdoctoral research training for the next generation of scientists and the computational resources needed for theoretical calculations. Activities that rely on experimental data, performed expressly for or with an experimental research collaboration, are not included in this research area.

Subprogram Contact:
- William (Bill) Kilgore, william.kilgore@science.doe.gov

Website: https://science.osti.gov/hep/research

(e) Accelerator Science and Technology R&D in High Energy Physics

The Accelerator Science and Technology R&D subprogram develops the next generation of particle accelerators and related technologies that are essential for discoveries in HEP. This research area supports world-leading research in the physics of charged particle beams, and long-range, early-stage exploratory research aimed at developing new acceleration concepts. This research area also provides graduate and postdoctoral research training, equipment for experiments, test facilities and related computational efforts.

Topics studied in the Accelerator Science and Technology R&D subprogram include but are not limited to: accelerator and beam physics, including the development of analytic and computational techniques for modeling particle beams and simulation of accelerator systems; novel acceleration concepts; the science of high gradients in accelerating cavities and structures; high-power radio-frequency sources; high-power targets; high-brightness beam sources; and beam instrumentation and controls. Also of interest are superconducting materials and conductor development for high field magnets; innovative magnet design and development of high-field superconducting magnets; as well as associated testing and cryogenic systems. R&D applications which are focused on accelerator uses outside of high-energy physics continue to be coordinated through the Accelerator Stewardship program, which has a separate NOFO.

Subprogram Contacts:
- Ken Marken, ken.marken@science.doe.gov
- Derun Li, derun.li@science.doe.gov

Website: https://science.osti.gov/hep/research

(f) Instrumentation and Detector R&D in High Energy Physics

The Detector R&D subprogram develops the next generation of instrumentation for HEP. It supports research leading to fundamental advances in the science of particle and radiation detection, and the development of new experimental techniques. This is typically long-term, "generic" R&D that is high-risk but has the potential for wide applicability and/or high impact. Applications should broadly align with the priority research directions identified in the report of the FY 2020 HEP Detector R&D Basic Research Needs study. Moreover, applications for "Blue-Sky" scientific research on innovative technologies not already in contention for implementation in future HEP projects are specifically encouraged.

Topics studied in the Detector R&D research area include but are not limited to: low-mass, high channel density charged particle vertexing and tracking detectors; high resolution, fast-readout calorimeters and particle identification detectors; techniques for improving the radiation tolerance and fast-timing capabilities of particle detectors; detectors for photons from ultraviolet to infrared wavelengths; detectors for cosmic microwave background radiation; detectors and experimental techniques for low-mass dark matter and ultralow-background experiments,

including those enabled by advances in QIS; and advanced electronics and data acquisition systems, including those enabled by advances in AI/ML and 3D integration. Support for graduate and postdoctoral research training, engineering and other technical efforts, and equipment and computational efforts required for experimental detector R&D and fabrication *is* included in this research area.

Subprogram Contact:
- Helmut Marsiske, helmut.marsiske@science.doe.gov

Website: https://science.osti.gov/hep/research

(g) Computational Research in High Energy Physics

This research area supports advanced computing research and development targeting challenges that are or have the capability of being broadly applicable to the increasingly complex HEP computing ecosystem. These challenges may include hardware-software co-design, development of collaborative software infrastructure, and research into high performance software and algorithms. These advanced computing techniques may include development of AI/ML techniques and novel applications that go well beyond current research standards, research that exploits unique aspects of HEP to learn about fundamental AI/ML techniques, and development that broadens participation in HEP AI/ML research. This subprogram also facilitates the effective use of DOE computing resources including, but not limited to, high-performance computing.

This program seeks applications into forward looking blue-sky seed research, and development of successful seed research into mature software products for the broader HEP community through bridge applications. This subprogram does not support computing research and/or activities specific to individual projects or experiments in the other research and technology R&D subprograms described in this solicitation. Support for specific operation efforts and/or hardware requests are also outside the scope of this area.

This program intends to hold a merit review of applications for Artificial Intelligence Research for HEP Theory and Data Analysis in 2025. These applications should be for ambitious projects with the potential to significantly improve or automate theoretical calculations and simulation of HEP relevant problems, as well as gain new insights from HEP experimental datasets. Research into topics related to symbolic calculation, AI-assisted simulation, physics informed Machine Learning, uncertainty quantification, differentiable simulation, and inverse problems are especially sought. For full consideration, applications should be submitted on or before April 18, 2025. HEP plans to issue a Program Announcement to the DOE National Laboratories in this subject area, which will be published at https://science.osti.gov/hep/Funding-Opportunities. Applicants in this topic under this NOFO may wish to coordinate their plans and submissions with proposers to the Program Announcement if considering a multi-institutional teaming arrangement. Additional details about the joint review of applications under this NOFO and applications under the Program Announcement will be published with the Program Announcement.

This program intends to hold a merit review of supplemental applications for HEP Traineeships in Accelerator Science & Engineering, Computational High Energy Physics, and High Energy Physics Instrumentation for additional research topics that include relevant use of Artificial Intelligence and Machine Learning. For full consideration, supplemental applications should be submitted on or before March 31, 2025. Recipients of current HEP Traineeship awards in Accelerator Science & Engineering, Computational High Energy Physics, and High Energy Physics are invited to submit supplemental applications requesting the addition of traineeship activities in Artificial Intelligence and Machine Learning (AI/ML). Only supplemental requests from current Traineeship recipients requesting to add AI/ML activities are responsive to this topic. All other requests for supplemental support to existing awards will be considered separately. Applications under this topic that either request additional time for the award or that request more support than is currently provided will be declined without review. Applications under this topic that seek to create new traineeships in AI/ML will be declined without review.

Subprogram Contact:
- Jeremy Love, jeremy.love@science.doe.gov

Website: https://science.osti.gov/hep/research

(h) Quantum Information Science for High Energy Physics Research

This research area is aligned to the SC and U.S. national initiatives in QIS, particularly those that focus on interdisciplinary partnerships between HEP and the wider QIS communities. This subprogram supports efforts that advance the HEP science drivers, as identified by P5, as well as the program mission of HEP in the context of broader benefits to QIS.

This research area will not participate in the annual HEP comparative review process in FY 2026. A separate, dedicated call for HEP QIS applications was published in FY 2024 (DE-FOA-0003354, QuantISED 2.0). However, applications in response to this NOFO may propose activities *in support of* HEP QIS research, which include, but are not limited to: supplemental support for research activities, conferences, experimental operations, conceptual research and development (R&D), or design or fabrication *directed towards a specific (pre)project* within the HEP QIS scientific program.

This subprogram does not support general (i.e., not related to the HEP mission) quantum computing research, algorithms, or hardware; or quantum networking R&D.

Subprogram Contact:
- Zachary Goff-Eldredge, Zachary.Goff-Eldredge@science.doe.gov

Website: https://science.osti.gov/hep/research

6. Nuclear Physics (NP)
Program Website: https://science.osti.gov/np/

The mission of the Nuclear Physics (NP) program is to explore the nature of matter: its basic constituents and how they interact to form the elements and the properties we observe. The largest contribution by far to the mass of the matter we are familiar with comes from protons,

neutrons, and heavier nuclei. Although the fundamental particles that compose nuclear matter—quarks and gluons—are themselves relatively well understood, exactly how they interact and combine to form the different types of matter observed in the universe today and during its evolution remains largely unknown.

The priority areas for NP are described in the *2023 Nuclear Science Advisory Committee Long Range Plan* and include the following:

- Develop experiments, methods and techniques to accurately describe and predict the interactions between neutrons and protons that drive nuclear structure and nuclear reactions.
- Advance forefront nuclear physics to determine how quarks and gluons make up protons, neutrons, and atomic nuclei.
- Enable efforts to use atomic nuclei to uncover physics beyond the Standard Model.
- Connect multi-messenger and nuclear physics observables to characterize the nuclear processes that drive the birth, life, and death of stars.
- Conceive, construct, and operate national scientific user facilities and develop novel detector and accelerator instrumentation and technologies.

Within each of these priority areas, unique nuclear physics opportunities using artificial intelligence (AI) or machine learning (ML), new developments in microelectronics, and R&D integration which advances detector and imaging technologies are also of NP programmatic interest. Applicants are encouraged to contact the relevant subprogram contact.

To carry out its mission and address these priorities, the NP program addresses three broad, tightly interrelated, scientific thrusts: Quantum Chromodynamics (QCD); Nuclei and Nuclear Astrophysics; and Fundamental Symmetries. NP supports basic research in seven subprograms areas: Medium Energy, Heavy Ion, Nuclear Structure and Nuclear Astrophysics, Fundamental Symmetries, Nuclear Theory, Nuclear Data, and Nuclear Physics Computing (a through g). Additionally, NP supports Advanced Technology Research and Development for Accelerators and Applications (h), NP Quantum Information Science (QIS) (i) which supports the QIS initiative and leverages opportunities for Nuclear Physics to benefit from advances in this topical area, and Electron-Ion Collider-related Generic Detector Research and Development (R&D) (j). Contact the relevant subprogram contacts for guidance if the proposed scope of work includes multiple NP subprograms.

While fully distinct and non-overlapping, the research topics supported by NP and High Energy Physics (HEP) may be of interest for the unique capabilities of research groups in either SC program. To ensure that "transitional" applications for groups exploring new research directions can be accommodated fairly, for a limited period not to exceed one award term, and subject as always to appropriate peer review, NP and HEP will allow for the possibility of support in their own portfolios for groups engaged in such crossover research.

To advance knowledge in nuclear science and effectively train and mentor the next generation of nuclear scientists, NP places a high priority on supporting Principal Investigators who are active-career tenured or tenure-track faculty researchers.

Applicants should pay attention to the following when preparing applications to NP under this NOFO:

- Applications in NP with research narratives in excess of 20 pages (with an additional 5 pages per major research thrust or separate task) may pose an undue burden on merit reviewers and may be declined without review;
- For all applications, the end of the project narrative must include a bulleted list of annual objectives;
- For renewal applications, the project narrative must describe the progress made under the previous award.

For all applications, a table in the budget justification section should specify the funding request by subprogram and, if relevant, AI/ML. An example follows.

	FY 2025	FY 2026	FY 2027
Medium Energy	$50,000	$40,000	$50,000
Fundamental Symmetries	$60,000	$80,000	$90,000

- Applications requesting support for graduate students must refer to the *2023 Nuclear Science Advisory Committee Long Range Plan* in justifying the requested level of support.
- For all applications, a student tracking table is required. This table must be included at the end of the project narrative and will not count against the narrative page limit.

Student	**Date Entered Grad. School**	**Date Joined Group**	**Degree Program**	**Date Degree Awarded/Expected**	**Advisor**
L. Meitner	Aug. 2023	Jan. 2024	Ph.D.	(May 2028)	M. Curie

Example Student Tracking Table

- For renewal applications, PIs are cautioned that the Renewal Proposal Products list generated in PAMS should only include publications from the immediately prior project period.
- For renewal applications, PIs should list their contributions to publications from the immediately prior project period. This list must be included at the end of the project narrative and will not count against the narrative page limit.

Applicants may email subprogram contacts regarding the technical requirements for the application. Administrative questions should be directed to sc.opencall@science.doe.gov.

The NP subprograms and their objectives follow:

(a) Medium Energy Nuclear Physics

The Medium Energy Nuclear Physics subprogram focuses primarily on understanding the structure of hadrons, how quarks move within a hadron and tests of the theory of the strong interaction known as QCD. According to QCD, all observed nuclear particles, collectively known as hadrons, arise from the strong interaction of quarks, antiquarks, and gluons. The protons and neutrons inside nuclei are the best-known examples of hadrons. QCD, although difficult to solve computationally, predicts which hadrons can exist in nature, and how they interact and decay. Specific questions addressed include: *What is the internal landscape of the protons and neutrons (collectively known as nucleons)? What does QCD predict for the properties of strongly interacting matter? What governs the transition of quarks and gluons into pions (hadronic subatomic particle) and nucleons? What is the role of gluons and gluon self-interactions in nucleons and nuclei?* The objectives of this subprogram are to develop a comprehensive picture of the spatial, momentum and angular momentum substructure of the nucleon, to elucidate quark confinement and hadron excitations, the origin of mass, and to understand the strong interaction in nuclei. Various experimental approaches are used to determine the distribution of "up", "down", and "strange" quarks, their antiquarks, and gluons within protons and neutrons, as well as clarifying the role of gluons in confining the quarks and antiquarks within hadrons. Polarized electron and proton beams are typically used to study the effects of the quark and gluon spins within nucleons, and the effect of the nuclear environment on the quarks and gluons. The subprogram also supports experimental searches for the spectrum of "excited states" and exotic hadrons predicted by QCD, as well as studies of their production mechanisms and decay properties. In pursuing these topics, the Medium Energy subprogram supports experimental research at the subprogram's primary research facility, the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson National Accelerator Facility (TJNAF), at other facilities, including the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL), the High Intensity Gamma Source (HIGS) at the Triangle Universities Nuclear Laboratory (TUNL) and at the future Electron-Ion Collider (EIC). Applications are sought for physics research efforts in support of current and future experiments in the Medium Energy program, as well as physics studies and pre-conceptual planning directed towards specific future experiments. Applications for instrumentation development for near-term experiments will also be considered. Searches for Dark Matter and Dark Energy may receive low or no priority from this subprogram.

Subprogram Contact:
- Gulshan Rai, Gulshan.Rai@science.doe.gov

Website: https://science.osti.gov/np/research/

(b) Heavy Ion Nuclear Physics

The Heavy Ion Nuclear Physics subprogram focuses on studies of condensed quark-gluon matter at extremely high densities and temperatures characteristic of the infant Universe. The primary facilities in the world currently capable of exploring the properties nuclear matter in these conditions are the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory

and the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN). The goal is to explore and understand unique manifestations of QCD in this many-body environment and their influence on the Universe's evolution. Important avenues of investigation are directed at resolving properties of the quark-gluon plasma at different length scales and learning more about its physical characteristics including its temperature, the energy loss mechanism for quarks and gluons traversing the quark-gluon plasma, determining the speed of sound in the quark-gluon plasma, understanding how quarks fragment and recombine to form hadronic matter (hadronization), and locating a possible critical point for the transition between the quark-gluon plasma and normal matter. The high baryon-density region of the phase diagram for nuclear matter continues to be explored. Experimental research is carried out primarily using the RHIC facility and the LHC. Applications for instrumentation development for near-term experiments will be considered. Applicants may propose research components related to the application of AI/ML tools and methods. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

NP anticipates holding a merit review panel of experts to evaluate applications in this subject. The panel is expected to meet in early 2025. Applications submitted by **November 15, 2024**, will be evaluated by the panel. Applications not submitted in time to be considered by the panel may be considered for funding in a future selection cycle.

Subprogram Contact:
- Ken Hicks, Kenneth.hicks@science.doe.gov

Website: https://science.osti.gov/np/research/

(c) Nuclear Structure and Nuclear Astrophysics

The subfield of nuclear structure addresses the underlying nature of atomic nuclei and the limits of their existence and describes dynamical processes such as nuclear reactions and fission. The goal is to develop a predictive understanding of nuclei and their interactions grounded in fundamental QCD and electroweak theory; furthermore, this understanding must be based on experimental data from a wide variety of nuclei.

At the intersection between observational astrophysics and nuclear physics, nuclear astrophysics can identify the conditions at the very core of stars and provide a record of the violent history of the universe. The scope includes the impact of nuclear processes on the evolution of the universe, the role of nuclear structure in influencing the evolution of the cosmos, and the cosmogenic origin of elements that are the building blocks of life.

Major goals of this subprogram are to develop a comprehensive description of nuclei across the entire nuclear chart, including as-yet undiscovered superheavy nuclei, to utilize rare isotope beams to reveal new nuclear phenomena and structures unlike those that are derived from studies using stable ion beams, and to measure the cross sections of nuclear reactions that power stars and spectacular stellar explosions and are responsible for the synthesis of the elements. Experimental research is currently carried out using the Facility for Rare Isotope Beams (FRIB) and the Argonne Tandem Linac Accelerator System (ATLAS), as well as the TUNL and the Texas A&M University Cyclotron Institute. Applicants may propose research components

related to the application of AI/ML tools and methods. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

NP anticipates holding a merit review panel of experts to evaluate applications in this subject. The panel is expected to meet in early 2025. Applications submitted by **November 15, 2024**, will receive full consideration. Applications not submitted in time to be considered by the panel may be considered for funding in a future selection cycle.

Subprogram Contact:
- Spiros Margetis, spyridon.margetis@science.doe.gov

Website: https://science.osti.gov/np/research/

(d) Fundamental Symmetries

This subprogram supports precision experiments to test the fundamental symmetries of nature and search for evidence of new forces or particles. Questions addressed in this frontier include: *What is the nature of neutrinos, what are their masses, and how have they shaped the evolution of the universe? Why is there now more matter than antimatter in the universe? What are the unseen forces that were present at the dawn of the universe but disappeared from view as the universe evolved?* Specifically, the subprogram seeks to support: research to measure the neutrino mass and to determine if the neutrino is its own antiparticle; experiments with cold and ultra-cold neutrons to investigate the dominance of matter over antimatter in the universe, and to determine the lifetime of the neutron; experiments to illuminate the fundamental symmetries of nature through precise measurements of beta decay and searches for anomalous parity violation; research on other aspects of Fundamental Symmetries and interactions involving nuclei. A major focus of this subprogram is furthering progress towards a major priority of the *2023 Nuclear Science Advisory Committee Long Range Plan for Nuclear Science*: the implementation of a ton-scale neutrino-less double beta decay experiment to determine whether the neutrino is its own anti-particle. Applicants may propose research components related to the application of AI/ML tools and methods. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

NP anticipates holding a merit review panel of experts to evaluate applications in this subject. The panel is expected to meet in early 2025. Applications submitted by **November 15, 2024**, will be evaluated by the panel. Applications not submitted in time to be considered by the panel may be considered for funding in a future selection cycle.

Subprogram Contact:
- Paul Sorensen, paul.sorensen@science.doe.gov

Website: https://science.osti.gov/np/research/

(e) Nuclear Theory

The Nuclear Theory subprogram provides the formal mathematical aspects of physics needed to explain the fundamental nature of the world around us. It provides the theoretical pillar needed to

complement and interpret the wide range of data obtained from the experimental nuclear science subprograms and to guide new ideas and hypotheses that can ascertain prospective areas of experimental investigations. This subprogram addresses all of the field's scientific thrusts described in NSAC's long range plan, as well as the specific questions listed for the experimental subprograms above. Theoretical research on QCD (the fundamental theory of quarks and gluons) addresses the questions of how the properties of the nuclei, hadrons, and nuclear matter observed experimentally arise from this theory, how the phenomenon of quark confinement arises, and what phases of nuclear matter occur at high densities and temperatures. In Nuclear Structure and Nuclear Astrophysics, theorists investigate a broad range of topics, including calculations of the properties of stable and unstable nuclear species, the limits of nuclear stability, the various types of nuclear transitions and decays, how nuclei arise from the forces between nucleons, and how nuclei are formed in cataclysmic astronomical events such as supernovae and neutron star mergers. In Fundamental Symmetries, nucleons and nuclei are used to test the Standard Model, which describes the interactions of elementary particles at the most fundamental level. Theoretical research in this area is concerned with determining how various (beyond) Standard Model aspects can be explored through nuclear physics experiments, including the interactions of neutrinos, unusual nuclear transitions, rare decays, and high-precision studies of cold neutrons. Applicants may propose research components related to the application of AI/ML tools and methods. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

NP anticipates holding a merit review panel of experts to evaluate applications in this subject. The panel is expected to meet in early 2025. Applications submitted by **November 15, 2024**, will be evaluated by the panel. Applications not submitted in time to be considered by the panel may be considered for funding in a future selection cycle.

Subprogram Contact:
- Astrid Morreale, Astrid.Morreale@science.doe.gov

Website: https://science.osti.gov/np/research/

(f) Nuclear Data

The Nuclear Data subprogram is multi-disciplinary with applications to energy, defense, space, and medicine. Nuclear data underlies modeling and simulation software in nuclear applications, so it is key for ensuring results are accurate. Working groups have been established among researchers, as well as federal programs, to help coordinate, prioritize, and fund research efforts to improve nuclear data in basic science and applied nuclear technologies.

In addition, the Nuclear Data subprogram collects, evaluates, and disseminates nuclear data with its support of the U.S. Nuclear Data Program (USNDP) and the National Nuclear Data Center (NNDC). This process combines historical and modern experiments, theory, and modeling to publish best values for nuclear properties such as cross sections and decay data. The extensive nuclear databases produced by this effort are an international resource consisting of carefully organized scientific information gathered over 50 years of low-energy nuclear physics research worldwide.

The highest priority research needs are addressed through the Nuclear Data InterAgency Working Group NOFO. However, additional research opportunities exist for both theoretical and experimental nuclear structure and nuclear reactions, with particular interest in predictive capabilities in emerging needs in applications such as, but not limited to, energy generation (fission and fusion), space exploration, and medicine. The most recent needs have been discussed at the annual Workshop on Applied Nuclear Data Activities (WANDA) found here: https://www.nndc.bnl.gov/ndwg/workshops.html. Applicants may propose research components related to the application of AI/ML tools and methods. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

Subprogram Contact:
- Keith Jankowski, Keith.Jankowski@science.doe.gov

Website: https://science.osti.gov/np/research/

(g) Nuclear Physics Computing

The Nuclear Physics Computing subprogram supports research in nuclear physics that relies on large-scale, high-performance computing. The topical areas this subprogram supports include: 1) low energy nuclear reactions; 2) the properties and structure of nuclei and nuclear interactions; 3) the internal structure of nucleons in terms of quarks and gluons; 4) hadron spectra and exotic states of QCD; 5) neutrino and electron interactions in nuclei and dense nuclear matter; 6) properties of quark-gluon plasma; and 7) nuclear astrophysics and nucleosynthesis. The Nuclear Physics Computing subprogram also supports the development of Lattice QCD computations and techniques that are critical to the understanding of nuclei, nuclear reactions, hadron structure, and the dynamics of strong interactions.

This subprogram supports the development of research software and advanced computing algorithms that are broadly applicable across the NP computing ecosystem, including the development of AI/ML techniques and novel applications unique to NP research. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

Subprogram Contact:
- Xiaofeng Guo, xiaofeng.guo@science.doe.gov

Website: https://science.osti.gov/np/research/

(h) Advanced Technology R&D for Accelerators and Applications

This NP activity supports a broad range of activities aimed at research and development related to the science, engineering, and technology of heavy-ion, electron, and proton accelerators and associated systems. Areas of interest include R&D of technologies for heavy ion and polarized proton beams; linear accelerators such as CEBAF at TJNAF; development of devices and/or methods in the generation of intense rare isotope beams at FRIB at Michigan State University and in the generation of stable isotope beams at the ATLAS, and R&D in accelerator science and technology in support of next generation Nuclear Physics accelerator facilities such as the EIC

Research aimed at transformative advances in ion sources, superconducting radiofrequency, and beam cooling is also encouraged, as well as R&D integration which leads to new capability in particle detection and/or advanced imaging technology. New imaging capability which has broader impacts is of particular interest.

Also of interest are R&D in emerging technologies in AI/ML with focus on increasing cost savings and operational efficiencies of NP accelerator user facilities and their experimental programs. The general approach here is the use of AI/ML tools and methods for nuclear physics experiments, simulation, theory, and accelerator operation to expand scientific reach and accelerate scientific discovery. Scope of AI/ML related work and its estimated budget should follow the guidance outlined in the NP introduction section of this NOFO.

Subprogram Contact:

- Manouchehr Farkhondeh, manouchehr.farkhondeh@science.doe.gov

Website: https://science.osti.gov/np/research/

(i) NP Quantum Information Science

The NP Quantum Information Science (QIS) subprogram priority, *Quantum Horizons: QIS Research and Innovation for Nuclear Science,* identifies and coordinates emerging opportunities in fundamental research and applied challenges at the interface of NP and QIS, providing new opportunities to address challenges of enormous interest and complexity in both fields. *Quantum Horizons* specifically encourages exploitation of the interdisciplinary nature of Quantum Computing and QIS to expand the frontiers of NP-supported research.

Applications must be responsive to one or two of the topics below:

> **Topic I**: QIS-NP collaborative research between the NP and QIS communities that leverage the respective strengths of universities, national laboratories, and industry. For example, science in support of QIS technologies such as "nuclear qubits" or the mitigation of effects of radiation on qubits are within the scope of this topic.
>
> **Topic II**: Theory QIS-NP research. Broad theory research on methods and quantum algorithms that solve important problems in NP using emerging digital quantum computers, hybrid computers, quantum annealers and quantum simulators; utilize QIS concepts to better understand nuclear phenomena.
>
> **Topic III**: Research to develop or capitalize on QIS technology with applications for nuclear physics. For example, research that utilizes QIS technology for detectors that can be used to advance basic research. Support for research to implement quantum sensors for nuclear physics applications would further the interests of both the NP and QIS communities, while helping to generate crucial collaborations. Quantum sensors should *exploit* distinct quantum phenomena - superposition, entanglement, and squeezing - that do not have classical counterparts, to acquire, process, and transmit information in ways that greatly exceed existing capabilities.

Topic IV: Grand Challenges. QIS research to address "grand challenges" in NP that may require both support for more than one 5-year cycle as well as larger multidisciplinary teams. For example, the development of a Nuclear Clock or Nuclear Qubits could fall under this opportunity. Prospective investigators should contact the subprogram contact to present their ideas and organizational entity.

Topic V: Ramping-up engagement. Applications for major conferences, workshops, pedagogical schools, high-level seminars, and PI exchange meetings for NP and QIS communities to promote technical exchanges, form new relationships, and deepen engagement will be considered. These applications may request other resources as needed to engage NP-supported individuals with external collaborators to advance NP-relevant quantum science and technology.

Applications to *Quantum Horizons:*

- May be from a single institution or from a multi-institutional team. If submitting an application for a multi-institutional team, a prime and subaward model with one application submitted by the lead institution is a better fit for applications to this subtopic.
- Must focus on no more than two of the topics above.
- Applications to topics I, III, or IV must involve researchers from both NP and QIS disciplines and explain how the proposed research will impact both disciplines.
- Applications for experimental research must include detailed timelines for achieving the research objectives.
- Applications with subawards from DOE/NNSA National Laboratories must detail how the proposed research is aligned with ongoing activities at the laboratory.

NP anticipates holding a merit review panel of experts to evaluate applications in this subject. The panel is expected to meet in early 2025. Applications submitted by **November 30, 2024**, will be evaluated by the panel. Applications not submitted in time to be considered by the panel may be considered for funding in a future selection cycle.

Applicants are strongly encouraged to review recent QIS awards from NP. Those awards can be found at https://science.osti.gov/np/Research/Quantum-Information-Science. To learn more about SC endeavors, visit the QIS Centers webpage https://science.osti.gov/Initiatives/QIS/QIS-Centers and the SC Program Offices QIS webpage https://science.osti.gov/Initiatives/QIS/Program-Offices-QIS-Pages.

Subprogram Contact:

- Gulshan Rai, Gulshan.Rai@science.doe.gov

Website: https://science.osti.gov/np/Research/Quantum-Information-Science

(j) EIC-related Generic Detector Research and Development

This NP activity supports generic detector R&D efforts to address the scientific requirements for measurements at the future EIC with the goal of advancing R&D on innovative, cost-effective detector concepts that reduce risk and could be incorporated into the on-project detector or an

envisioned second detector. The EIC project scope includes one detector known as ePIC (https://www.bnl.gov/eic/epic.php). The scientific community is planning for a future second detector (https://indico.bnl.gov/event/18414/) that is off-project. The EIC User Group authored the Yellow Report (https://www.osti.gov/biblio/1764596) that includes requirements for both detectors.

Applications should be aimed at optimizing detection capability to enhance the scientific reach of polarized electron-proton and electron-ion collisions with center-of-mass energies in the range 30-140 GeV and e-p equivalent luminosities up to a few times 10^{34} $cm^{-2}s^{-1}$. Detector technology areas of interest include particle identification, calorimetry, particle tracking, as well as associated readout electronics.

This program will not duplicate, but instead exist synergistically with NP's Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) program.

NP anticipates holding a merit review panel of experts to evaluate applications in this subject. The panel is expected to meet in early 2025. Applications submitted by **November 15, 2024**, will be evaluated by the panel. Applications not submitted in time to be considered by the panel may be considered for funding in a future selection cycle.

Subprogram Contact:
- Michelle Shinn, michelle.shinn@science.doe.gov

Website: https://www.bnl.gov/eic/ and associated links within

7. Isotope R&D and Production (DOE IP)
Program Website: https://science.osti.gov/Isotope-Research-Development-and-Production

The mission of the Office of Isotope R&D and Production, commonly referred to as the DOE Isotope Program (DOE IP), is to produce and/or distribute stable isotopes and radioisotopes in short supply or unavailable in the U.S., including related isotope services; maintain mission readiness of critical national facilities, equipment, and core competencies needed to manufacture isotopes and ensure the U.S. is prepared to respond to supply chain gaps during a national crisis; conduct R&D to develop transformative isotope production, separation, and enrichment technologies; nurture an inclusive and diverse domestic workforce with unique and world-leading core competencies; and mitigate U.S. dependence on foreign supplies of isotopes and promote robust domestic supply chains for U.S. economic resilience. Only the basic, fundamental, and use-inspired research portion of the DOE IP mission is supported by this NOFO. The DOE IP relies on expertise across numerous technical disciplines to accomplish its mission, including nuclear and radiochemistry, nuclear physics, accelerator and reactor science, materials science and engineering, separations science, nuclear data, and others. The DOE IP utilizes domestic facilities and capabilities for the production and distribution of stable and radioactive isotopes to research, federal, and commercial entities. Radioactive and enriched stable isotopes are made available using unique facilities stewarded by DOE IP at Brookhaven National Laboratory, Los Alamos National Laboratory, Argonne National Laboratory, and Oak Ridge National Laboratory. DOE IP also coordinates and supports isotope production at a suite

of universities and other national laboratories throughout the nation to promote a reliable, domestic supply of isotopes.

While not an exhaustive list, four broad basic, fundamental, and use-inspired research topics of interest to the DOE IP R&D portfolio are listed below. The topics seek basic research supporting the development of advanced, cost-effective, and efficient technologies for producing, processing (including isotopic separations, and the development of biological tracers), extracting, recycling, and distributing isotopes in short supply. This includes basic research supporting technologies for production of radioisotopes using reactor and accelerator facilities, extraction radioisotopes from legacy materials or other sources, and enrichment of stable and radioisotopes. Workforce development is viewed as an essential component of the Program's R&D portfolio.

Excluded from this call are applications related to the production of Mo-99 and Pu-238, as these isotopes are under the purview of the National Nuclear Security Administration Office of Materials Management and Minimization and the DOE Office of Nuclear Energy, respectively. A primary document that has guided DOE IP priorities is entitled "Meeting Isotope Needs and Capturing Opportunities for the Future: The 2015 Long Range Plan for the DOE-NP Isotope Program." This document may be accessed at: https://science.osti.gov/~/media/np/nsac/pdf/docs/2015/2015_NSACI_Report_to_NSAC_Final.pdf. Additional information about the DOE IP may be found at: https://science.osti.gov/Isotope-Research-Development-and-Production.

(a) Targetry and Isotope Production Research

Applications to this topic should be focused on basic research supporting novel or improved capabilities for inducing transmutation of atoms in targets to create radioisotopes that strongly align with the DOE IP mission space inclusive of any potential workforce development activities (e.g., travel bursaries for students and postdoctoral trainees to present results at scientific conferences). This includes aspects of targetry and target fabrication, as well as the development of innovative approaches, including integration of Artificial Intelligence and Machine Learning (AI and ML) techniques to model and predict the behavior of targets undergoing irradiation to optimize yield and minimize target failures during routine isotope production. It is understood that accelerator- and reactor-based isotope production have different considerations. Applications to this topic can address either production modality. Robotics and advanced manufacturing techniques, as they apply to isotope production and processing, may also be proposed. All applications should first be discussed with the subprogram contact listed below.

Subprogram Contact:

- Ethan Balkin, Ethan.Balkin@science.doe.gov

Website: https://science.osti.gov/Isotope-Research-Development-and-Production

(b) Nuclear and Radiochemical Separation, Purification and Radiochemical Synthesis

Work in this topic is broadly applicable to basic research supporting the improvement and/or development of novel chemical and physical processes to recover and purify radioisotopes from multiple sources. Applications proposing scopes of work dealing with isotopes resulting from

activated targets along with those not necessarily resulting from direct transmutation of target material (e.g., the recovery and purification of radioisotopes from legacy materials, facility components, used nuclear fuel, or waste streams/effluents of other processing efforts) are also considered responsive. Scopes of work should be strongly aligned with the DOE IP mission space inclusive of any potential workforce development activities (e.g., travel bursaries for students and postdoctoral trainees to present results at scientific conferences).

Additionally, basic research supporting the development or synthesis of chemical constructs with physical or chemical properties that make them particularly useful in the isotope science landscape (e.g., the synthesis and development of novel chelating agents or other ligands) are programmatically very relevant. Development of automated production and processing techniques to enhance the efficiency and safety of radioisotope production and processing (including uses of AI or ML and advanced manufacturing) are also encouraged. It is important to note that the development of purification and separation techniques may, but do not have to, include the handling of radioactive materials or irradiation of targets (e.g., experiments based on surrogate material are acceptable). All applications should first be discussed with the subprogram contact listed below.

Subprogram Contact:
- Ethan Balkin, Ethan.Balkin@science.doe.gov

Website: https://science.osti.gov/Isotope-Research-Development-and-Production

(c) Biological Tracers, Imaging, and Therapeutics

Work in this topic should be focused on basic research supporting the development of isotopes that might be useful as biological tracers, imaging and/or therapeutic agents. The development or modification of chemical constructs which have physical or chemical properties that make them particularly useful with isotopes in this category would also be considered responsive. Included in this topic are the modification of existing agents, synthesis and development of: novel ligands, pharmacokinetic modifying linkers, or other hydrodynamic volume altering compounds. Please note that DOE IP funds only basic science R&D. Studies investigating the applications of isotopes will not be considered for funding. All applications should first be discussed with the subprogram contact listed below.

Subprogram Contact:
- Ethan Balkin, Ethan.Balkin@science.doe.gov

Website: https://science.osti.gov/Isotope-Research-Development-and-Production

(d) Isotopic Enrichment Technology

Work in this area should advance current technologies in electromagnetic ion separation (EMIS), atomic vapor laser ion separation (AVLIS), thermal diffusion and novel enrichment approaches. Responsive work scope might explore, but are not limited to: the development of EMIS-based ion sources capable of greater than 20% ionization efficiency of the lanthanide and actinide series of elements at 1 mA intensity or greater; understanding the plasma chemistry and atomic physics effects associated with high intensity heavy ion plasma and ion sources; understanding

the sputter physics of materials with energy and angular dependence; development of high efficiency, high purity magnetized radiofrequency driven ion source technology for EMIS-based enrichment; resolving the uncertainty around applying modern approaches to AVLIS isotope enrichment.

In addition, the specifications for feed stock and resulting chemistry are often very process dependent. This can lead to material compatibility issues when working across different enrichment technologies. DOE IP is interested in applications focused on mitigating these material compatibility issues. Responsive work scope might explore, but is not limited to, plasma/ion formation of challenging feed material and chemistry, physics, or engineering based materials analyses. The development of enrichment techniques and capabilities to produce hydrogen (H-2 or deuterium) are also encouraged. Studies aimed at the development of automated techniques to enhance the efficiency and safety of materials processing and enrichment (including uses of AI or ML, multi-physics modeling, and advanced manufacturing) are also encouraged. All applications should first be discussed with the subprogram contact listed below.

Subprogram Contact:
- April Gillens, April.Gillens@science.doe.gov

Website: https://science.osti.gov/Isotope-Research-Development-and-Production

8. Accelerator R&D and Production (ARDAP)
Program Website: https://science.osti.gov/ardap

The mission of the Accelerator R&D and Production (ARDAP) program is to coordinate Office of Science accelerator R&D; advance accelerator science and technology relevant to the Department, other Federal Agencies, and U.S. industry; foster public-private partnerships and other collaborative R&D activities to develop, demonstrate, and enable the commercial deployment of accelerator technology; support the development of a skilled, diverse, and inclusive workforce; and provide access to accelerator design and engineering resources. Applicants addressing *cross-cutting accelerator research or technology development* activities in one or more of the following five research areas are *strongly encouraged* to submit applications to either the annual Research Opportunities in Accelerator Stewardship NOFO and/or to the annual Early Career Research Program NOFO, each available through https://www.grants.gov. Applications that are in direct support of ARDAP research activities may be submitted to this NOFO but will likely be assigned a lower programmatic priority than those from the Accelerator Stewardship comparative review process. Prior to any submission to this NOFO, applicants are *strongly encouraged* to contact the program contact listed below to develop applications that address the program's goals.

Topics funded through the ARDAP program include, but are not limited to:
1. Superconducting accelerator systems—both radiofrequency accelerators and high-field magnets—including research on superconducting materials, engineering, and cryogenic techniques.
2. Beam physics and high-fidelity computer modeling, together with better diagnostics and advanced control systems, including theory and simulation to accurately model the next

generation of particle accelerators; better diagnostics, more sophisticated and automated control systems; and advances in particle-collider-specific beam physics including final focusing and advanced cooling techniques.
3. Very high brightness and high current electron sources and in high intensity proton and ion sources and more robust megawatt-class targets for secondary beam production.
4. High average power radiofrequency and ultrafast laser sources, including improvements in power handling devices such as waveguide windows and couplers for radiofrequency systems, and high-power optics and coatings for laser systems.
5. High-risk high-reward advances in accelerator science and technology, including novel particle sources, advanced beam dynamics, new acceleration techniques, and next-generation materials.

Program Contact:
- Eric R. Colby, Eric.Colby@science.doe.gov

Website: https://science.osti.gov/ardap

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.

Conferences

Consistent with SC's Statement of Commitment (https://science.osti.gov/SW-DEI/SC-Statement-of-Commitment), 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. Further, SC is committed to advancing belonging, accessibility, justice, equity, diversity, and inclusion across the portfolio of activities it sponsors. For applications requesting SC funds for the purpose of supporting (hosting) a conference, symposium, or workshop, the meeting must have a policy or code of conduct in place that addresses discrimination and harassment, including sexual harassment, other forms of harassment, and sexual assault, and that includes processes for reporting complaints and addressing complaints. The policy or code-of-conduct must be shared with all participants prior to the conference, symposium, or workshop (hereinafter the 'meeting') and made easily available.

Conference applications must include:
- An online link to the current code of conduct of the host organization for the meeting, or the

link to where the code of conduct will be posted. If a code of conduct has not yet been established by the meeting organizers, the application must describe the process and timeline by which a code of conduct will be written, approved, and endorsed.
- A recruitment and accessibility plan for speakers and attendees that includes discussion of recruitment of individuals from groups underrepresented in the research/professional community associated with the technical focus of the meeting, and discussion on plans to address possible barriers for attendees, including but not limited to physical barriers.

Multi-Institutional Teams

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

COLLABORATIVE APPLICATIONS

Teams of multiple institutions may submit collaborative applications. Each submitted application in such a team must indicate that it is part of a collaborative project/group. Every partner institution must submit an application through its own sponsored research office. Each multi-institutional team can have only one lead institution. Each application within the multi-institutional team, including the narrative, starting with the title page, and all required appendices and attachments, must be identical with the following exceptions:
- Each application must contain a correct SF-424 (R&R)[5] cover page for the submitting institution only.
- Each application must contain a unique budget corresponding to the expenditures for that application's submitting institution only.
- Each application must contain a unique budget justification corresponding to the expenditures for that application's submitting institution only.
- Each application must contain a Project/Performance Site Location(s) form for the submitting institution and its subawards.
- Each application must include a list for the Identification of Merit Review Conflicts for the submitting institution's senior/key personnel and its subawards' senior/key personnel.
- Each application must include a Research and Related Senior/Key Person Profile (Expanded) form with the biographical sketches and current and pending support from that institution's senior/key personnel. The applicant leading the multi-institutional team must include biographical sketches and current and pending support from each institution's senior/key personnel.

Our intent is to create from the various applications associated with a multi-institutional team one document for merit review that consists of the common, identical materials combined with a set of detailed budgets from the partner institutions. Each team member's application must contain the same project title. Team members may use Grants.gov Workspace(s), webforms, and their system-to-system services in any combination.

[5] The Standard Form 424 (SF-424) family of forms is used to apply for Federal financial assistance through https://www.Grants.gov. The Research and Related (R&R) set of forms is used by the Office of Science.

SUBAWARDS[6]

Multi-institutional teams may submit one application from a designated lead institution with all other team members proposed as subrecipients.

DOE/National Nuclear Security Administration (NNSA) National Laboratories[7], other Federal agencies, and another Federal agency's FFRDCs[8], if participating in a team led by another institution, may be proposed as subrecipients.

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

DISTINGUISHING BETWEEN COLLABORATIVE APPLICATIONS AND SUBAWARDS

The following points of advice to applicants may be helpful:

1. Both collaborative applications and proposed subawards are methods by which multiple institutions can work together to reach the scientific objectives described in this NOFO. Choose the appropriate structure based on the nature of the scientific work being proposed. If multiple institutions will be functioning as a network of peer-level researchers, a collaborative structure would be more appropriate. If multiple institutions will be functioning with leadership and direction coming from one institution, a subaward arrangement would be more appropriate.
    a. Collaborative applications are assembled from multiple identical applications submitted by the proposing institution. Such applications may be submitted under this NOFO in Grants.gov. The multiple applications will be assembled into one joint collaborative application, which will be merit-reviewed as one document, with recommendations to fund or decline the application made at the level of each independent application.
    b. Subawards exist when multiple institutions work together to submit one application with a designated prime recipient and multiple potential subrecipients.
    c. DOE/NNSA National Laboratories, other Federal agencies, and another Federal agency's FFRDCs may be proposed as subrecipients, but the value of any such proposed subaward may be removed from any such prime award: DOE will often make separate awards to Federally affiliated institutions.
2. A well-thought-out research plan and its associated budget(s) should leave no confusion about which institution will do which parts of the research.

[6] Subawards are made to subrecipients. Both terms are defined in 2 CFR 200.1 (https://www.ecfr.gov)
[7] The phrase "National Laboratories" is used broadly to encompass DOE/NNSA laboratories and sites capable of performing the work described in this NOFO and capable of receiving funds through the DOE Field Work System.
[8] An authoritative list of all Federally Funded Research and Development Centers (FFRDCs) may be found at https://www.nsf.gov/statistics/ffrdclist/

All entities submitting applications to this NOFO must recognize the moral and legal obligations to comply with export controls and policies that limit the transfer of technologies with potential dual use. Applicants are reminded that international activities must comply with nonproliferation, sanction, and other protocols described at https://www.trade.gov/export-solutions.

International activities related to special nuclear materials (SNM) are subject to additional requirements. Please see 10 CFR 810 for further information.

All work proposed under this NOFO must be for basic and fundamental research whose results may be published in scholarly literature. Do not submit applications containing restricted data or unclassified controlled nuclear information as defined in the Atomic Energy Act of 1954, as amended, 42 USC 2011, et seq., 10 CFR 1017, 10 CFR 1045.

B. Program Goals, Objectives, and Priorities

The Office of Science's (SC) mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States (U.S.). SC is the Nation's largest Federal sponsor of basic research in the physical sciences and the lead Federal agency supporting fundamental scientific research for our Nation's energy future.

SC accomplishes its mission and advances national goals by supporting:

- The frontiers of science—exploring nature's mysteries from the study of fundamental subatomic particles, atoms, and molecules that are the building blocks of the materials of our universe and everything in it to the DNA, proteins, and cells that are the building blocks of life. Each of the programs in SC supports research probing the most fundamental disciplinary questions.
- The 21st Century tools of science—providing the nation's researchers with 28 state-of-the-art national scientific user facilities, the most advanced tools of modern science, propelling the U.S. to the forefront of science, technology development, and deployment through innovation.
- Science for energy and the environment—paving the knowledge foundation to spur discoveries and innovations for advancing the Department's mission in energy and environment. SC supports a wide range of funding modalities from single principal investigators to large team-based activities to engage in fundamental research on energy production, conversion, storage, transmission, and use, and on our understanding of the earth systems.

SC is an established leader of the U.S. scientific discovery and innovation enterprise. Over the decades, SC investments and accomplishments in basic research and enabling research capabilities have provided the foundations for new technologies, businesses, and industries, making significant contributions to our nation's economy, national security, and quality of life

C. Award Contribution to Goals and Objectives

Awards resulting from this NOFO are intended to increase our understanding of scientific phenomena.

D. Performance Goals

You will be expected to demonstrate progress toward increasing knowledge in periodic progress reports.

E. Substantial Involvement

Either a grant or cooperative agreement may be awarded under this NOFO. If the award is a cooperative agreement, the DOE contract specialist/grants management specialist and DOE program manager will negotiate a Statement of Substantial Involvement prior to award.

F. Program Unallowable Costs

You must apply the cost principles of 2 CFR 200, as modified by 2 CFR 910 and 10 CFR 605, to your application and any resulting award.

G. Citations to Statute and Regulations

The programmatic authorizing statutes and regulations are:
Section 646 of Public Law 95-91, U.S. Department of Energy Organization Act
Section 901, et seq. of Public Law 109-58, Energy Policy Act of 2005
Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, codified at 2 CFR 200
U.S. Department of Energy Financial Assistance Rules, codified at 2 CFR 910
U.S. Department of Energy, Office of Science Financial Assistance Program Rule, codified at 10 CFR 605
U.S. Department of Energy, Technology Investment Agreements, codified at 10 CFR 603

H. Program History

You can learn about SC's history at https://science.osti.gov/About/History. You can read about our achievements at https://science.osti.gov/Science-Features/Science-Highlights. You can find information about all of our awards at https://pamspublic.science.energy.gov/WebPAMSExternal/interface/awards/AwardSearchExternal.aspx.

I. Other Information

ANTICIPATED AWARD SIZE

The award size will depend on the number of meritorious applications and the availability of

appropriated funds.

Historically, awards from $5,000 to $5,000,000 have been made in response to the NOFO each year.

Period of Performance

DOE anticipates making awards with a project period of six months to five years, with the most common project period being three 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 application; (3) submission of required reports; and (4) compliance with the terms and conditions of the award.

Award Budget Periods

SC is committed to distributing workloads (internally and externally) across as much of the calendar as is practical. Accordingly, awards made under this NOFO will generally be made with budget periods that end between December 1 and June 30. New awards may be made with a first budget period of more than 12 months. Renewal awards may be made with first budget periods that may be longer or shorter than 12 months.

Applicants should prepare budgets with 12-month budget periods. Actual start dates and cycle dates will be negotiated if an application is recommended for award. Budget periods will generally not be made for less than 9 months or more than 18 months.

IV. Application Contents and Format

A. Preliminary Submissions

1. Letter of Intent (LOI)

Not applicable.

2. Pre-application

PRE-APPLICATION DUE DATE

Pre-applications may be submitted at any time while this NOFO is available. Note that some topics may have required or strongly encouraged submissions by specified dates if an application is to be considered by a review panel.

A pre-application (also called a white paper) is recommended but optional. Before submitting a pre-application, read the information in Section III of this NOFO carefully to make sure your idea is responsive and to select the topical subprogram most relevant to your idea.

You will be required to select a program manager when you submit your pre-application using the DOE SC Portfolio Analysis and Management System (PAMS) website. Choose the subprogram contact for the topical area most relevant to your idea from those listed in Section III of this NOFO.

Feedback from DOE to the principal investigator is optional, but you are encouraged to use your submitted pre-application/white paper to initiate a discussion with the listed program manager about the appropriateness of the proposed research for this solicitation.

If a multi-institutional team is submitting collaborative applications, only the lead institution may submit a pre-application.

The pre-application must begin with a title page that will not count toward the pre-application page limitation. Include, at the top of the first page, the following information:

Title of Pre-application
Principal Investigator Name, Job Title
[Lead] Institution
PI Phone Number, PI Email Address
NOFO Number: Include the NOFO Number indicated on the cover of this NOFO
Include a list of all senior/key personnel at the applicant and, if applicable, team member institutions.

This information must be followed by a clear and concise description of the objectives and technical approach of the proposed research. The pre-application may not exceed three pages, when printed using standard letter-size (8.5-inch x 11-inch) paper with 1-inch margins (top,

bottom, left, and right). The body text font must not be smaller than 11 point. Figures and references, if included, must fit within the three-page limit.

In addition, the pre-application must include a listing of senior/key personnel and a listing of individuals who should not serve as merit reviewers of a subsequent application. Detailed instructions for how to craft the required listings are provided in Section IX of this NOFO. **Note that the listing of individuals who should not serve as merit reviewers is rarely empty because the instructions contain mandatory inclusions requirements.** This listing will not count toward the pre-application's page limit. The list of individuals must be included as an "Additional Attachment" to your pre-application in PAMS.

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

The absence of a pre-application will not negatively affect a thorough evaluation of a responsive application submitted in a timely fashion.

PRE-APPLICATION SUBMISSION

Pre-applications 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-application in PAMS. Do not submit a pre-application through FedConnect or Grants.gov.

Pre-applications may be submitted by a PI or by other users 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-application and when an application is submitted, to ensure that their application is properly linked to their pre-application and that reviewers are properly assigned to the application.

Detailed instructions about how to submit a pre-application are in Section IX of this NOFO.

B. Application

Applications in response to this NOFO must be submitted through Grants.gov. Detailed instructions for registering in and using Grants.gov are in Section IX of this NOFO.

C. Component Pieces of the Application

LETTERS OF COLLABORATION OR ACCESS

Letters from collaborators or from institutions providing access to data, models, software, equipment and/or facilities may be appended to your project narrative and are not considered part of the project narrative's page limit. 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 or the access to data, models, software, equipment and/or facilities. Letters of recommendation are not allowed in applications under this NOFO.

Letters of collaboration or access should be placed in Appendix 7 (Other Attachments). Letters of collaboration or access must not be written as recommendation or endorsement letters, which are not allowed. Each letter of collaboration or access may contain two and only two sentences and must use the following format:

> Dear <Principal Investigator Name>:
>
> If your application entitled, "<Application Name>," is selected for funding under the FY 2025 Continuation of Solicitation for the Office of Science Financial Assistance Program, it is my intent to collaborate in this research by <Complete Sentence With a Very Short Description of What the Collaborator Offers to Do or Provide>.
>
> Thank you for the opportunity to participate.
>
> Sincerely,
>
> <Collaborator's Name and Signature Block>

SCIENTIFIC USER FACILITIES

Documentation from any SC scientific user facility (https://science.osti.gov/User-Facilities) may be provided with other letters of collaboration or access in Appendix 7.

If the proposed research includes activities at the DIII-D National Fusion Facility, a U.S. DOE Office of Science user facility, then a Record of Discussion from the facility must be included in the submission. The Record of Discussion documents potential resources required by the facility to support the proposed research scope. Information on the Record of Discussion process at DIII-D is available at https://d3dfusion.org/become-a-user/ under the "Records of Discussion" header. A Record of Discussion form is available for download from that site.

1. SF-424 (R&R)

Complete this form first to populate data in other forms. Complete all the required fields in accordance with the pop-up instructions on the form. The list of certifications and assurances referenced in Field 17 is available on the DOE Financial Assistance Forms Page at https://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Certifications and Assurances[9]. Applicants are bound by their representations and certifications in SAM.gov.

[9] No separate form or submission is required for the Certifications and Assurances.

TYPE OF SUBMISSION (FIELD 1)

Select the checkbox for "Application" for an initial submission. Select the checkbox for "Changed/Corrected Application" if submitting an updated version of an application. Do not submit pre-applications via Grants.gov: Do not select the checkbox for "Pre-application."

IDENTIFYING NUMBERS (FIELD 4)

For renewals and supplemental funding, enter the DOE award number in Field 4a. Do not enter any other number in Field 4a. Do not enter anything in Field 4b. If submitting an updated version of an application, you may enter the previous Grants.gov Tracking ID in Field 4c, though this is not required.

UEI AND EIN NUMBERS (FIELDS 5 AND 6)

The Uniform Entity Identifier (UEI) and Employer Identification Number (EIN) fields on the SF-424 (R&R) form are used in PAMS to confirm the identity of the individual or organization submitting an application.

- Enter the UEI as a 12-digit alpha-numerical sequence.
- Enter the EIN as a nine-digit number.
- Do not use hyphens or dashes.
- SC does not use the 12-digit EIN format required by some other agencies.
- Applications will not be rejected if an applicant's system-to-system service uses a 12-digit EIN format or inserts hyphens or dashes in an EIN.

TYPE OF APPLICATION (FIELD 8)

A **new** application is one in which DOE support for the proposed research is being requested for the first time. A **renewal** application requests additional funding for a period of time following a current award. If the application requests a significant change in the scope of work, please consult with the Program contact identified in this NOFO to determine if the application should be considered new or a renewal.

SC does not make use of the Resubmission or Continuation options.

Applications for supplemental support of an existing award should be marked as "Revision."

Please answer "yes" to the question "Is this application being submitted to other agencies?" if substantially similar, identical, or closely related research objectives are being submitted to another Federal agency. Indicate the agency or agencies to which the similar objectives have been submitted.

Do not attach pre-applications to Field 20 of the SF-424(R&R) form or letters of intent to Field 21 of the SF-424(R&R) form.

DOE will accept new, renewal, and supplemental applications under this NOFO. Information about how to distinguish between new and renewal applications is located in Section IX.

Applications for supplemental funding to existing SC awards compete for funding with all other applications submitted under this NOFO. Applications for supplemental funding may be made in two broad types:

1. **Supplemental funding**. Such applications must indicate that they are being made to request additional funding and must describe how the additional funds will be used. These applications must mark the box for "A. Increase Award" in Field 8 of the SF-424 (R&R) application form.
2. **Supplemental funding with additional time**. Such applications must also indicate the need for additional time. These applications must mark the boxes for "A. Increase Award" and "C. Increase Duration" in Field 8 of the SF-424 (R&R) application form.

Regardless of whether or not an application for supplemental funding requests additional time, the application may propose a change in the scope of the award. If, in SC's determination, an application for supplemental funding proposes a change in scope, the application will be subject to merit review.

Applications for supplemental funding must include the existing award number in Field 4.a. of the SF-424 (R&R) application form and indicate that the type of application is a "Revision" in Field 8 of the SF-424 (R&R) application form.

Applicants intending to submit an application for supplemental funding are strongly encouraged to consult their DOE program manager before submitting the application.

Applications for supplemental funding to an existing SC award are typically intended to address extraordinary or unexpected circumstances, and may include, but are not limited to, requests for:

- Support for additional personnel (e.g., graduate students, postdocs, research technicians or equivalent).
- Replacing or repairing equipment (items with a useful life of more than 12 months and a per-item acquisition cost of more than $5,000) required to conduct proposed research.
- Previously unrequested travel for project personnel to attend one or more user facility, scientific conference, workshop, or professional society meetings relevant to the proposed research.
- Support for temporary personnel to continue productivity of work while project personnel are on extended leave in accordance with the recipient institution's policies, whether for family, parental, military service, or other extended leave. *Note that the disengagement of a PI or other senior/key personnel for more than three months (or 25% of their approved effort) requires agency prior approval, separate from the request for supplemental funds.*
- Purchase of new equipment or modification of existing equipment, and/or the provision of services necessary to enable work to be carried out by project personnel with disabilities.
- Support for increased costs for previously budgeted and approved materials, supplies, or equipment.

All costs requested in a budget must conform to the applicable cost principles.

2. Research and Related Other Project Information

Complete questions in fields 1 through 6 of the SF-424 Research and Related Other Project Information form.

Note regarding question 4.a. and 4.b.:

If any environmental impact, positive or negative, is anticipated, indicate "yes" in response to question 4.a., "potential impact – positive or negative - on the environment." Disclosure of the impact should be provided in response to question 4.b. First indicate whether the impact is positive or negative and then identify the area of concern (e.g., air, water, exposure to radiation, impacts to endangered species or historic properties, etc.). Should the applicant have any uncertainty, they should check "yes."

DOE understands the phrase in field 4.a., "potential impact … negative" to apply if the work described in the application could potentially have any of the impacts listed in (1) through (5) of 10 CFR 1021, Appendix B, Conditions that Are Integral Elements of the Classes of Action in Appendix B. (https://www.ecfr.gov)

Additionally, for actions which could have any other adverse impacts to the environment or have any possibility for adverse impacts to human health (e.g., use of human subjects, Biosafety Level 3-4 laboratory construction/operation, manufacture or use of certain nanoscale materials which are known to impact human health, or any activities involving transuranic or high level radioactive waste, or use of or exposure to any radioactive materials beyond de minimis levels), applicants should indicate a "negative" impact on the environment.

Lastly, 1) if there would be extraordinary circumstances (i.e., factor or circumstance that could increase the level of significance of environmental effects normally associated with the proposed action) (10 CFR 1021.410 (b)(2)), 2) if the work is connected to other actions with potentially significant impacts (10 CFR 1021.410 (b)(3), or 3) if the work is related to other nearby actions with the potential for cumulatively significant impacts (10 CFR 1021.410 (b)(3)), applicants should indicate a "negative" impact on the environment.

The bulk of your application will consist of files attached to the Research and Related Other Project Information form. The files must comply with the following instructions:

PROJECT SUMMARY/ABSTRACT (FIELD 7 ON THE FORM)

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. The project summary/abstract must be comprised of:

- The project title, the PI name and the PI's institutional affiliation, and any coinvestigators and their institutional affiliations. This information will not count toward the abstract's one-page limit.
- This information must be followed by a statement of the project's objectives, a description of the project, including methods to be employed, and the potential impact of the project (i.e., benefits, outcomes).
- The description of the proposed research may not exceed one page (excluding Project Title and list of investigators) when printed using standard letter-size (8.5-inch x 11-inch) paper with 1-inch margins (top, bottom, left, and right). The body text font must not be smaller than 11 point. Figures and references, if included, must fit within the one-page limit.

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 (no more than one page, excluding Project Title and list of investigators)

If an application 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 to prepare public reports about supported research.

DOE TITLE PAGE
(PART OF PROJECT NARRATIVE ATTACHED TO FIELD 8 ON THE FORM)

The application narrative must begin with a title page. The title page must include the following items:

- The project title:
- Applicant/Institution:
- Street Address/City/State/ZIP:
- Postal Address:
- Lead PI name, telephone number, email:
- Administrative Point of Contact name, telephone number, email:
- NOFO Number: Include the NOFO number printed on the cover of this NOFO.
- DOE/SC Program Office:
- DOE/SC Program Office Technical Contact:

- DOE Award Number (if Renewal Application):
- PAMS Pre-application tracking number (if applicable):
- Research area or areas as identified in Section III of this NOFO:

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 … Budget**	**Total Budget**

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, all required appendices, and other attachments. This single PDF file may not be scanned from a printed document and must be attached in Field 8 on the Grants.gov form. 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 project 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 project 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 project narrative. Once a project narrative has been assembled, please submit the combined project 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. Do not attach any of the appendices listed in this paragraph separately in any other field in Grants.gov. If you do, these additional attachments will not become part of the application in PAMS.

TITLE PAGE SUPPLEMENT FOR COLLABORATIVE APPLICATIONS
(PART OF PROJECT NARRATIVE ATTACHED TO FIELD 8 ON THE FORM)

If a multi-institutional team is submitting collaborative applications, provide the following information on a separate page as a supplement to the title page. This page will not count toward the project narrative page limitation.

- List all institutions by name with each institution's PI on the same line.
- Indicate the lead PI who will be the point of contact and coordinator for the combined research activity.
- Provide a statement explaining the leadership structure of the team.

- Include a description of each institution's facilities, equipment, and resources that will be made available to the team.
- If applicable, explain how students and early-stage researchers will be trained and mentored by senior researchers.
- Include a table modeled on the following chart providing summary budget information from all institutions. Provide the total costs of the budget request in each year for each institution and totals for all rows and columns. Modify the table to provide the correct number of budget years.

Collaborative Application Information								
	Name	**Institution**	**Year 1 Budget**	**Year 2 Budget**	**Year 3 Budget**	**Year 4 Budget**	**Year 5 Budget**	**Total Budget**
Lead PI								
Co-PI								
Co-PI								
Co-PI								

Example budget table ($ in thousands)

* Note that collaborating applications must be submitted separately.

PROJECT NARRATIVE (FIELD 8 ON THE FORM)

The project narrative consists 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 body text font of all main text must not be smaller than 11 point.

Do not include any websites (URLs) that provide supplementary or additional information that constitutes a part of the application. Merit reviewers are not required to access websites; however, Internet publications in a list of references will be treated identically to print publications. See Section IX of this NOFO for instructions on how to mark proprietary application information. To attach a Project Narrative, click "Add Attachment."

The Project Narrative comprises the research plan for the project. It should contain enough background material in the Introduction, including a brief review of the relevant literature and any prior research in this area, 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 methods 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.

The following organization of the Project Narrative is suggested:

- **Background/Introduction**: Explanation of the importance and relevance of the proposed work as well as a review of the relevant literature.
- **Project Objectives:** This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.
- **Progress Report (for Renewal Applications Only):** The Project Narrative of a renewal application must include a separate section that includes a description of results of the work accomplished during the current project period (since the last new or renewal award), an analysis of how the results relate to the activities proposed to be undertaken during the renewal period, and a description of any changes that affected the overall direction of the research being performed. Include an estimate of any remaining funds from the current project period at its anticipated end.
- **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.

Buy America Requirement for Infrastructure Projects

Awards funded through this NOFO that are for, or contain, construction, alteration, maintenance, or repair of public infrastructure in the United States undertaken by applicable recipient types, require that:

- All iron, steel, and manufactured products used in the infrastructure project are produced in the United States; and
- All construction materials used in the infrastructure project are manufactured in the United States.

Applicants should consult Section IX of this NOFO to determine whether the Buy America Requirement applies and if they should consider the application of the Buy America Requirement in the proposed project's budget and/or schedule.

Within the first two (2) pages of the Project Narrative, include a short statement on whether the project will involve the construction, alteration, maintenance and/or repair of public infrastructure in the United States. See Section IX of this NOFO for applicable definitions and other information regarding Infrastructure Projects and the Buy America Requirement.

The Project Narrative is considered the intellectual work of the proposed researchers. Concurrent submission of the same or substantially similar narratives attributed to different researchers may constitute academic dishonesty or research misconduct. Submission of a project narrative that is not the work of the proposed researchers, including machine-generated project narratives, may constitute academic dishonesty or research misconduct.

For Collaborative Applications Only: Each institution in a multi-institutional team submitting collaborative applications must submit an identical common narrative, including all appendices. Collaborative applications will necessarily be longer than single-institution applications. The common narrative must identify which tasks and activities will be performed by which of the institutions in every

budget period of the proposed project. The budget and the budget justification—which are unique to each institution—may refer to parts of the common narrative to further identify each institution's activities in the joint project. There should be no ambiguity about each institution's role and participation in the team.

SC will use the multiple applications associated with a multi-institutional team to create one consolidated document for merit review that consists of the common, identical application materials, a set of detailed budgets from the partner institutions, and the senior/key personnel form (with attached biographical sketches and current and pending support statements). It is very important that every project narrative in the team be identical (including the title).

Do not attach any of the requested appendices described below as files for fields 9, 10, 11, and 12 in Grants.gov. Follow the below instructions to include the information as appendices in the single project narrative file.

Biographical sketches and current and pending support may no longer be provided as attachments to a project narrative. These documents must be attached to the Research and Related Senior/Key Person Profile (Expanded) form in an application.

APPENDIX 1: 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 10 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 application. Provide the Bibliography and References Cited information as an appendix to your project narrative.

- Do not attach a bibliography to Field 9 of the Research and Related Other Project Information form.

APPENDIX 2: FACILITIES & OTHER RESOURCES

This information is used to assess the capability of the organizational resources, including subrecipient 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. Such documents, provided that they do not become letters of support or recommendation, may be printed on any letterhead. Please provide the Facility and Other Resource information as an appendix to your project narrative.

- Do not attach a facilities and other resources statement to Field 10 of the Research and Related Other Project Information form.

APPENDIX 3: 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 an equipment statement to Field 11 of the Research and Related Other Project Information form.

APPENDIX 4: DATA MANAGEMENT PLAN

Provide a Data Management Plan (DMP) as an appendix to the project narrative. Data management plans are not required for applications that only request support for a conference, workshop, or scientific meeting. Subject to the applicable cost principles, applications may request costs necessary for implementing the DMP.

- Do not attach a separate file to Field 12 of the Research and Related Other Project Information form.

The standard requirements for a DMP may be found in Section IX of this NOFO. The DMP should specifically address:

- How FAIR (Findable, Accessible, Interoperable, and Reusable)[10] principles will apply to the anticipated data sets, software[11], and models[12] 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 5: PROMOTING INCLUSIVE AND EQUITABLE RESEARCH (PIER) PLAN

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[10] 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

[11] 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

[12] 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

All new and renewal applications that are not for conference support must provide a Promoting Inclusive and Equitable Research (PIER) Plan as an appendix to the project narrative. The PIER plan should describe the activities and strategies of the applicant to promote equity and inclusion as an integral element to advancing scientific excellence in the research project within the context of the proposing institution and any associated research group(s)[13]. Plans may include, but are not limited to: strategies 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.[14] PIER Plans should be tailored to the research project. While PIER Plans may incorporate or build upon existing efforts of the project key personnel or applicant institution(s) to recruit diverse participants and create inclusive research environments, plans should not be a re-statement of standard institutional policies or broad principles. The complexity and detail of a PIER Plan is expected to increase with the size of the research team and the number of personnel to be supported.

For renewal applications only: Discuss briefly how the PIER Plan builds on or expands upon actions and accomplishments of the relevant efforts (e.g., PIER Plan or related activities) of the currently supported research.

Resources about PIER plans are available at https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans. Subject to the applicable cost principles, applications may request costs necessary for implementing the PIER Plan.

- PIER plans are not required for applications for supplemental funding or conference support.
- This appendix should not exceed a page limit of 3 pages when printed using standard letter-size (8.5-inch x 11-inch) paper with 1-inch margins (top, bottom, left, and right).
- SC may determine that based on the complexity and scale of the proposed work, an exception to the 3-page limit may be granted. Approval to exceed the 3-page limit must be granted in advance by the SC subprogram contact. Any exceptions may not exceed two additional pages.
- Do not attach a separate file to Field 12 of the Research and Related Other Project Information form.

APPENDIX 6: SYNERGISTIC ACTIVITIES (OPTIONAL)

In addition to biographical sketches in the Common Format, each senior/key person may provide

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

[14] Please see additional information on things to consider when developing a PIER Plan: https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans/Things-to-Consider-When-Developing-a-PIER-Plan.

a one-page list of no more than five distinct examples of synergistic activities that demonstrate the individual's professional and scholarly activities that focus on the integration, transfer, and creation of knowledge as related to the application.

- Do not attach a separate file to Field 12 of the Research and Related Other Project Information form.
- This appendix may not exceed a limit of the same number of pages as the number of senior/key personnel when printed using standard letter-size (8.5-inch x 11-inch) paper with 1-inch margins (top, bottom, left, and right).

APPENDIX 7: OTHER ATTACHMENT

If you need to elaborate on your responses to questions 1-6 on the "Other Project Information" document, 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 application. Reviewers are not required to consider information in this appendix.

- Do not attach a separate file to Field 12 of the Research and Related Other Project Information form.

REMINDERS REGARDING ALL APPENDICES

- **Follow the above instructions to include the information as appendices to the project narrative file.**
- **Do not attach any appendices to fields 9, 10, 11, or 12.**

3. Research and Related Senior/Key Person Profile (Expanded)

Complete the Research and Related Senior/Key Person Profile (Expanded) form in accordance with the instructions on the form and the following instructions. Complete this form before the Budget form to populate data on the Budget form.

You must submit this information for the PI and all senior/key personnel who will be identified by name in Section A of the application's budget. List all other personnel who contribute in a substantive, meaningful way to the scientific development or execution of the project, whether or not salaries are requested. Consultants should be included in this "Senior/Key Person Profile (Expanded)" Form if they meet this definition. List individuals that meet the definition of senior/key regardless of what organization they work for. Senior/key personnel must be aware that they are included in the application and must agree to perform the work if awarded. The form will pre-populate with the PI identified on the SF-424(R&R) form. For each senior/key person:

- Complete the required sections in their profile.
- In the "credential" field, enter the person's PAMS username, if known.
- Attach the person's biographical sketch, following the instructions in Section IX of this NOFO for crafting a biographical sketch.
- Attach the person's current and pending support, following the instructions in Section IX of this NOFO for crafting current and pending support.

The Senior/Key Person Profile (Expanded) form will support the PI and up to 99 additional senior/key personnel. On the addition of the 99th senior/key person, you will be presented with an option to upload an additional file with the required information for all other senior/key personnel.

4. Research And Related Budget

Complete the Research and Related Budget form in accordance with the instructions on the form (Activate Help Mode to see instructions) and the following instructions. You must complete a separate budget for each year of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. All fields with a red border are required, but you may enter a zero "0" in any field in which funds are not being requested. You may request funds under any of the categories listed as long as the item and amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this NOFO.

Additional information is found in Section IX of this NOFO.

BUDGET JUSTIFICATION (FIELD L ON THE FORM)

Provide a justification that explains all costs proposed in the budget. The following items of advice are offered to assist you in developing a justification.

- Organize the justification by listing items in the same order as presented on the budget.
- Ensure that the narrative matches the budget in dollar amounts and language.
- Explain the line items. If costs are estimated, provide a basis for the estimate. Explain if costs are based on prior experience of similar activities. If a cost is based on the product of two numbers (such as a number of items at a per-item price), ensure that your math is correct.
- If including an inflationary factor for future budget periods, explain the basis for the inflationary factor.

Provide any other information you wish to submit to justify your budget request. Including items in the budget justification is not considered a form of cost-sharing: Provide the details of all personnel (key or other) who will be working on the award, regardless of their source(s) of compensation. Explain their source(s) of compensation if it is not from this award. Include the indirect cost rate agreement as a part of the budget justification.

Attach a single budget justification file for the entire project period in field L. The file automatically carries over to each budget year.

Additional information is found in Section IX of this NOFO.

5. R&R Subaward Budget Attachment(s) Form

Budgets for Subawards: You must provide a separate R&R budget and budget justification for

each subrecipient. Download the R&R Budget Attachment from the R&R SUBAWARD BUDGET ATTACHMENT(S) FORM and either email it to each subrecipient that is required to submit a separate budget or use the collaborative features of Workspace. After the subrecipient has either emailed its completed budget back to you or completed it within Workspace, attach it to one of the blocks provided on the form. All fields with a red border are required, but you may enter a zero "0" in any field in which funds are not being requested. Use up to 10 letters of the subrecipient's name (plus.pdf) as the file name (e.g., ucla.pdf or energyres.pdf). Filenames must not exceed 50 characters.

If the project involves more subrecipients than there are places in the SUBAWARD BUDGET ATTACHMENT(S) FORM, the additional subaward budgets may be saved as PDF files and appended to the Budget Justification attached to Field L.

Applicants should consult their local information technology ("IT") support resources for any necessary assistance in converting the forms downloaded from Grants.gov into plain PDF files that can be combined into one non-Portfolio PDF file (the Budget Justification).

Ensure that any files received from subrecipients are the PDF files extracted from the SUBAWARD BUDGET ATTACHMENT(S) FORM. Errors will be created if a subrecipient sends a prime applicant a budget form that was not extracted from the application package.

Note: If an application proposes subawards to a DOE/NNSA National Laboratory, a Federal agency, or another Federal agency's FFRDC, the value of such proposed subawards may be deducted from any resulting award: Those classes of organizations may be paid directly by SC. However, the details of such proposed budgets are an essential for understanding and analyzing the proposed research.

If the budget for an application is comprised of discrete or separable projects or tasks, the SUBAWARD BUDGET ATTACHMENT(S) FORM allows you to identify a budget as belonging to either a "project" or a "subaward."

The standard subaward budget form allows for a maximum of 10 subawards. If an application contains more than 10 subawards, please present the budgets for the eleventh and subsequent subawards in a tabular format, followed by the appropriate budget justification, as a part of the lead applicant's budget justification.

6. Project/Performance Site Location(s)

Indicate the primary site where the work will be performed. If a portion of the project will be performed at any other site(s), identify the site location(s) in the blocks provided.

Note that the Project/Performance Site Congressional District is entered in the format of the 2 digit state code followed by a dash and a 3 digit Congressional district code, for example VA-001. Hover over this field for additional instructions.

Use the Next Site button to expand the form to add additional Project/Performance Site Locations.

7. Disclosure of Lobbying Activities (SF-LLL)

If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying." Applicants that have never paid any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress do not need to submit this form.

8. Identification of Merit Reviewer Conflicts

Provide a list of individuals who should not serve as merit reviewers of this application, following the instructions in Section IX of this NOFO. Attach this information to Field 12 of the Research and Related Other Project Information Form.

9. Summary of Required Forms/Files

Your application must include the following items:

Name of Document	Format	Attach to
SF 424 (R&R)	Form	N/A
RESEARCH AND RELATED Other Project Information	Form	N/A
Project Summary/Abstract	PDF	Field 7
Project Narrative, including required appendices	PDF	Field 8
Identification of Merit Review Conflicts	File	Field 12
RESEARCH & RELATED Senior/Key Person Profile (Expanded)	Form	N/A
RESEARCH & RELATED BUDGET	Form	N/A
Budget Justification	PDF	Field L
R&R SUBAWARD BUDGET ATTACHMENT(S) FORM (if applicable)	Form	N/A
Subaward Budget Justification (if applicable)	PDF	Field L of the subaward budget
PROJECT/PERFORMANCE SITE LOCATION(S)	Form	N/A
SF-LLL Disclosure of Lobbying Activities, if applicable	Form	N/A

D. Information that Must be Submitted After Application but Before Award

If selected for award, DOE reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to:

- Indirect cost information
- Other budget information
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Commitment Letter from Third Parties Contributing to Cost Sharing, if applicable
- Environmental Information
- Information required to resolve concerns about conflicts of interest, conflicts of commitment, potential duplication of support

Applicants that are not institutions of higher education, that request indirect costs, and that do not already have an Indirect Cost Rate Agreement with their Cognizant Federal Agency or documentation of rates accepted for estimating purposes by DOE or another Federal agency, are advised to begin preparing an Indirect Cost Rate Proposal for submission, upon request, to the DOE contract specialist/grants management specialist who will evaluate your application if you are selected for award.

V. Submission Requirements and Deadlines

A. Address to Request Application Package

Application forms and instructions are available at Grants.gov. To access these materials, go to https://www.Grants.gov, select "Search Grants", and then enter the Catalog of Federal Domestic Assistance (CFDA)[15] number (81.049) and/or the NOFO number shown on the cover of this NOFO. Select the "Apply" button to access the application package.

Applications submitted through www.FedConnect.net will not be accepted. Applications may not be submitted through PAMS at https://pamspublic.science.energy.gov.

Detailed instructions for registering in and using Grants.gov are in Section VIII of this NOFO.

B. Unique Entity Identifier (UEI) and System for Award Management (SAM.gov)

Applicants must complete a series of registrations and enrollments to submit applications in response to this NOFO. Applicants not currently registered with SAM and Grants.gov should allow **at least four weeks** to complete these requirements. Applicants refers to the legal entity submitting an application: This is usually a corporate entity, not an individual investigator.

You should start the process as soon as possible.

You may not be able to use your preferred Internet browser: Each system has its own requirements.

Applicants must register with SAM at https://www.sam.gov/ and obtain a Unique Entity Identifier (UEI). Assistance is available at https://sam.gov/content/help.

Applicants must provide a Taxpayer Identification Number (TIN) to complete their registration in www.SAM.gov. An applicant's TIN is an EIN assigned by the Internal Revenue Service (IRS). In limited circumstances, a Social Security Number (SSN) assigned by the Social Security Administration (SSA) may be used as a TIN. You may obtain an EIN from the IRS at https://www.irs.gov/businesses/small-businesses-self-employed/apply-for-an-employer-identification-number-ein-online.

If entities have technical difficulties with the UEI validation or SAM registration process, they should utilize the HELP feature on SAM.gov. SAM.gov will work entity service tickets in the order in which they are received and asks that entities not create multiple service tickets for the same request or technical issue.

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[15] The Catalog of Federal Domestic Assistance has been replaced by the Assistance Listings in the System for Award Management at https://www.SAM.gov. They are still listed as CFDA in Grants.gov at https://www.grants.gov.

Do not use a SSN as a TIN.
Obtain a TIN from the IRS using the website listed above.

1. Requirement for System for Award Management

Unless exempt from this requirement under 2 CFR 25.110, the recipient must maintain a current and active registration in SAM.gov. The recipient's registration must always be current and active until the recipient submits all final reports required under this Federal award or receives the final payment, whichever is later. The recipient must review and update its information in SAM.gov at least annually from the date of its initial registration or any subsequent updates to ensure it is current, accurate, and complete. If applicable, this includes identifying the recipient's immediate and highest-level owner and subsidiaries and providing information about the recipient's predecessors that have received a Federal award or contract within the last three years.

2. Requirement for Unique Entity Identifier (UEI)

If the recipient is authorized to make subawards under this Federal award, the recipient:

- Must notify potential subrecipients that no entity may receive a subaward until the entity has provided its UEI to the recipient.
- Must not make a subaward to an entity unless the entity has provided its UEI to the recipient. Subrecipients are not required to complete full registration in SAM.gov to obtain a UEI.

C. Submission Instructions

Letters of Intent (LOIs) and pre-applications, if permitted under this NOFO, must be submitted in PAMS at https://pamspublic.science.energy.gov. Detailed instructions for LOIs are in Section IX of this NOFO. Detailed instructions for pre-applications are in Section IX of this NOFO.

Applications must be submitted in Grants.gov at https://www.grants.gov. Detailed instructions are in Section IX of this NOFO.

D. Submission Dates and Times

1. Letter of Intent Due Date

Not applicable.

2. Pre-application Due Date

Optional, though recommended pre-applications may be submitted at any time while this NOFO is available. Note that some topics may have required or strongly encouraged submissions by specified dates if an application is to be considered by a review panel.

3. Application Due Date

This NOFO will remain open until September 30, 2025, 11:59 PM Eastern Time, or until it is succeeded by another issuance, whichever occurs first. This NOFO succeeds DE-FOA-0003177, which was published September 29, 2023.

Applications for conference or workshop support must be submitted at least six months before the meeting date and no later than April 1, 2025, to be considered for FY 2025 funding.

Renewal applications compete with all other applications and must be submitted through Grants.gov at least six months before the scheduled expiration of the current award's project period. Earlier submission is strongly encouraged to allow for timely processing.

VI. Application Review Information

A. Responsiveness Review

Prior to a comprehensive merit evaluation, DOE will perform an initial review in accordance with 10 CFR 605.10(b) to determine that (1) the applicant is eligible for the award; (2) the information required by the NOFO has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the NOFO; and (5) the proposed project is not duplicative of programmatic work. Applications that fail to pass the initial review will not be forwarded for merit review and will be eliminated from further consideration.

B. Review Criteria

Applications will be subjected to scientific merit review (peer review) and will be evaluated against the following criteria, listed in descending order of importance, as found in 10 CFR 605.10 (d), the Office of Science Financial Assistance Program Rule.

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

Note that external peer reviewers are selected regarding both their scientific expertise and the absence of conflict-of-interest issues. Both Federal and non-Federal reviewers may be used, and submission of an application 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 established by regulation:

1. Scientific and/or Technical Merit of the Project

- What is the scientific innovation of the proposed research?
- What is the likelihood of achieving valuable results?
- How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?
- How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality?
- 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?
- *For renewal applications only:* Is the proposed work an appropriate outgrowth of, continuation to, or successor of the currently supported research?

- *For applications requesting conference support:* Consistent with SC's Statement of Commitment, does the host organization's code of conduct or equivalent policy for addressing discrimination and harassment sufficiently address all forms of harassment and include protocols for addressing complaints?
- *For applications requesting conference support:* Consistent with SC's Statement of Commitment, to what extent is the recruitment and accessibility plan likely to lead to participation of individuals from diverse backgrounds, including individuals historically underrepresented in the technical focus area of the conference or meeting?

2. Appropriateness of the Proposed Method or Approach

- How logical and feasible are the research approaches?
- Does the proposed research employ innovative concepts or methods?
- Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions?
- Does the applicant recognize significant potential problems and consider alternative strategies?
- Is the proposed research aligned with the published priorities identified or incorporated by reference in Section III of this NOFO such as program strategic plans?
- *For applications requesting conference support*: Does the host organization's code of conduct or equivalent policy for addressing discrimination and harassment sufficiently address all forms of harassment and include protocols for addressing complaints? To what extent is the recruitment and accessibility plan likely to lead to participation of individuals from diverse backgrounds, including individuals historically underrepresented in the technical focus area of the conference?

3. Competency of Applicant's Personnel and Adequacy of Proposed Resources

- What is the past performance and potential of the research team?
- How well qualified is the research team to carry out the proposed research?
- Are the research environment and facilities adequate for performing the research?
- Does the proposed work take advantage of unique facilities and capabilities?

4. Reasonableness and Appropriateness of the Proposed Budget

- Are the proposed budget and staffing levels adequate to carry out the proposed research?
- Is the budget reasonable and appropriate for the scope?

5. Quality and Efficacy of the Promoting Inclusive and Equitable Research Plan

- *For applications for supplemental funding or conference support:* This merit review criterion is not applicable.
- How well integrated is the Promoting Inclusive and Equitable Research (PIER) Plan with the proposed project?

- Are all aspects of the PIER Plan actionable and are the goals attainable during the project's period of performance?
- 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 of project personnel?
- How are the proposed resources and budget for the PIER Plan reasonable and appropriate?
- 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?
- *For renewal applications only*: How does the proposed plan build or expand upon actions and strategies to promote diversity and professional, inclusive research environments in the currently supported research?

C. Review and Selection Process

Applications submitted to this NOFO will be reviewed and considered for funding on a rolling basis. Applicants are cautioned that the Federal budget cycle may impact the availability of funds. Applications submitted in the latter half of the Federal fiscal year (April 1 – September 30) may be considered for funding in the next fiscal year.

1. Merit Review

Applications that pass the initial review will be subjected to a formal merit review and will be evaluated based on the criteria codified at 10 CFR 605.10(d) in accordance with the guidance provided in the "Office of Science Merit Review System for Financial Assistance," which is available at: https://science.osti.gov/grants/policy-and-guidance/merit-review-system/.

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
- Performance under current awards
- Commitment to sharing the results and products of research
- Promoting principal investigators not previously supported by SC
- Promoting the diversity of supported investigators and researchers
- Promoting the diversity of institutions receiving awards
- Increasing participation of institutions historically underrepresented in the SC research portfolio
- Promoting principal investigators with a commitment to improving diversity, equity, and inclusion in the STEM community

- Institutional history of training and mentoring of students, postdoctoral and early-career researchers
- Participation with multi-institutional teams in accordance with program priorities identified and incorporated in Section III of this NOFO

3. Selection

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

4. Discussions and Award

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to the following: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the recipient is capable of complying with the requirements in 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation); and/or (4) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

D. Risk Review

Pursuant to 2 CFR 200.206, DOE will conduct a review of any potential risks posed by the applicant. Such review of risk will include:
- Quality of the application,
- Reports and findings from audits performed under 2 CFR 200 and/or 2 CFR 910, and
- Systems maintained under 2 CFR 180.

DOE may make use of other publicly available information and the history of an applicant's performance under DOE or other Federal agency awards.

Applicants with no prior performance of DOE awards may be asked to provide information about their financial stability and or their ability to comply with the management standards of 2 CFR 200.

DOE may incorporate specific award conditions of a programmatic and/or administrative nature if an applicant exhibits one or more high-risk factors under 2 CFR 200.208.

The result(s) of any pre-award review of risk may supersede the results of merit review under 2 CFR 200.205, preventing DOE from selecting an application for award, requiring DOE to reverse a selection for award, or requiring the disengagement of specific personnel. The results of any post-award review of risk may result in requiring the disengagement of specific personnel, the imposition of other requirements, or the termination of an award that "no longer effectuates the program goals or agency priorities" under 2 CFR 200.340(a)(2). 2 CFR 200.206(c).

Pursuant to 2 CFR 910.128, the results of any pre-award review of risk are not appealable. Any pre-award decision to not select an application for award, reverse a selection for award, or require the disengagement of specific personnel will be made by the Selection Official or SC Program Official. Pursuant to 2 CFR 910.128, the results of any post-award review of risk may be appealable. Any post-award decision to require the disengagement of specific personnel, the imposition of other requirements, or the termination of an award will be made by the Contracting Officer.

DOE may conduct a review, through Government resources, of the applicant and project personnel with a connection to a foreign country. This includes, but is not limited to, (1) performance of work in, (2) travel to, and (3) awardee personnel's higher education in a foreign Country, as well as (4) partnerships with international collaborators. As part of the research, technology, and economic security risk review, DOE may contact the applicant and/or proposed project team members for additional information to inform the review.

VII. Award Notices

A. Type of Award Instrument

DOE anticipates awarding grants, cooperative agreements, other transactions (OTs), technology investment agreements (TIAs), and/or interagency agreements under this NOFO.

DOE will consider funding multi-institution teams submitted as collaborative applications, in which each institution must submit its own application with an identical common project narrative, under this NOFO. Multi-institutional teams may also apply using a prime and subaward model with one application submitted by the lead institution.

B. Anticipated Timeline for Notice of Selection for Award Negotiation

DOE anticipates making funding decisions within six months. The time interval begins on the date the application is received.

1. Notice of Selection for Award Negotiation

Applicants Selected for Award Negotiation Notification: DOE will notify applicants selected for award negotiation. This notice of selection for award negotiation is not an authorization for the applicant/recipient to begin performance.

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

2. Notice of Award

An Assistance Agreement issued by the DOE Contracting Officer is the authorizing award document. It normally includes, either as an attachment or by reference, the following items: (1) Special Terms and Conditions, (2) Intellectual Property Provisions, (3) Federal Assistance Reporting Checklist and Instructions, (4) Budget Pages, (5) The Research Terms and Conditions, available at https://www.nsf.gov/pubs/policydocs/rtc/rtcoverlay_march17.pdf, and DOE Agency Specific Requirements, available at https://www.nsf.gov/awards/managing/rtc.jsp, (6) Applicable program regulations, 10 CFR 605 at https://www.ecfr.gov/, (7) DOE Assistance Regulations, 2 CFR 200 as amended by 2 CFR 910 at https://www.ecfr.gov/, (8) Application/proposal as approved by DOE, (9) National Policy Assurances to Be Incorporated as Award Terms in effect on date of award at https://www.nsf.gov/awards/managing/rtc.jsp.

TERMS AND CONDITIONS

Sample DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at https://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Terms.

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

NATIONAL POLICY ASSURANCES

The National Policy Assurances To Be Incorporated As Award Terms are located at https://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Terms.

VIII. Post-Award Requirements and Administration

A. Administrative and National Policy Requirements

Additional policy provisions applicable to this NOFO are included in the list below. Awards made under this NOFO are subject to the respective Administrative and National Policy Requirements. The full text of each provision is in Section IX of this NOFO and may be accessed by navigating to the hyperlinks below:

39. Updating Your Portfolio Analysis and Management System (PAMS) Profile

B. Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award agreement. The standard checklist is available at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Forms: Individual awards may impose additional requirements.

C. Reporting of Matters Related to Recipient Integrity and Performance (December 2015)

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

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

DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as described in 2 CFR 200.206 Federal awarding agency review of risk posed by applicants.

D. Interim Conflict of Interest Policy for Financial Assistance

1. Policy

The DOE interim Conflict of Interest Policy for Financial Assistance (COI Policy) can be found at https://www.energy.gov/management/department-energy-interim-conflict-interest-policy-requirements-financial-assistance. This policy is applicable to all non-Federal entities applying for, or that receive, DOE funding by means of a financial assistance award (e.g., a grant, cooperative agreement, or technology investment agreement) and, through the implementation of this policy by the entity, to each Investigator who is planning to participate in, or is participating in, the project funded wholly or in part under the DOE financial assistance award. DOE's interim COI Policy establishes standards that provide a reasonable expectation that the design, conduct, and reporting of projects funded wholly or in part under DOE financial assistance awards will be free from bias resulting from financial conflicts of interest or organizational conflicts of interest. The applicant is subject to the requirements of the interim COI Policy and within each application for financial assistance, the applicant must certify that it is, or will be by the time of receiving any financial assistance award, compliant with all requirements in the interim COI

Policy. The applicant must flow down the requirements of the interim COI Policy to any subrecipient non-Federal entities.

2. SC Implementation

SC only requires that unmanaged or unmanageable financial conflicts of interest be included in the financial conflict of interest (FCOI) report.

IX. Other Information

A. Checklist for Avoiding Common Errors

Note that not all items in this checklist will apply to every submission under every NOFO.

Item	Issue
Applications	Submitted in Grants.gov. Do not submit applications in PAMS or FedConnect.
Grants.gov Submission	Ensure that applications are submitted under the correct Opportunity Number. Standard Form (SF)-424 Research and Related (R&R): - Attach nothing to field 20 - Attach nothing to field 21 SF-424 Research and Related Other Project Information form: - Attach the abstract to field 7 - Attach the project narrative, with all appendices, to field 8 - Attach nothing to field 9 - Attach nothing to field 10 - Attach nothing to field 11 - Attach the list of individuals who should not serve as merit reviewers (Collaborator Template) to field 12 - Do not attach other files to field 12 - NOTE: Files attached to field 12 will not be shared with merit reviewers.
Pre-Applications	- Submit your pre-application in PAMS. - Do not submit your pre-application in Grants.gov. - Do not attach your pre-application to the SF-424 Research and Related (R&R) form. - Follow the instructions in Section IV for the preparation of a pre-application.
Page Limits	Strictly followed throughout application, including particular attention to: - Project narrative, if stated in Section III - Biographical sketches - Promoting Inclusive and Equitable Research (PIER) Plan - Letter(s) of Collaboration or Access, if any

Item	Issue
Personally Identifiable Information	None present in the application
Project Narrative	Composed of one PDF file including all appendices (bibliography, facilities, equipment, DMP, PIER)
Project Summary / Abstract	Name of PI, 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. Attach the biographical sketch to the Senior/Key Person Profile (Expanded) Form.
Current and Pending Support	Ensure complete listing of all activities, regardless of source of funding. Attach the current and pending support to the Senior/Key Person Profile (Expanded) Form.
List of Individuals who Should not Serve as Merit Reviews	Attach to field 12 of the SF-424 Research and Related Other Project Information form.
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 required for new and renewal applications that are not for conference, workshop, or meeting support.
Applications requesting support for conferences, workshops, and scientific meetings	Provide link to Code of Conduct and include recruitment and accessibility plan.

B. How-To Guides

The how-to guides provided in this section are intended as general guidance about SC. Not all parts will be applicable to every NOFO, every application, or every institution.

1. How to Distinguish Between a New and Renewal Application

New Application: An application must be submitted as "new" in the following circumstances:

- When applying for funding to create a new research award that has not previously received DOE funding, including any funding for the current year,
- When applying for funding to support continued research from the same applicant institution

as the current grant but with a significant change in fundamental nature of the research, or
- When applying for funding to support continued research supported by an existing DOE award but at a new applicant institution.

Renewal Application: A renewal application is appropriate when funds are requested for an award from the same recipient/applicant institution that has no significant changes in the following items:
- The award's senior leadership, and
- The fundamental nature of the award.

A change in an award's PI does not necessarily require submission as a new application: The change in personnel must be considered in light of other changes.

Renewal applications compete for funds with all other peer-reviewed applications and must be developed as fully as though the applicant were applying for the first time. Renewal applications must be submitted by the same sponsoring institution as that holding the current award for which renewal funding is requested, and the proposed research topic must be logical scientific extensions of the research that has been performed in the current award.

2. How Federally Affiliated Organizations May Participate and Be Funded

VALUE/FUNDING FOR DOE/NNSA NATIONAL LABORATORIES AND NON-DOE/NNSA FFRDCS

For grant awards, the value of, and funding for, a DOE/NNSA National Laboratory contractor, a non-DOE/NNSA Federally Funded Research and Development Center (FFRDC) contractor, or another Federal agency's portion of the work will not be included in the award to the successful applicant. DOE will fund a DOE/NNSA National Laboratory contractor through the DOE field work authorization system or other appropriate process and may fund non-DOE/NNSA FFRDC contractors and other Federal agencies through an interagency agreement in accordance with the Economy Act, 31 USC 1535, or other statutory authority.

RESPONSIBILITY

The successful prime applicant/recipient (lead organization) will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and any team member, and/or subrecipient.

If an award is made to a DOE/NNSA National Laboratory, all Disputes and Claims will be resolved in accordance with the terms and conditions of the DOE/NNSA National Laboratory's management and operating (M&O) contract, as applicable, in consultation between DOE and the prime recipient.

If an award is made to another Federal agency or its FFRDC contractor, all Disputes and Claims will be resolved in accordance with the terms and conditions of the interagency agreement in consultation between DOE and the prime recipient.

3. How Federally Affiliated Organizations May Apply

DOE/NNSA NATIONAL LABORATORIES

DOE/NNSA National Laboratories, if eligible either as a prime applicant or a proposed team member on another entity's application, should ensure that their cognizant DOE/NNSA Contracting Officer provides written authorization. This authorization should be submitted with the application as part of the Budget Justification for DOE/NNSA National Laboratory Contractor File. [This is not required for the National Energy Technology Laboratory because it is a Government Owned/Government Operated (GOGO) Laboratory.] **Please note that failure to provide this authorization may result in rejection of an application prior to merit review.** If a DOE/NNSA National Laboratory Contractor is selected for award, or proposed as a team member, the proposed work will be authorized under the DOE field work authorization system or other appropriate process and performed under the laboratory Contractor's M&O contract, as applicable. The authorization may be addressed "To Whom It May Concern:". The following wording is acceptable for the authorization:

> "Authorization is granted for the _____ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory and will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

(End of acceptable authorization)

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

NON-DOE/NNSA FFRDCS

Non-DOE/NNSA FFRDCs, if eligible either as a prime applicant or a proposed team member on another entity's application, should follow the following guidelines:

The prime applicant must obtain written authorization for non-DOE/NNSA FFRDC participation. The cognizant Contracting Officer for the Federal agency sponsoring the FFRDC contractor must authorize in writing the participation of the FFRDC contractor on the proposed project and this authorization should be submitted with the application. The written authorization must also contain a determination that the use of a FFRDC contractor is consistent with the contractor's authority under its award and does not place the FFRDC contractor in direct competition with the private sector, in accordance with FAR Part 17.5. **Please note that failure to provide this authorization may result in rejection of an application prior to merit review.** The authorization may be addressed "To Whom It May Concern:". The following wording is acceptable for the authorization:

> "Authorization is granted for the _____ Laboratory to participate in the

proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory and will not adversely impact execution of the (insert agency) assigned programs at the laboratory. This laboratory is authorized to perform the work proposed in the application submitted under DOE Funding Opportunity Announcement <<Include the NOFO number on the cover page>> by the following statutory authority (insert statute name, citation, and section)."

(End of acceptable authorization)

OTHER FEDERAL AGENCIES

Other Federal Agencies, if eligible either as a prime applicant or a proposed team member on another entity's application, must include in their budget justifications any specific statutory authorization (other than the Economy Act) that permits their receipt of an interagency agreement or that authorizes the payment of certain costs.

4. 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 (though neither required nor considered); and
- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

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

5. How to Submit Letters of Intent

Do not submit an LOI unless a NOFO requires or allows their submission.

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 LOI. **All PIs and those submitting LOIs on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.**

Submit Your Letter of Intent:

- Create your LOI 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 / Respond to Funding Opportunity 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 LOI.
- 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.
- If this NOFO requires that LOIs be submitted only by an authorized institutional official, the PI (or the PI's delegate) will only be able to send the LOI to a user at the PI's institution with the institutional "submit to DOE" privilege. That user will then apply an institutional countersignature to the LOI when it is sent to DOE.

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 revise a previously submitted LOI in the time between your submission and the deadline. Doing so will remove your previously submitted version from consideration. If you have not submitted the revision at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

Do not attach pre-applications to Field 20 of the SF-424(R&R) form or letters of intent to Field 21 of the SF-424(R&R) form. Doing so will render your application unreadable.

6. How to Submit a Pre-Application

Do not submit a pre-application unless a NOFO requires or permits their submission.

It is important that the pre-application 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-application. All PIs and those submitting pre-applications on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.

Submit Your Pre-Application:

- Create your pre-application (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 / Respond to Funding Opportunity 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.
- If this NOFO requires that pre-applications be submitted only by an authorized institutional official, the PI (or the PI's delegate) will only be able to send the pre-application to a user at the PI's institution with the institutional "submit to DOE" privilege. That user will then apply an institutional countersignature to the pre-application when it is sent to DOE.

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 revise a previously submitted pre-application in the time between your submission and the deadline. Doing so will remove your previously submitted version from consideration. If you have not submitted the revision at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline..

Do not attach pre-applications to Field 20 of the SF-424(R&R) form or letters of intent to Field 21 of the SF-424(R&R) form. Doing so will render your application unreadable.

7. How to Register and Submit an Application in Grants.gov

This section provides the application submission and receipt instructions for applications to SC. Please read the following instructions carefully and completely.

ELECTRONIC DELIVERY

SC is participating in the Grants.gov initiative to provide the grant community with a single site

to find and apply for grant funding opportunities. SC requires applicants to submit their applications online through Grants.gov.

HOW TO REGISTER TO APPLY THROUGH GRANTS.GOV

a. Instructions: Read the instructions below about registering to apply for SC funds. Applicants should read the registration instructions carefully and prepare the information requested before beginning the registration process. Reviewing and assembling the required information before beginning the registration process will alleviate last-minute searches for required information.

   Organizations must have an active System for Award Management (SAM) registration which provides a Unique Entity Identifier (UEI), and Grants.gov account to apply for grants. If individual applicants (those submitting on their own behalf) are eligible to apply for this funding opportunity, they need only refer to steps 2 and 3 below.

   Creating a Grants.gov account can be completed online in minutes, but SAM registration may take several weeks. Therefore, an organization's registration should be done in sufficient time to ensure it does not impact the entity's ability to meet required application submission deadlines.

   1) *Register with SAM*: All organizations applying online through Grants.gov must register with SAM at https://www.sam.gov. Failure to register with SAM will prevent your organization from applying through Grants.gov. SAM registration must be renewed annually. For more detailed instructions for registering with SAM, refer to: https://www.grants.gov/applicants/applicant-registration/

   2) *Create a Grants.gov Account*: The next step is to register an account with Grants.gov. Follow the on-screen instructions provided on the registration page.

   3) *Add a Profile to a Grants.gov Account*: A profile in Grants.gov corresponds to a single applicant organization the user represents (i.e., an applicant) or an individual applicant. If you work for or consult with multiple organizations and have a profile for each, you may log in to one Grants.gov account to access all of your grant applications. To add an organizational profile to your Grants.gov account, enter the UEI (Unique Entity Identifier) for the organization in the UEI field. If you are an individual applicant submitting on your own behalf, you do not need a UEI to add the profile. For more detailed instructions about creating a profile on Grants.gov, refer to: https://www.grants.gov/applicants/applicant-registration/add-profile

   4) *EBiz POC Authorized Profile Roles*: After you register with Grants.gov and create an Organization Applicant Profile, the organization applicant's request for Grants.gov roles and access is sent to the Electronic Business Point of Contact (EBiz POC)[16]. The

[16] Individuals with the EBiz POC role are commonly found in an Office of Sponsored Research or similar institutional business office. Other than small businesses, a PI would usually not have the EBiz POC role.

EBiz POC will then log in to Grants.gov and authorize the appropriate roles, which may include the Authorized Organization Representative (AOR) role, thereby giving you permission to complete and submit applications on behalf of the organization. You will be able to submit your application online any time after you have been assigned the AOR role. For more detailed instructions about creating a profile on Grants.gov, refer to: https://www.grants.gov/applicants/applicant-registration/ebiz-poc-authorizes-profile-roles

5) *Track Role Status*: To track your role request, refer to: https://www.grants.gov/applicants/applicant-registration/track-profile-role-status

b. Electronic Signature: When applications are submitted through Grants.gov, the name of the organization applicant with the AOR role that submitted the application is inserted into the signature line of the application, serving as the electronic signature. The EBiz POC **must** authorize people who are able to make legally binding commitments on behalf of the organization as a user with the AOR role; **this step is often missed and it is crucial for valid and timely submissions.**

HOW TO APPLY TO SC VIA GRANTS.GOV

Grants.gov applicants can apply online using Workspace. Workspace is a shared, online environment where members of a grant team may simultaneously access and edit different webforms within an application. For each NOFO, you can create individual instances of a workspace.

For an overview of applying on Grants.gov using Workspaces, refer to: https://www.grants.gov/applicants/workspace-overview/

1) Create a Workspace: Creating a workspace allows you to complete it online and route it through your organization for review before submitting.

2) Complete a Workspace: Add participants to the workspace to work on the application together, complete all the required forms online or by downloading PDF versions, and check for errors before submission. The Workspace progress bar will display the state of your application process as you apply. As you apply using Workspace, you may click the blue question mark icon near the upper-right corner of each page to access context-sensitive help.

a. Adobe Reader: If you decide not to apply by filling out webforms you can download individual PDF forms in Workspace so that they will appear similar to other Standard forms. The individual PDF forms can be downloaded and saved to your local device storage, network drive(s), or external drives, then accessed through Adobe Reader.

NOTE: Visit the Adobe Software Compatibility page on Grants.gov to download the appropriate version of the software at: https://www.grants.gov/applicants/adobe-software-compatibility

b. Mandatory Fields in Forms: In the forms, you will note fields marked with an asterisk and a different background color. These fields are mandatory fields that must be completed to successfully submit your application.

c. Complete SF-424 Fields First: These forms are designed to fill in common required fields across other forms, such as the applicant's name, address, and SAM UEI. Once it is completed, the information will transfer to the other forms.

3) Submit a Workspace: An application may be submitted through workspace by clicking the Sign and Submit button on the Manage Workspace page, under the Forms tab. Grants.gov recommends submitting your application package *at least 24-48 hours prior to the close date* to provide you with time to correct any potential technical issues that may disrupt the application submission.

4) Track a Workspace: After successfully submitting a workspace package, a Grants.gov Tracking Number (GRANTXXXXXXXX) is automatically assigned to the package. The number will be listed on the Confirmation page that is generated after submission.

For additional training resources, including video tutorials, refer to:
https://www.grants.gov/applicants/applicant-training

Applicant Support: Grants.gov provides applicants 24/7 support via the toll-free number 1-800-518-4726 and email at support@Grants.gov. For questions related to the specific grant opportunity, contact the number listed in the application package of the grant you are applying for funding.

If you are experiencing difficulties with your submission, it is best to call the Grants.gov Support Center and get a ticket number. The Support Center ticket number will assist SC with tracking your issue and understanding background information on the issue.

TIMELY RECEIPT REQUIREMENTS AND PROOF OF TIMELY SUBMISSION

Proof of timely submission is automatically recorded by Grants.gov. An electronic date/time stamp is generated within the system when the application is successfully received by Grants.gov. The applicant AOR will receive an acknowledgement of receipt and a tracking number (GRANTXXXXXXXX) from Grants.gov with the successful transmission of their application. Applicant AORs will also receive the official date/time stamp and Grants.gov Tracking number in an email serving as proof of their timely submission.

When SC successfully retrieves the application from Grants.gov, and acknowledges the download of submissions, Grants.gov will provide an electronic acknowledgment of receipt of the application to the email address of the applicant with the AOR role. Again, proof of timely submission shall be the official date and time that Grants.gov receives your application. Applications received by Grants.gov after the established due date for the program will be considered late and may not be considered for funding by SC.

Applicants using unreliable internet connections should be aware that the process of completing the Workspace can take some time. Therefore, applicants should allow enough time to prepare and submit the application before the package closing date.

Grants.gov will provide either an error or a successfully received submission message in the form of an email sent to the applicant with the AOR role attempting to submit the application.

If you do not promptly receive an email from Grants.gov with an agency tracking number, indicating receipt of the application by SC, please contact the Grants.gov Helpdesk at 800-518-4726 (toll-free) or support@Grants.gov immediately. SC will have no records of your attempted submission without the second email from Grants.gov.

8. How to Prepare an Application

APPLICATION PREPARATION

You must submit the application through Grants.gov at https://www.Grants.gov/, using either the online webforms or downloaded forms. (Additional instructions are provided above.)

You are required to use the compatible version of Adobe Reader software to complete a Grants.gov Adobe application package. To ensure you have the Grants.gov compatible version of Adobe Reader, visit the software compatibility page at https://www.Grants.gov/web/grants/applicants/adobe-software-compatibility.html.

You must complete the mandatory forms and any applicable optional forms (e.g., Disclosure of Lobbying Activities (SF-LLL)) in accordance with the instructions on the forms and the additional instructions below.

Files that are attached to the forms must be PDF files unless otherwise specified in this NOFO. 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 application:

- 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 application to be rejected or cause issues during processing.

Renewal Applications

For renewal applications only, the PI is required to submit a Renewal Proposal Products section through the PAMS website at https://pamspublic.science.energy.gov. The PI must enter into PAMS each product created during the course of the previous project period. Types of products include publications, intellectual property, technologies or techniques, and other products such as databases or software. As soon as the renewal application is assigned to a DOE program manager, the PI will receive an automated email from PAMS (PAMS.Autoreply@science.doe.gov) instructing him or her to navigate to the PAMS Task tab to complete and submit the Renewal Proposal Products. The submitted product list will be sent for merit review as part of the application. The application will not be considered complete and cannot be sent for review until the product list has been submitted.

Resubmission of Applications

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

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

Note that there may be a delay between the application's submission in Grants.gov and when it is available to be withdrawn in PAMS. SC will usually consider the last submission, according to its Grants.gov timestamp, to be the intended version. Please consult with your program manager to resolve any confusion about which version of an application should be considered.

Improper Contents of Applications

Applications submitted under this NOFO 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 that a non-Federal entity may not openly distribute, whether classified, export control, or unclassified controlled nuclear information. Non-Federal entities are not subject to any restrictions on distributing controlled unclassified information (CUI).
- 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.

CHANGE OF RECIPIENT INSTITUTION

If a recipient chooses to relinquish an award made under this NOFO to permit the transfer of the award to a new institution, the new institution must apply under the then-available SC "annual" or "open" NOFO.

9. 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/. The fillable PDFs provided by the National Science Foundation are no longer available. SciENcv has been updated to meet the interagency common format biographical sketches.

The biographical information (curriculum vitae) must include the following items within its page limit:

- **Education and Training**: Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.
- **Research and Professional Experience**: Beginning with the current position, list professional/academic positions in chronological order with a brief description. List all current academic, professional or institutional appointments, foreign or domestic, at the applicant institution or elsewhere, whether remuneration is received, and, whether full-time, part-time, or voluntary.
- **Publications**: Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically. Patents, copyrights and software systems developed may be provided in addition to or substituted for publications. An abbreviated style such as the Physical Review Letters (PRL) convention for citations (list only the first author) may be used for publications with more than 10 authors.

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

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.

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). If not using SciENcv, append the following signed and dated certification to a biographical sketch:

> I, [Full Name and Title], certify to the best of my knowledge and belief that the information contained in this Current and Pending Support Disclosure Statement is true, complete, and accurate. I understand that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or omissions of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (18 U.S.C. §§ 1001 and 287, and 31 U.S.C. 3729-3733 and 3801-3812). I further understand and agree that (1) the statements and representations made herein are material to DOE's funding decision, and (2) I have a responsibility to update the disclosures during the period of performance of the award should circumstances change which impact the responses provided above.

Biographical sketches must be attached to the Research and Related Senior/Key Person Profile (Expanded) form in an application.

Personally Identifiable Information: Do not include sensitive and protected personally identifiable information including social security numbers, birthdates, citizenship, marital status, or home addresses. Do not include information that a merit reviewer should not make use of.

10. 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 senior/key person who is planned to be or is identified in Section A of the R&R 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 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 R&R 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 Collaborator Template is available at https://science.osti.gov/grants/Policy-and-Guidance/Agreement-Forms. The template may also be posted with this NOFO in Grants.gov. 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

11. 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. Include the current application and any application submitted to any source of funding in a list of current and pending support. All sources of support must be disclosed, but for work that is subject to government classification or enforceable non-disclosure agreements, the general area of the research should be described without disclosing sensitive details and the sponsor should be listed as "Government Agency" or "private sponsor." 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/. The fillable PDFs provided by the National Science Foundation are no longer available. SciENcv has been updated to meet the interagency common format for current and pending support.

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.

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). If not using SciENcv, append the following signed and dated certification to current and pending support:

> I, [Full Name and Title], certify to the best of my knowledge and belief that the information contained in this Current and Pending Support Disclosure Statement is true, complete, and accurate. I understand that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or omissions of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (18 U.S.C. §§ 1001 and 287, and 31 U.S.C. 3729-3733 and 3801-3812). I further understand and agree that (1) the statements and representations made herein are material to DOE's funding decision, and (2) I have a responsibility to update the disclosures during the period of performance of the award should circumstances change which impact the responses provided above.

Current and pending support must be attached to the Research and Related Senior/Key Person Profile (Expanded) form in an application.

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.

12. 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 application 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

13. How to Prepare a Research and Related 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.

- If a field is required (indicated with either an asterisk or a differently-colored background) and no funds are being requested, enter a zero "0."
- 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.

If you are proposing indirect costs and do not already have an Indirect Cost Rate Agreement with your Cognizant Federal Agency or documentation of rates accepted for estimating purposes by DOE or another Federal agency, it is recommended that you begin preparing an Indirect Cost Rate Proposal to be submitted, upon request, to the DOE contract specialist/grants management specialist who will evaluate your application if you are selected for award.

For your convenience in preparing an Indirect Cost Rate proposal, a link to applicant resources, including indirect rate model templates, has been provided below: https://science.osti.gov/sbir/applicant-resources/grant-application/.

Please provide the total funding requested across all budget fields to support the implementation of the project PIER Plan.

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 postgraduate) 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. Cloud computing costs must be included under this item. 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).
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.

GUIDANCE FOR APPLICATION BUDGETS AND COSTS

All costs requested in a budget must adhere to standard requirements for all Federal awards:
- Costs must be reasonable, using a prudent-person standard. (2 CFR 200.404),
- Costs must be allocable, related to the particular Federal award. (2 CFR 200.405),

- Costs must be allowable under the relevant Federal cost principles. (See 2 CFR 200.420 and following),
- Costs must be consistently treated, whether they are paid for with Federal funds or institutional funds. (2 CFR 200.403(c))

Allowable costs may include, but are not limited to, the following, subject to the applicable cost principles:

- "Buying out" faculty time dedicated to teaching or administrative responsibilities,
- Support for administrative personnel dedicated to the proposed activity,
- Support for professional development, training, mentoring of students and junior researchers,
- Travel to meet with collaborators at other institutions and relevant DOE/NNSA national laboratories, including costs for internships at the national laboratories; or to attend one or more science team, user facility, scientific conference, workshop, or professional society meetings relevant to the proposed research; or for the conduct of off-site research,
- Fringe benefits, which must be paid in accordance with an institution's negotiated rates agreement, institutional policies, and the individual's appointment,
- Temporary dependent-care costs incurred during travel,
- Membership costs in relevant professional societies, including both scientific societies and those dedicated to research administration,
- Instrumentation required to conduct proposed research,
- Equipment (items with a useful life of more than 12 months and a per-item acquisition cost of more than $5,000) required to conduct proposed research,
- Purchase of equipment, modification of equipment, or provision of services necessary to enable work to be carried out by project personnel with a disability,
- Stipends and benefits for students and post-doctoral researchers, recognizing their dual nature as both trainees and employees,
- Participation in standards development relevant to the proposed research, including travel and membership costs,
- Salary support to cover time to participate in outreach for recruitment, internships, and training events, science team meetings, partnership development, or information gathering, and
- Other direct costs, e.g., materials and supplies such as office supplies, desktop or laptop computer, and/or software licenses that are directly necessary to enable the proposed activities.

14. How to Register in PAMS

After you submit your application through Grants.gov, the application will automatically transfer into the Portfolio Analysis and Management System (PAMS) for processing by the DOE SC. Many functions for grants and cooperative agreements can be done in PAMS, which is available at https://pamspublic.science.energy.gov.

You will want to "register to" your application: a process of linking yourself to the application after it has been submitted through Grants.gov and processed by DOE.

You must register in PAMS to submit a pre-application or a LOI.

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 an application, you may already be linked to an institution in PAMS. If this happens, you will be taken to the PAMS home page.)

REGISTER TO YOUR INSTITUTION:

- 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.)
- PAMS will take you to the "Register to Institution" page.
- 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.)

- 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.
- 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.
- 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 "PAMS Help" 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 NOFO should reference the NOFO number printed on the cover page.

15. How to View Applications in PAMS

Each Grants.gov application submitted to the DOE SC automatically transfers into PAMS and is subsequently assigned to a program manager. At the time of program manager assignment, the three people listed on the SF-424 (R&R) cover page will receive an email with the subject line, "Receipt of Proposal 0000xxxxxx by the DOE Office of Science." These three people are the PI (Block 14), Authorized Representative (Block 19), and Point of Contact (Block 5). In PAMS notation, applications are known as proposals, the PI is known as the PI, the Authorized Representative is known as the Sponsored Research Officer/Business Officer/Administrative Officer (SRO/BO/AO), and the Point of Contact is known as the POC.

There will be a period of time between the application's receipt at Grants.gov and its assignment to a DOE SC program manager. Program managers are typically assigned two weeks after applications are due at Grants.gov: please refrain from attempting to view the proposal in PAMS until you receive an email providing the assignment of a program manager.

Once the email is sent, the PI, SRO/BO/PO, and POC will each be able to view the submitted proposal in PAMS. Viewing the proposal is optional.

Following are two sets of instructions for viewing the submitted proposal, one for individuals who already have PAMS accounts and one for those who do not.

If you already have a PAMS account, follow these instructions:
1. Log in to PAMS at https://pamspublic.science.energy.gov/.
2. Click the "Proposals" tab and click "Access Previously Submitted Grants.gov Proposal."
3. Enter the following information:
    - Proposal ID: Enter the ten-digit PAMS proposal ID, including the leading zeros (e.g., 00002xxxxx). Do not use the Grants.gov proposal number. Use the PAMS number previously sent to you in the email with subject line, "Receipt of Proposal …".

- Email (as entered in Grants.gov application): Enter your email address as it appears on the SF424(R&R) Cover Page.
- Choose Role: Select the radio button in front of the role corresponding to the SF-424 (R&R) cover page. If your name appears in block 19 of the SF-424 (R&R) cover page as the authorizing representative, select "SRO/BO/AO (Sponsored Research Officer/Business Officer/Administrative Officer)." If your name appears in block 14 of the SF424 R&R cover page as the PI, select "Principal Investigator (PI)." If your name appears in block 5 of the SF424 R&R as the point of contact, select "Other (POC)."

4. Click the "Save and Continue" button. You will be taken to your "My Proposals" page. The Grants.gov proposal will now appear in your list of proposals. Click the "Actions/Views" link in the options column next to this proposal to obtain a dropdown list. Select "Proposal" from the dropdown to see the proposal. Note that the steps above will work only for proposals submitted to the DOE SC since May 2012.

If you do not already have a PAMS account, follow these instructions:

1. To register, click the "Create New PAMS Account" link on the website https://pamspublic.science.energy.gov/.
2. Click the "No, I have never had an account" link and then the "Create Account" button.
3. 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.
4. 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.
5. 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.
6. You will be taken to the Register to Institution page. Select the link labeled, "Option 1: My institution has submitted a proposal in Grants.gov. I am here to register as an SRO, PI, or POC (Sponsored Research Officer, Principal Investigator, or Point of Contact)."
7. Enter the following information:
   - Proposal ID: Enter the ten-digit PAMS proposal ID, including the leading zeros (e.g., 00002xxxxx). Do not use the Grants.gov proposal number. Use the PAMS number previously sent to you in the email with subject line, "Receipt of Proposal …".
   - Email (as entered in Grants.gov proposal): Enter your email address as it appears on the SF424(R&R) Cover Page.
   - Choose Role: Select the radio button in front of the role corresponding to the SF-424 (R&R) cover page. If your name appears in block 19 of the SF-424 (R&R) cover page as the authorizing representative, select "SRO/BO/AO (Sponsored Research Officer/Business Officer/Administrative Officer)." If your name appears in block 14 of the SF424 R&R cover page as the PI, select "Principal Investigator (PI)." If your name appears in block 5 of the SF424 R&R as the point of contact, select "Other (POC)."
8. Click the "Save and Continue" button. You will be taken to your "My Proposals" page. The Grants.gov proposal will now appear in your list of proposals. Click the "Actions/Views" link in the options column next to this proposal to obtain a dropdown list. Select "Proposal" from the dropdown to see the proposal.

If you were listed as the PI on a prior submission but you have not previously created an account, you may already be listed in PAMS. If this is the case, you will be taken to the PAMS home page after agreeing to the Rules of Behavior. If that happens, follow the instructions listed above under "If you already have a PAMS account…" to access your Grants.gov proposal.

16. How to Register in Other Systems Before Submitting an Application

Systems to Register In

Applicants must register with FedConnect at www.FedConnect.net. The full, binding version of assistance agreements will be posted to FedConnect. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnectReady_Set_Go.pdf.

Recipients must register with the Federal Funding Accountability and Transparency Act Subaward Reporting System at https://www.fsrs.gov. This registration must be completed before an award may be made: you are advised to register while preparing your application.

Registering in Grants.gov

Applicants must register with Grants.gov, following the instructions at https://www.Grants.gov/web/grants/applicants/registration.html and described above.

Where to Submit an Application

You must submit the application through Grants.gov at www.Grants.gov, using either the online webforms or downloaded forms, or a system-to-system service

Submit electronic applications through the "Apply for Grants" function at www.Grants.gov. If you have problems completing the registration process or submitting your application, call Grants.gov at 1-800-518-4726 or send an email to support@Grants.gov.

Please ensure that you have read the applicable instructions, guides, help notices, frequently asked questions, and other forms of technical support on Grants.gov.

DOE SC Portfolio Analysis and Management System (PAMS)

Applicants must register in the Portfolio Analysis and Management System (PAMS) to submit letters of intent and pre-applications, to view merit reviewer comments, or to take a number of post-award actions.

C. Administrative and National Policy Requirements

1. Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulations).

2. 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 DOE Contracting Officer for this award and until the recipient receives notice of such availability, to be confirmed in writing by the DOE Contracting Officer.

3. Buy America Requirement for Infrastructure Projects

Required use of Iron, Steel, Manufacture Products, and Construction Materials Produced in the United States

A. DEFINITIONS

For purposes of the Buy America Requirement, the following definitions apply:

Components are defined as the articles, materials, or supplies incorporated directly into the end manufactured product(s).

Construction Materials are an article, material, or supply—other than an item primarily of iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives—that is used in an infrastructure project and is or consists primarily of non-ferrous metals, plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables), glass (including optic glass), lumber, drywall, coatings (paints and stains), optical fiber, clay brick; composite building materials; or engineered wood products.

Domestic Content Procurement Preference Requirement – means a requirement that no amounts made available through a program for federal financial assistance may be obligated for an infrastructure project unless—
(A) all iron and steel used in the project are produced in the United States;
(B) the manufactured products used in the project are produced in the United States; or
(C) the construction materials used in the project are produced in the United States.
Also referred to as the **Buy America Requirement**.

Infrastructure includes, at a minimum, the structures, facilities, and equipment located in the United States, for: roads, highways, and bridges; public transportation; dams, ports, harbors, and other maritime facilities; intercity passenger and freight railroads; freight and intermodal

facilities; airports; water systems, including drinking water and wastewater systems; electrical transmission facilities and systems; utilities; broadband infrastructure; and buildings and real property; and generation, transportation, and distribution of energy—including electric vehicle (EV) charging.

The term "infrastructure" should be interpreted broadly, and the definition provided above should be considered as illustrative and not exhaustive.

Manufactured Products are items used for an infrastructure project made up of components that are not primarily of iron or steel; construction materials; cement and cementitious materials' aggregates such as stone, sand, or gravel; or aggregate binding agents or additives.

Primarily of iron or steel means greater than 50% iron or steel, measured by cost.

Project – means the construction, alteration, maintenance, or repair of infrastructure in the United States.

Public – The Buy America Requirement does not apply to non-public infrastructure projects. For purposes of this guidance, infrastructure should be considered "public" if it is: (1) publicly owned or (2) privately owned but utilized primarily for a public purpose. Infrastructure should be considered to be "utilized primarily for a public purpose" if it is privately operated on behalf of the public or is a place of public accommodation.

B. BUY AMERICA REQUIREMENT FOR INFRASTRUCTURE PROJECTS (BUY AMERICA REQUIREMENT)

None of the award funds (includes federal share and Recipient cost share) may be used for a public infrastructure project unless:

> (1) all iron and steel used in the project is produced in the United States—this means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;
> (2) all manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation; and
> (3) all construction materials[17] are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States.

The Buy America Requirement only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply

[17] Excludes cement and cementitious materials, aggregates such as stone, sand, or gravel, or aggregate binding agents or additives.

to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does the Buy America Requirement apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project but are not an integral part of the structure or permanently affixed to the infrastructure project.

The Buy America Requirement does not statutorily apply to Prime Recipients that are For-Profit Entities. However, the Buy America Requirement is applicable to a For-Profit Entity if: (1) it is a sub-recipient or sub-awardee under an award that contains the Buy America Requirement term and condition, or (2) it is the Prime Recipient that voluntarily chooses to use domestically sourced iron, steel, manufactured products, and constructions materials by stating so in its proposed application containing an infrastructure project. If the For-Profit Entity specifically states that it will comply with the Buy America Requirements in its application and it is selected for an award, its award will contain a Buy America Requirement for Infrastructure Projects term and condition.

The Prime Recipient is responsible for flowing the Buy America Requirement down to all sub-awards, all contracts, subcontracts, and purchase orders for work performed under the proposed infrastructure project, including to For-Profit Entities when the For-Profit Entity is a sub-recipient or sub-awardee.

Recipients must certify or provide equivalent documentation for proof of compliance that a good faith effort was made to solicit bids for domestic products used in the infrastructure project under this award.

Recipients must also maintain certifications or equivalent documentation for proof of compliance that those articles, materials, and supplies that are consumed in, incorporated into, affixed to, or otherwise used in the infrastructure project, not covered by a waiver or exemption, are produced in the United States. The certification or proof of compliance must be provided by the suppliers or manufacturers of the iron, steel, manufactured products and construction materials and flow up from all subrecipients, contractors and vendors to the recipient. Recipients must keep these certifications with the award/project files and be able to produce them upon request from DOE, auditors or Office of Inspector General.

C. DOE SUBMISSION REQUIREMENTS FOR FULL APPLICATION

Within the first two pages of the workplan or project description, applicants must provide a short statement on whether the project will involve the construction, alteration, maintenance and/or repair of infrastructure in the United States. The ultimate determination about whether a project includes infrastructure remains with DOE, but the applicant's statement will assist project planning and integration of the Buy America Requirement, which may impact the project's proposed budget and/or schedule.

D. WAIVERS

In limited circumstances, DOE may waive the application of the Buy America Requirement in an award where DOE determines that:

> (1) applying the Buy America requirements would be inconsistent with the public interest (Public Interest);
> (2) the types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality (Non-Availability); or
> (3) the inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent (Unreasonable Cost).

DOE will only process waiver requests after an award has been made and for which the requests have been submitted in accordance with the terms and conditions of the award. Waiver requests must be reviewed by DOE and the Office of Management and Budget's Made in America Office and are subject to a public comment period of no less than 15 calendar days.

DOE or OMB may request additional information for consideration of the wavier. DOE may reject or grant waivers in whole or in part depending on its review, analysis, and/or feedback from OMB or the public. DOEs final determination regarding approval or rejection of the waiver request may not be appealed by a Recipient.

Requests to waive the Buy America Requirement must include the following:

- Waiver type (Public Interest, Non-Availability, or Unreasonable Cost);
- Recipient name and Unique Entity Identifier (UEI);
- Award information (Federal Award Identification Number, Assistance Listing number);
- A brief description of the project, its location, and the specific infrastructure involved;
- Total estimated project cost, with estimated federal share and recipient cost share breakdowns;
- Total estimated infrastructure costs, with estimated federal share and recipient cost share breakdowns;
- List and description of iron or steel item(s), manufactured goods, and/or construction material(s) the recipient seeks to waive from the Buy America Requirement, including name, cost, quantity(ies), country(ies) of origin, and relevant Product Service Codes (PSC) and North American Industry Classification System (NAICS) codes for each;
- A detailed justification as to how the non-domestic item(s) is/are essential the project;
- A certification that the recipient made a good faith effort to solicit bids for domestic products supported by terms included in requests for proposals, contracts, and non-proprietary communications with potential suppliers;
- A justification statement—based on one of the applicable justifications outlined above—as to why the listed items cannot be procured domestically, including the due diligence performed (e.g., market research, industry outreach, cost analysis, cost-benefit analysis) by the recipient to attempt to avoid the need for a waiver. This justification may cite, if

applicable, the absence of any Buy America-compliant bids received for domestic products in response to a solicitation; and
- Anticipated impact to the project if no waiver is issued.

The following principles should be incorporated as minimum requirements in waiver request:
- Time-limited: Consider a waiver constrained principally by a length of time, rather than by the specific project/award to which it applies. Waivers of this type may be appropriate, for example, when an item that is "non-available" is widely used in the project. When requesting such a waiver, the recipient should identify a reasonable, definite time frame (e.g., no more than one to two years) designed so that the waiver is reviewed to ensure the condition for the waiver ("non-availability") has not changed (e.g., domestic supplies have become more available).
- Targeted: Waiver requests should apply only to the item(s), product(s), or material(s) or category(ies) of item(s), product(s), or material(s) as necessary and justified. Waivers should not be overly broad as this will undermine domestic preference policies.
- Conditional: The recipient may request a waiver with specific conditions that support the policies of IIJA/BABA and Executive Order 14017.

4. Conference Spending (February 2015)

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

5. Commitment of Public Funds

(a) A DOE financial assistance award is valid only if it is in writing and is signed, either in writing or electronically, by a DOE Contracting Officer.

(b) Recipients are free to accept or reject the award. A request to draw down DOE funds constitutes the Recipient's acceptance of the terms and conditions of this Award.

6. Corporate Felony Conviction and Federal Tax Liability Representations (March 2014)

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

For purposes of these representations the following definitions apply:

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

7. Digital Persistent Identifier (PID)

Covered individuals[18] listed on applications must provide a digital persistent identifier (PID) in the common Biographical Sketch and Current and Pending (Other) Support forms as part of the application. Included PIDs must meet the common/core standards specified in the NSPM-33 Implementation Guidance or successor guidance (e.g., an ORCID iD). The inclusion of an individual's PID will be optional until May 1, 2025, and mandatory thereafter.

8. 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 subrecipients at any tier.

9. 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 application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign a conflict-of-interest agreement and a certificate of confidentiality prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

10. 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 subrecipients at any tier.

[18] Covered Individual has the same meaning as in the Research Security Training Requirement provision.

11. Foreign Travel

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

12. Funding Restrictions

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

Cost Principles: Costs must be allowable, allocable and reasonable in accordance with the applicable Federal cost principles referenced in 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation).

Pre-award Costs: Recipients may charge to an award resulting from this NOFO pre-award costs that were incurred within the 90-day calendar period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation). Recipients must obtain the prior approval of the DOE Contracting Officer for any pre-award costs that are for periods greater than this 90-day calendar period.

Pre-award costs are incurred at the applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a lesser amount than the applicant expected.

13. Government Right to Reject or Negotiate

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

14. Intergovernmental Review

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

15. Living Wages

SC is committed to ensuring that students, trainees, and postdoctoral fellows are paid a fair and equitable wage sufficient to allow a reasonable standard of living. Applicant institutions are

strongly encouraged to examine their institutional pay scales to ensure that all personnel earn a living wage. The provision of fellowships, traineeships, stipends, honoraria, subsistence allowances, and other similar payments may be allowable expenses on SC financial assistance awards, per 2 CFR 200.430, § 200.431, and § 200.466. For graduate students, SC considers a reasonable living wage to be an annual income of $45,000, excluding benefits.

16. Logos and Wordmarks

DOE created a logo that recipients may use. The logos and best practices may be found at https://www.energy.gov/management/pf-2023-19-department-energy-awardee-usage-branding-and-logo-guide. Information about the DOE logo, seal, and wordmark may be found at https://www.energy.gov/management/doe-logo-seal-and-word-mark. Information about the SC logo may be found at https://science.osti.gov/About/Resources/Logos.

17. Modifications

Notices of any modifications to this NOFO will be posted on Grants.gov and the FedConnect portal. You can receive an email when a modification or a NOFO message is posted by registering with FedConnect as an interested party for this NOFO. It is recommended that you register as soon after release of the NOFO as possible to ensure you receive timely notice of any modifications or other NOFOs. More information is available at www.FedConnect.net.

18. National Environmental Policy Act (NEPA) Compliance

If the question 4.a. on the "Research and Related Other Project Information" disclosure indicates "potential impact on the environment, negative", or if DOE's own review indicates it, DOE may ask the applicant to provide additional information on those impacts in order to prepare an environmental critique/synopsis per 10 CFR 1021.216. Note that this pre-award environmental critique/synopsis process would be separate from the preparation of a NEPA compliance document such as a categorical exclusion (CX), environmental impact statement (EIS),) or an environmental assessment (EA) prepared after selection.

This CX, EIS, or EA process would need to be completed prior to the applicant taking any action on the proposed project that could have adverse environmental effects or that could limit the choice of reasonable alternatives. The three processes would each begin with a request from DOE for an environmental disclosure. If DOE is able to make a CX determination base on that disclosure, that would end the NEPA process.). If DOE determines that an EIS or EA is necessary, it would need to be funded by the applicant and at DOE's discretion also their participation. Note that in most cases, even when "Potential Impact to the Environment" is checked "Yes" on the other Project Information Form, preparation of EISs and EAs is rarely necessary, but DOE has the expectation that the recipient will disclose the potential, which would serve to initiate dialog with DOE as necessary. The inability to satisfy the NEPA requirements after an award would result in cancellation of the award.

19. Nondisclosure and Confidentiality Agreements Representations (June 2015)

By submitting an application in response to this NOFO, the Applicant represents that:

(1) It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contactors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

(2) It **does not and will not** use any Federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

a. *''These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.''*

b. The limitation above shall not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

c. Notwithstanding provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

20. Notice Regarding Eligible/Ineligible Activities

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

21. Portable Document Format (PDF) Generation

The project narrative in an application must be one single 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 attached in Field 8 on the Grants.gov form. This must be a plain PDF file consisting of text, numbers, and images. The project narrative will be read by SC staff using the full version of Adobe Acrobat: Please ensure that the narrative is readable in Acrobat.

Do not submit files with editable fields, password-protection, encryption, redactions, comments, or any other advanced features in some PDF-compatible software. If a file cannot be opened and searched, an application may be declined.

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 project narrative.

Once a project narrative has been assembled, please submit the combined project 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.

Review your submission to ensure that blank pages are not present.

22. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment

As set forth in 2 CFR 200.216, recipients and subrecipients are prohibited from obligating or expending project funds (federal funds and recipient cost share) to procure or obtain; extend or renew a contract to procure or obtain; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Section 889 of Public Law 115-232, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

See Public Law 115-232, Section 889, 2 CFR 200.216, and 2 CFR 200.471 for additional information.

23. Prohibition on Discrimination and Harassment

All people conducting, supporting, or participating in scientific research under this award must be able to do so on the basis of their abilities and without any unnecessary barriers. Recipients of awards resulting from this NOFO are prohibited from engaging in discrimination on any basis prohibited by law, including harassment (sexual or non-sexual) as contained in 10 CFR 1040, 1041, and 1042.

Recipients may contact the DOE's Office of Civil Rights for technical assistance in meeting their institutional requirements under these regulations, including assistance in addressing complaints

of discrimination or harassment (https://www.energy.gov/diversity/title-ix). The United States Equal Employment Opportunity Commission also makes a number of resources available at https://www.eeoc.gov/eeoc/publications/index.cfm to ensure that employees may perform their work without hindrance. Graduate students and post-doctoral researchers are understood to have a dual role as both trainees and employees, in accordance with 2 CFR 200.400 (f).

24. Prohibition on Entities of Concern

DOE is prohibited by law from using funds made available by the Consolidated Appropriations Act, 2024 (Public Law 118-42) to award any grant, contract, cooperative agreement, or loan of $10 million or more in DOE funds to entities of concern, as defined in section 10114 of Public Law 117-167 (42 USC 18912), also known as the CHIPS and Science Act[19]. In addition, such entities (including an individual that owns or controls, is owned or controlled by, or is under common ownership or control with an entity of concern) are prohibited from receiving any funds or performing work under any award involving Department activities authorized under Division A or B of Public Law 117-167, subject to certain penalties. See section 10114 of Public Law 117-167 (42 USC 18912) and section 310 of Public Law 118-42 for additional information.

Congress has given DOE authority to require the submission of documentation necessary to implement the requirements of this term by an entity seeking or receiving this award.

25. Prohibition on Lobbying Activity

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

26. Prohibition Related to Foreign Government-Sponsored Talent Recruitment Programs

a. Prohibition
Persons participating in a Foreign Government-Sponsored Talent Recruitment Program of a Foreign Country of Risk are prohibited from participating in projects selected for federal funding

[19] DOE activities authorized under Public Law 117-167 include Office of Science user facilities, basic energy sciences program, computational materials and chemical sciences centers, foundational nuclear science, carbon materials science initiative, carbon sequestration research and geologic computational science initiative, biological and environmental research, advanced scientific computing research program, quantum network infrastructure research and development and user expansion programs, fusion energy research, high energy physics program, nuclear physics program, accelerator research and development, isotope research and development, high intensity laser research, biological threat preparedness research initiative. See sections 10101-10113. Authorized DOE activities also include technology transfer and laboratory activities such as the Foundation for Energy Security and Innovation (section 10691), the national clean incubator program (section 10713), clean energy technology transfer (sections 10714-10715), Lab partnering service pilot program (section 10716), Lab-embedded entrepreneurship program (section 10717), small business voucher program (section 10718), entrepreneurial leave program (section 10719) , and non-federal employee outside employment authority (section 10720).

under this NOFO. Should an award result from this NOFO, the recipient must exercise ongoing due diligence to reasonably ensure that no individuals participating on the DOE-funded project are participating in a Foreign Government-Sponsored Talent Recruitment Program of a Foreign Country of Risk. Consequences for violations of this prohibition will be determined according to applicable law, regulations, and policy. Further, the recipient must notify DOE within five (5) business days upon learning that an individual on the project team is or is believed to be participating in a foreign government talent recruitment program of a foreign country of risk. DOE may modify and add requirements related to this prohibition to the extent required by law.

b. Definitions

1. Foreign Government-Sponsored Talent Recruitment Program. An effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to relocate physically to the foreign state for the above purpose. Some programs allow for or encourage continued employment at United States research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

2. Foreign Country of Risk. DOE has designated the following countries as foreign countries of risk: Iran, North Korea, Russia, and China. This list is subject to change.

27. Proprietary Application Information

Department of Energy (DOE) takes very seriously the confidentiality of all applicants and will treat information submitted in applications, as well as the identity of applicants, as confidential to the fullest extent permissible under Federal law. In order for DOE to protect confidential information, the applicant must also treat the information as confidential and properly mark it as described below. DOE will not be able to protect information that the applicant has released publicly or is in the public domain. For additional information on DOE's Freedom of Information Act (FOIA) regulations, see 10 CFR 1004.

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

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

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

The cover sheet of the Application and other submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

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

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

IMPORTANT GUIDANCE FOR COMPANY SUBMITTERS:

As per DOE's FOIA regulations and Department of Justice FOIA guidance, if DOE receives a FOIA request the following general steps will be taken:

1. DOE will review the request to determine whether your company's information is subject to the request. Only federal records are subject to FOIA requests. Depending on the circumstances, information submitted by an outside entity may be considered "federal records" for purposes of FOIA.
2. If your company information is determined to be a federal record and responsive to a FOIA request, DOE will review what was submitted in order to determine if DOE can make a determination whether the information is legally exempt.

a. If DOE determines your information is fully exempt under an exemption and that it will not be released, DOE may not contact you.
b. If DOE is unable to determine whether the information is exempt under an exemption or is planning on releasing some or all of your information, DOE will first contact you in order for you to have an opportunity to respond and provide additional justification as to why it may be exempt. DOE will do all that it can to work with company submitters to be in compliance with the law and maintain positive relations with company submitters.
c. It is critical if DOE or DOE's contractors who are processing your FOIA contact you that you respond in a timely manner. DOE is under strict deadlines when processing a FOIA request.

28. Publications

The recipient is expected to publish or otherwise make publicly available the results of the work conducted under any award resulting from this NOFO. Publications and other methods of public communication describing any work based on or developed under an award resulting from this NOFO 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 publication 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. Awards made under this NOFO are subject to DOE's Public Access Plan. Full-text versions of scientific publications must be made publicly accessible at no charge to readers.

29. Registration Requirements

Additional administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR 25 (See: www.eCFR.gov). Prime recipients must keep their data in SAM current at www.SAM.gov. Subrecipients at all tiers must obtain UEI numbers and provide the UEI to the prime recipient before the subaward can be issued.

30. Research Misconduct

Scientific discoveries can only take place when scientific research is conducted in a fair, transparent, and honestly reported manner. Any form of dishonesty—whether plagiarism, falsifying results, or misrepresenting conditions—makes it impossible to advance our understanding of the physical universe.

Recipients are "responsible for maintaining the integrity of research of any kind under an award from DOE including the prevention, detection, and remediation of research misconduct, and the conduct of inquiries, investigations, and adjudication of allegations of research misconduct," and conducting appropriate administrative processes in response to allegations of research misconduct in accordance with 2 CFR 910.132. Allegations of any misconduct under an award resulting from this NOFO must be reported to the appropriate institutional officials in accordance

with institutional policies against misconduct. Additional information on DOE research misconduct policies can be found at: https://science.osti.gov/grants/Policy-and-Guidance/Research-Misconduct.

31. Research Security Training Requirement

Covered individuals listed on the application are required to certify that they have taken research security trainings consistent with Section 10634 of the CHIPS and Science Act of 2022. In addition, Applicants must maintain sufficient records (records must be made available to DOE upon request) of their compliance with this requirement for covered individuals at the recipient organization and they must extend this requirement to any and all subrecipients. To fulfill this requirement, applicants may utilize the four training modules developed by the National Science Foundation at https://new.nsf.gov/research-security/training or develop and implement their own research security training program aligned with the requirements in Section 10634(B) of the CHIPS and Science Act of 2022. The submission of an application to this NOFO constitutes the applicant's acceptance of this requirement.

Covered Individual means an individual who (a) contributes in a substantive, meaningful way to the development or execution of the scope of work of a project funded by DOE or proposed for funding by DOE, and (b) is designated as a covered individual by DOE.

DOE designates as covered individuals any principal investigator (PI); project director (PD); co-principal investigator (Co-PI); co-project director (Co-PD); project manager; and any individual regardless of title that is functionally performing as a PI, PD, Co-PI, Co-PD, or project manager. Status as a consultant, graduate (master's or PhD) student, or postdoctoral associate does not automatically disqualify a person from being designated as a "covered individual" if they meet the definition in (a) above.

The prime applicant is responsible for assessing the applicability of (a) against each person listed on the application. Further, the prime applicant is responsible for identifying any such individual to DOE for designation as a covered individual, if not already designated by DOE as described above.

Individuals committing no measurable effort or "as-needed" effort are not automatically exempt from being designated as a covered individual. The prime applicant's listing of an individual in the "Senior/Key Person" section of an SF-424(R&R) budget serves as an acknowledgement that DOE designates that person as a covered individual.

DOE may further designate covered individuals during award negotiations or the award period of performance.

32. Rights in Technical Data

Normally, the government has unlimited rights in technical data created under a DOE agreement, including the right to distribute to the public. Delivery or third-party licensing of proprietary software or data developed solely at private expense ("Limited Rights Data") will not normally

be required except as specifically negotiated in a particular agreement to satisfy DOE's own needs or to ensure the commercialization of technology developed under a DOE agreement.

If software is specified for delivery to DOE, or if other special circumstances exist, e.g., DOE specifying "open-source" treatment of software, then the DOE Contracting Officer, after negotiation with the recipient, may include in the award special provisions requiring the recipient to obtain written approval of the DOE Contracting Officer prior to asserting copyright in the software, modifying the retained Government license, and/or otherwise altering the copyright provisions.

33. 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 science, technology, engineering, and math (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

34. Statement of Federal Stewardship

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

35. Subaward and Executive Reporting

Additional administrative requirements necessary for DOE grants and cooperative agreements to

comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR 170. (See: www.eCFR.gov). Prime recipients must register with the new Federal Funding and Transparency Act Subaward Reporting System (FSRS) at https://www.fsrs.gov and report the required data on their first tier subrecipients. Prime recipients may be required to report the total compensation for their five most highly compensated executives as part of their registration profile in SAM.gov and for first-tier subrecipients' five most highly compensated executives as in FSRS.gov.

36. Title to Subject Inventions

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

- **Nonprofit organizations or small business firms**: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), nonprofit organizations or small business firms as defined by 35 U.S.C. 201 may elect to retain title to their subject inventions.
- **All other parties**: The federal Non-Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the government obtains title to new inventions unless a waiver is granted (see below).
- **Patent Waiver**: DOE has issued Class Patent Waiver W(C) 2022-03 which allows domestic large businesses providing at least 20% cost share to elect to retain title to their subject inventions. Class Patent Waiver W(C) 2022-03 includes a U.S. Competitiveness provision requiring any products embodying or produced through the use of a subject invention first created or reduced to practice in the performance of work under this NOFO to be substantially manufactured in the United States. A domestic large business is any for-profit entity that does not qualify as a "small business" and is incorporated (or otherwise formed) under the laws of a particular state or territory of the United States and is not owned, controlled, or influenced by a foreign government, agency, firm, corporation, or person. Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this NOFO, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784. For more information, see https://www.energy.gov/gc/office-assistant-general-counsel-technology-transfer-and-intellectual-property Nonprofit organizations and small business firms do not need a patent waiver in order to retain title to their subject inventions (see above).
- **Determination of Exceptional Circumstances (DEC)**: On June 07, 2021, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES (DEC) UNDER THE BAYH-DOLE ACT TO FURTHER PROMOTE DOMESTIC MANUFACTURE OF DOE SCIENCE AND ENERGY TECHNOLOGIES. In accordance with this DEC, all awards, including sub-awards, under this NOFO shall include the U.S. Competitiveness Provision in accordance with Section IX of this NOFO. A copy of the DEC can be found at https://www.energy.gov/gc/determination-exceptional-circumstances-decs.
- Pursuant to 37 CFR § 401.4, any nonprofit organization or small business firm as defined by 35 U.S.C. 201 affected by any DEC has the right to appeal it by providing written notice to DOE within 30 working days from the time it receives a copy of the determination.

- DOE may issue and publish on the website above further DECs prior to the issuance of awards under this NOFO. DOE may require additional submissions or requirements as authorized by any applicable DEC.
- **[IF APPLICABLE] DEC**: **QUANTUM INFORMATION SCIENCE TECHNOLOGIES DEC**: On August 28, 2020, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES UNDER THE BAYH-DOLE ACT FOR QUANTUM INFORMATION SCIENCE TECHNOLOGIES, pursuant to 37 CFR 401.3(a)(2), which applies to agreements issued under this NOFO requiring each applicant to agree to a U.S. Competitiveness Provision. DOE has determined that exceptional circumstances exist that warrant the modification of the standard patent rights clause for small businesses and non-profit recipients under the Bayh-Dole Act, 35 U.S.C. 200 et seq., to the extent necessary to ensure that DOE "obtains sufficient rights in the federally supported inventions to meet the needs of [DOE]" and "to promote the commercialization and public availability of inventions made in the United States by United States industry and labor" and/or further promote other purposes of the Bayh-Dole Act. 35 U.S.C. § 200. In accordance with this DEC, all awards, including sub-awards, under this NOFO shall include the U.S. Competitiveness Provision in accordance with Section IX of this NOFO. A copy of the DEC can be found at https://www.energy.gov/gc/determination-exceptional-circumstances-decs.

[IF APPLICABLE] Class Patent Waiver: DOE has issued Class Patent Waiver No. W(C) 2020-001 of Patent Rights Related to Quantum Information Science and its Technology Applications that applies to this NOFO for any domestic large business that is a recipient, or subrecipient at any tier to this NOFO and is providing at least 20% cost share. Under this Class Patent Waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class patent waiver, a domestic large business must agree that any products embodying or produced using a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States. Entities not eligible under the Class Patent Waiver are still able to petition DOE for rights under an Advanced or Identified Patent Waiver as described above.

Nonprofit organizations and small business firms do not need a patent waiver in order to retain title to their subject inventions (see above).

37. Trafficking in Persons

Awards resulting from this NOFO are subject to the requirements of 2 CFR 175 (https://www.ecfr.gov) which prohibit recipients, their employees, subrecipients, and their employees from severe forms of trafficking in persons; the procurement of a commercial sex act during the period of time that this award or any subaward is in effect; the use of forced labor in the performance of this award or any subaward; or acts that directly support or advance trafficking in persons.

38. U.S. Competitiveness

A primary objective of DOE's multi-billion-dollar research, development and demonstration

investments is to cultivate new research and development ecosystems, manufacturing capabilities, and supply chains for and by U.S. industry and labor. Therefore, in exchange for receiving taxpayer dollars to support an applicant's project, the applicant must agree to a U.S. Competitiveness provision requiring to any products embodying any subject invention or produced using any subject invention will be manufactured substantially in the United States unless the Recipient can show to the satisfaction of DOE that it is not commercially feasible. Award terms, including the U.S. Competitiveness Provision, are available at https://www.energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

Please note that a subject invention is any invention conceived or first actually reduced in performance of work under an award. An invention is any invention or discovery which is or may be patentable. The recipient includes any awardee, recipient, sub-awardee, or sub-recipient.

As noted in the U.S. Competitiveness Provision, if an entity cannot meet the requirements of the U.S. Competitiveness Provision, the entity may request a modification or waiver of the U.S. Competitiveness Provision. For example, the entity may propose modifying the language of the U.S. Competitiveness Provision in order to change the scope of the requirements or to provide more specifics on the application of the requirements for a particular technology. As another example, the entity may request that the U.S. Competitiveness Provision be waived in lieu of a net benefits statement or U.S. manufacturing plan. The statement or plan would contain specific and enforceable commitments that would be beneficial to the U.S. economy and competitiveness. Examples of such commitments could include manufacturing specific products in the U.S., making a specific investment in a new or existing U.S. manufacturing facility, keeping certain activities based in the U.S. or supporting a certain number of jobs in the U.S. related to the technology. DOE may, in its sole discretion, determine that the proposed modification or waiver promotes commercialization and provides sufficient U.S. economic benefits, and grant the request. If granted, DOE will modify the award terms and conditions for the requesting entity accordingly. More information and guidance on the waiver and modification request process can be found in the DOE Financial Assistance Letter on this topic, available here at https://www.energy.gov/management/pf-2022-09-fal-2022-01-implementation-doe-determination-exceptional-circumstances-under. Additional information on DOE's Commitment to Domestic Manufacturing for DOE-funded R&D is available at https://www.energy.gov/gc/us-manufacturing.

The U.S. Competitiveness Provision is implemented by DOE pursuant to a Determination of Exceptional Circumstances (DEC) under the Bayh-Dole Act and DOE Patent Waivers. See Section IX.

39. 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 recipient 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 NOFO may be reviewed by a Committee of Visitors.

D. Reference Material

Glossary of Useful Grants and Cooperative Agreement terms

Acquisition cost	*Acquisition cost* means the cost of the asset including the cost to ready the asset for its intended use. Acquisition cost for equipment, for example, means the net invoice price of the equipment, including the cost of any modifications, attachments, accessories, or auxiliary apparatus necessary to make it usable for the purpose for which it is acquired. Acquisition costs for software includes those development costs capitalized in accordance with generally accepted accounting principles (GAAP). Ancillary charges, such as taxes, duty, protective in transit insurance, freight, and installation may be included in or excluded from the acquisition cost in accordance with the non-Federal entity's regular accounting practices.
Administrative requirements	*Administrative requirement*s mean the general business management practices that are common to the administration of all grants, such as financial accountability, reporting, equipment management, and retention of records.
Advance payment	*Advance payment* means a payment that a Federal awarding agency or pass-through entity makes by any appropriate payment mechanism, including a predetermined payment schedule, before the non-Federal entity disburses the funds for program purposes.
Allocation	*Allocation* means the process of assigning a cost, or a group of costs, to one or more cost objective(s), in reasonable proportion to the benefit provided or other equitable relationship. The process may entail assigning a cost(s) directly to a final cost objective or through one or more intermediate cost objectives.
Allocability	*Allocability* means the principle which requires that an expense or service charged must directly benefit and be necessary for the performance of the project; when multiple projects are benefited reasonable proportions must be able to be assigned. See 2 CFR 200.405.
Allowable cost	*Allowable cost* means a cost incurred by a recipient that is: (1) reasonable for the performance of the award; (2) allocable; (3) in conformance with any limitations or exclusions set forth in the Federal cost principles applicable to the organization incurring the cost or in the award documents as to the type or amount of cost; (4) consistent with regulations, policies, and procedures of the recipient that are applied uniformly to both federally supported and other activities of the organization; (5) accorded consistent treatment as a direct or indirect cost; (6) determined in accordance with generally accepted accounting principles; and (7) not included as a cost in any other federally supported award (unless specifically authorized by statute). See 2 CFR 200.403.
Application	*Application* means a request for financial support of a project or activity submitted to DOE on specified forms and in accordance with DOE instructions. Also known as a proposal.

Appropriation Act	*Appropriation act* means the statute that provides the authority for Federal agencies to incur obligations to and make payments out of the U.S. treasury for specified purposes.
Approved budget	The *approved budget* for the Federal award summarizes the financial aspects of the project or program as approved during the Federal award process. It may include either the Federal and non-Federal share or only the Federal share, depending upon Federal awarding agency requirements. It must be related to performance for program evaluation purposes whenever appropriate. See 2 CFR 200.308(a).
Assurance	*Assurance* means a certification by an applicant, normally included with the application or State plan, indicating that the entity complies with, or that it will comply with, a particular requirement if awarded a Federal grant.
Authorized organizational representative	*Authorized organizational representative* means the individual, named by the applicant organization, who is authorized to act for the applicant and to assume the obligations imposed by the Federal laws, regulations, requirements, and conditions that apply to grant applications or grant awards.
Award	*Award* means the provision of funds by DOE, based on an approved application and budget or progress report, to an organizational entity or an individual to carry out a project or activity.
Award documents	*Award documents* means the entirety of the documents describing the legal relationship between DOE and an awardee or recipient. The award documents include an Assistance Agreement and other documents which may be incorporated by reference or as attachments to the Assistance Agreement. The award documents are the official, legally binding document, signed (or the electronic equivalent of signature) by a Contracting Officer that: • notifies the recipient of the award of an award; • contains or references all the terms and conditions of the grant and Federal funding limits and obligations; and, • provides the documentary basis for recording the obligation of Federal funds in the DOE accounting system.
Bayh-Dole Act	*Bayh-Dole Act* means a law which encourages universities and researchers to develop their inventions into marketable products; formal citation is Section 6 of the Patent and Trademark Amendment of 1980, Pub. L 96-517 as amended.
Budget	*Budget* means the financial plan for the project or program that the Federal awarding agency or pass-through entity approves during the Federal award process or in subsequent amendments to the Federal award. It may include the Federal and non-Federal share or only the Federal share, as determined by the Federal awarding agency or pass-through entity.
Budget period	*Budget period* means the intervals of time (usually 12 months each) into which a project period is divided for budgetary and funding purposes.
Business officer	*Business officer* means the financial official of the recipient who has primary fiscal responsibility for the grant. Also known as authorized organizational representative.
Capital assets	*Capital assets* means tangible or intangible assets used in operations having a useful life of more than one year which are capitalized in accordance with GAAP. Capital assets include: (a) Land, buildings (facilities), equipment, and intellectual property (including software) whether acquired by purchase, construction, manufacture, lease-purchase, exchange, or through capital leases; and (b) Additions, improvements, modifications, replacements, rearrangements, reinstallations, renovations or alterations to capital assets that materially increase their value or useful life (not ordinary repairs and maintenance).
Carryover	*Carryover* means unobligated Federal funds remaining at the end of any budget period that may be carried forward to another budget period to cover

	allowable costs of that budget period (whether as an offset or additional authorization). Obligated, but unliquidated, funds are not considered carryover.
Change in scope	*Change in scope* means an activity whereby the objectives or specific aims identified in the approved grant application are significantly changed by the recipient after award. Contracting Officer prior approval is required for a change in scope to be allowable under an award.
Closeout	*Closeout* means the process by which a Federal awarding agency determines that all applicable administrative actions and all required work under an award have been completed by the recipient and the Federal awarding agency.
Competitive segment	*Competitive segment* means the initial project period recommended for support or each extension of a project period resulting from a renewal award.
Conference (domestic or international)	*Conference (domestic or international)* means a symposium, seminar, workshop, or any other organized and formal meeting, whether conducted face-to-face or via the Internet, where individuals assemble (or meet virtually) to exchange information and views or explore or clarify a defined subject, problem, or area of knowledge, a published report results from such meeting.
Consortium or sub-award agreement	*Consortium or sub-award agreement* means a formalized agreement whereby a research project is carried out by the recipient and one or more other organizations that are separate legal entities. Under the agreement, the recipient must perform a substantive role in the conduct of the planned research and not merely serve as a conduit of funds to another party or parties. These agreements typically involve a specific level of effort from the consortium organization's PD/PI and a categorical breakdown of costs, such as personnel, supplies, and other allowable expenses, including F&A costs. The relationship between the recipient and the collaborating organizations is considered a sub-award relationship.
Consultant	*Consultant* means an individual who provides professional advice or services for a fee, but not as an employee of the engaging party. To prevent apparent or actual conflicts of interest, recipients and consultants must establish written guidelines indicating the conditions of payment of consulting fees. Consultants also include firms that provide professional advice or services. See 2 CFR 200.459.
Continuation application/award	*Continuation application/award* means a financial assistance request (in the form of an application or progress report) or resulting award for a subsequent budget period within a previously approved project period for which a recipient does not have to compete with other applicants.
Contract	*Contract* means a legal instrument by which a non-Federal entity purchases property or services needed to carry out the project or program under a Federal award. The term as used in this part does not include a legal instrument, even if the non-Federal entity considers it a contract, when the substance of the transaction meets the definition of a Federal award or sub-award (see 2 CFR 200.1 Subaward).
Contractor	*Contractor* means an entity that receives a contract as defined in 2 CFR 200.1 Contract.
Contracting (or Grants) Officer	*Contracting (or Grants) Officer* means a DOE official responsible for the business management aspects of grants and cooperative agreements, including review, negotiation, award, and administration, and for the interpretation of grants administration policies and provisions. COs and GOs are delegated the authority to obligate DOE to the expenditure of funds and permit changes to approved projects on behalf of DOE.
Contracting (or Grants Management) specialist	*Contracting (or Grants Management) specialist* means a DOE staff member who works with a Contracting or Grants Officer and is assigned the day-to-day management of a portfolio of grants and/or cooperative agreements. These activities include, but are not limited to, evaluating grant applications for administrative content and compliance with statutes, regulations, and

	guidelines; negotiating grants; providing consultation and technical assistance to recipients; and administering grants after award.
Cooperative agreement	*Cooperative agreement* means a type of financial assistance used when there will be substantial Federal scientific or programmatic involvement. Substantial involvement means that, after award, scientific or program staff will assist, guide, coordinate, or participate in project activities.
Cost principles	*Cost principles* means the government-wide principles, 2 CFR 200 Subpart E (or, in the case of commercial organizations, the Federal Acquisition Regulation [48 CFR 31], or, in the case of hospitals, see Appendix IX to Part 200—Hospital Cost Principles, Appendix E, "Principles for Determining Costs Applicable to Research and Development Under Grants and Contracts with Hospitals"), on allowability and unallowability of costs under federally sponsored agreements.
Cost sharing or matching	*Cost sharing or matching* means the portion of project costs not paid by Federal funds (unless otherwise authorized by Federal statute). See also 2 CFR 200.306 Cost sharing or matching.
Deadline	*Deadline* means the published date and/or time that a grant application is to be submitted to the funding agency.
Debarment and suspension	*Debarment and suspension* mean the actions taken by a debarring official in accordance with OMB guidance at 2 CFR 180, "Non-procurement Debarment and Suspension," to exclude a person or organization from participating in grants and other non-procurement awards government-wide. If debarred or suspended, the person or organization may not receive financial assistance (under a grant, cooperative agreement, or sub-award, or contract under a grant) for a specified period of time. Debarments and suspensions carried out pursuant to 2 CFR 376 are distinct from post-award suspension action by an awarding agency. See 2 CFR 901 for DOE implementation.
Direct costs	*Direct costs* mean costs that can be identified specifically with a particular sponsored project, an instructional activity, or any other institutional activity, or that can be directly assigned to such activities relatively easily with a high degree of accuracy. See 2 CFR 200.413.
Disallowed costs	*Disallowed costs* mean those charges to a Federal award that the Federal awarding agency or pass-through entity determines to be unallowable, in accordance with the applicable Federal statutes, regulations, or the terms and conditions of the Federal award.
Domestic organization	*Domestic organization* means a public (including a State or other governmental agency) or private non-profit or for-profit organization that is located in the United States or its territories, is subject to U.S. laws, and assumes legal and financial accountability for awarded funds and for the performance of the grant-supported activities.
Effort	*Effort* means the amount of time, usually expressed as a percentage of the total, which a faculty member or other employee spends on a sponsored project. No one is allowed to spend more than 100% total commitment on all academic activities, including grant-sponsored research, university-sponsored research, teaching, administration, advising and other contracted duties. Effort is indicated on the budget in units of person-months.
Equipment	*Equipment* means tangible personal property (including information technology systems) having a useful life of more than one year and a per-unit acquisition cost which equals or exceeds the lesser of the capitalization level established by the non-Federal entity for financial statement purposes, or $5,000. See also 2 CFR 200.1 Capital assets, Computing devices, General purpose equipment, Information technology systems, Special purpose equipment, and Supplies.
Expanded authorities	*Expanded authorities* means authorization to recipients under certain research grant mechanisms which waives the requirement for prior agency approval for

	specified actions related to awards. Example: 90-day pre-award spending authority, no cost extensions for up to one additional year, and automatic carryover of unobligated funds from one budget period to the next. The expanded authorities are now contained in Uniform Guidance of 2 CFR 200 as being applicable to all research awards.
Expiration date	*Expiration date* means generally, the date signifying the end of the current project period, after which the recipient is not authorized to obligate grant funds.
Facilities and administrative costs	*Facilities and administrative costs* mean costs that are incurred by a recipient for common or joint objectives and that, therefore, cannot be identified specifically with a particular project or program. These costs also are known as indirect costs.
Federal financial report	*Federal financial report* means submitted on Standard Form (SF) 425, to indicate the status of awarded funds for the period covered. Frequency of reporting is specified in the Reporting Checklist provided as part of the award documents.
Financial assistance	*Financial assistance* means transfer by DOE of money or property to an eligible entity to support or stimulate a public purpose authorized by statute.
Financial status report	*Financial status report* means see Federal Financial Report.
Foreign travel	*Foreign travel* is meant to include travel outside of North America (Canada, Mexico, and the United States) and U.S. territories and possessions (Guam, American Samoa, Puerto Rico, the U.S. Virgin Islands. A trip is considered foreign travel for all legs of the itinerary if the traveler does not return to his or her post prior to departure for a foreign destination. Costs for foreign travel may be restricted by the language of a Funding Opportunity Announcement.
Grant agreement	*Grant agreement* means a legal instrument of financial assistance between a Federal awarding agency or pass-through entity and a non-Federal entity that, consistent with 31 USC 6302, 6304: (a) Is used to enter into a relationship the principal purpose of which is to transfer anything of value from the Federal awarding agency or pass-through entity to the non-Federal entity to carry out a public purpose authorized by a law of the United States (see 31 USC 6101(3)); and not to acquire property or services for the Federal awarding agency or pass-through entity's direct benefit or use; (b) Is distinguished from a cooperative agreement in that it does not provide for substantial involvement between the Federal awarding agency or pass-through entity and the non-Federal entity in carrying out the activity contemplated by the Federal award. (c) Does not include an agreement that provides only: (1) Direct United States Government cash assistance to an individual; (2) A subsidy; (3) A loan; (4) A loan guarantee; or (5) Insurance.
Grant-supported project or activity	*Grant-supported project or activity* means those activities specified or described in a grant application or in a subsequent submission that are approved by DOE for funding, regardless of whether Federal funding constitutes all or only a portion of the financial support necessary to carry them out.
Grants.gov	*Grants.gov* (https://www.Grants.gov/) has been designated by the Office of Management and Budget as the single access point for all grant programs offered by 26 Federal grant-making agencies. It provides a single interface for agencies to announce their grant opportunities and for all applicants to find and apply for those opportunities.

Indirect costs (facilities & administrative)	*Indirect (F&A) costs* mean those costs incurred for a common or joint purpose benefitting more than one cost objective, and not readily assignable to the cost objectives specifically benefitted, without effort disproportionate to the results achieved. To facilitate equitable distribution of indirect expenses to the cost objectives served, it may be necessary to establish several pools of indirect (F&A) costs. Indirect (F&A) cost pools must be distributed to benefitted cost objectives on bases that will produce an equitable result in consideration of relative benefits derived.
Institutional base salary	*Institutional base salary* means the annual compensation paid by an organization for an employee's appointment, whether that individual's time is spent on research, teaching, patient care, or other activities. Base salary excludes any income that an individual may be permitted to earn outside of duties for the applicant/recipient organization. Base salary may not be increased as a result of replacing organizational salary funds with grant funds.
Matching or cost sharing	*Matching or cost sharing* means the value of third-party in-kind contributions and the portion of the costs of a federally assisted project or program not borne by the Federal government. Matching or cost sharing may be required by statute or program regulation. Costs used to satisfy matching or cost-sharing requirements are subject to the same policies governing allowability as other costs under the approved budget.
Merit (or peer) review	*Merit (or peer) review* means the process that involves the consistent application of standards and procedures that produce fair, equitable, and objective examinations of applications based on an evaluation of scientific or technical merit or other relevant aspects of the application. The review is performed by experts (reviewers) in the field of endeavor for which support is requested. Merit review is intended to provide guidance to the DOE individuals responsible for making award decisions.
Monitoring	*Monitoring* means a process whereby the programmatic and business management performance aspects of a grant are assessed by reviewing information gathered from various required reports, audits, site visits, and other sources.
NEPA	*NEPA* means the National Environmental Policy Act (NEPA), Public Law 91-190, as amended. NEPA requires Federal agencies to assess the environmental effects of proposed major Federal actions prior to making decisions.
No-cost extension	*No-cost extension* means an extension of time to a project period and/or budget period to complete the work of the grant under that period, without additional Federal funds or competition.
Non-Federal share	*Non-Federal share* means when cost sharing or matching is required as a condition of an award, the portion of allowable project/program costs not borne by the Federal government.
Notice of Funding Opportunity (NOFO)	*Notice of Funding Opportunity (NOFO)* means a publicly available document by which a Federal Agency makes known its intentions to award discretionary grants or cooperative agreements, usually as a result of competition for funds. NOFOs may be known as program announcements, requests for applications, notices of funding availability, solicitations, or other names depending on the Agency and type of program. NOFOs can be found at www.Grants.gov. A NOFO may also be known as a solicitation. NOFOs were previously known as Funding Opportunity Announcements (FOAs).
Obligations	*Obligations,* when used in connection with a non-Federal entity's utilization of funds under a Federal award, mean orders placed for property and services, contracts and sub-awards made, and similar transactions during a given period that require payment by the non-Federal entity during the same or a future period.
OMB circulars	*OMB circulars* are government-wide guidance issued to Heads of Federal agencies by the Director of the Office of Management and Budget.

Other significant contributors	*Other significant contributors* mean individuals who have committed to contribute to the scientific development or execution of the project, but are not committing any specified measurable effort (i.e., person months) to the project. These individuals are typically presented at "effort of zero person months" or "as needed." Individuals with measurable effort may not be listed as Other Significant Contributors (OSCs). Consultants should be included if they meet this definition.
Program participant	*Program participants* are the recipients of service or training provided at a workshop, conference, seminar, symposium or other short-term instructional or information-sharing activity funded by an external grant or award, or the training beneficiaries of the project or program funded by an external grant or award. A participant is not involved in providing any deliverable to the recipient or a third party or would not be terminated or replaced for failure to perform.
Participant support costs	*Participant support costs* mean direct costs for items such as stipends or subsistence allowances, travel allowances, and registration fees paid to or on behalf of participants or trainees (but not employees) in connection with conferences, or training projects.
Person months	*Person months* is the metric for expressing the effort (amount of time) PD/PI(s), faculty and other senior/key personnel devote to a specific project. The effort is based on the type of appointment of the individual with the organization, e.g., calendar year, academic year, and/or summer term; and the organization's definition of such. For instance, some institutions define the academic year as a nine (9)-month appointment while others define it as a 10-month appointment.
Pre-application or pre-proposal	*Pre-application or pre-proposal* means a brief outline or narrative of proposed work and sometimes budget, for informal review by a sponsor to determine whether an application should be submitted. Three predominant reasons for requiring submission of a preliminary pre-application are: • Reduce the applicant's unnecessary effort in proposal preparation when the chance of success is very small. This is particularly true of exploratory initiatives where the community senses that a major new direction is being identified, or competitions that will result in a small number of actual awards. • Increase the overall quality of the submission. • Distill the number of applications that will be submitted to the agency and the number of anticipated reviewers needed to review.
Pre-award costs	*Pre-award costs* mean any cost incurred prior to the beginning date of the project period or the initial budget period of a competitive segment (under a multi-year award), in anticipation of the award and at the applicant's own risk, for otherwise allowable costs.
Prior approval	*Prior approval* means written approval from the designated Contracting Officer.
Program Director/ Principal Investigator	*Program Director/ Principal Investigator* means the individual(s) designated by the applicant organization to have the appropriate level of authority and responsibility to direct the project or program to be supported by the award. The applicant organization may designate multiple individuals as program directors/principal investigators (PD/PIs) who share the authority and responsibility for leading and directing the project, intellectually and logistically. When multiple PD/PIs are named, each is responsible and accountable to the applicant organization, or as appropriate, to a collaborating organization for the proper conduct of the project or program including the submission of all required reports. The presence of more than one PD/PI on an application or award diminishes neither the responsibility nor the accountability of any individual PD/PI.

Program income	*Program income* means gross income earned by the non-Federal entity that is directly generated by a supported activity or earned as a result of the Federal award during the period of performance except as provided in 2 CFR 200.307 paragraph (f). (See 2 CFR 200.1 Period of performance.) Program income includes but is not limited to income from fees for services performed, the use or rental or real or personal property acquired under Federal awards, the sale of commodities or items fabricated under a Federal award, license fees and royalties on patents and copyrights, and principal and interest on loans made with Federal award funds. Interest earned on advances of Federal funds is not program income. Except as otherwise provided in Federal statutes, regulations, or the terms and conditions of the Federal award, program income does not include rebates, credits, discounts, and interest earned on any of them. See also 2 CFR 200.407 Prior written approval (prior approval). See also 35 USC 200-212 "Disposition of Rights in Educational Awards" for inventions made under Federal awards.
Program Manager	*Program Manager* means the DOE official responsible for the programmatic, scientific, and/or technical aspects of a grant. The same role is filled by Program Directors, Program Officers, or Project Directors at other Federal agencies.
Progress report	*Progress report* means periodic, frequently annual, report submitted by the recipient and used by DOE to assess progress and to determine whether to provide funding for the budget period that covered by the report.
Project/performance site	*Project/ performance site* means location(s) of where the work described in the research plan will be conducted.
Project period	*Project period* means the total time for which Federal support of a project has been programmatically approved as shown in the award documents; however, it does not constitute a commitment by the Federal government to fund the entire period. The total award period comprises the initial competitive segment, any subsequent competitive segments resulting from a renewal award(s), and extensions.
Proposal	See application.
Re-budgeting	*Re-budgeting* means reallocation of funds available for spending between approved budget categories to allow best use of funds to accomplish the project goals.
Real Property	*Real property* means land, including land improvements, structures and appurtenances thereto, but excludes moveable machinery and equipment.
Recipient	*Recipient* means the organization or individual awarded a grant or cooperative agreement by DOE that is responsible and accountable for the use of the funds provided and for the performance of the grant-supported project or activity. The recipient is the entire legal entity even if a particular component is designated in award documents. The recipient is legally responsible and accountable to DOE for the performance and financial aspects of the grant-supported project or activity. Also known as awardee or grantee.
Renewal application	*Renewal application* means an application requesting additional funding for a period subsequent to that provided by a current award. Renewal applications compete for funds with all other peer reviewed applications and must be developed as fully as though the applicant is applying for the first time.
Research	*Research* is defined as a systematic study directed toward fuller scientific knowledge or understanding of the subject studied. See 2 CFR 200.1 Research and Development (R&D).
Research misconduct	*Research misconduct* means fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results, but does not include honest error or differences of opinion. See 10 CFR 733.

SAM.gov	*SAM.gov* is the System for Award Management (SAM) a consolidated service that includes Entity Registration, Assistance Listings, and other services for making, managing, and receiving Federal awards.
Scope of work	*Scope of work* means the aims, objectives, and purposes of a grant; as well as the methodology, approach, analyses or other activities; and the tools, technologies, and timeframes needed to meet the grant's objectives. This includes the research or training plan included with the original grant application, along with any approved modifications.
Senior/Key Personnel	*Senior/Key personnel* means the PD/PI and other individuals who contribute to the scientific development or execution of a project in a substantive, measurable way, whether or not they receive salaries or compensation under the grant. Typically, these individuals have doctoral or other professional degrees, although individuals at the masters or baccalaureate level may be considered senior/key personnel if their involvement meets this definition. Consultants and those with a postdoctoral role also may be considered senior/key personnel if they meet this definition. "Zero percent" effort or "as needed" is not an acceptable level of involvement for Senior/Key Personnel.
Significant re-budgeting	*Significant re-budgeting* means a threshold that is reached when expenditures in a single direct cost budget category deviate (increase or decrease) from the categorical commitment level established for the budget period by more than 25 percent of the total costs awarded. Significant re-budgeting is one indicator of change in scope.
Small business concern	*Small business concern* means a business that meets the regulatory and size requirements established by the SBA at 13 CFR 121.
Solicitation	See Funding Opportunity Announcement.
Subaward	*Subaward* means a legal instrument by which a recipient provides funds (or property in lieu of funds) to an eligible subrecipient (or a lower-tier transaction) to perform a substantive portion of the grant-supported program or project. The term includes such financial assistance when provided by any legal agreement (even if the agreement is called a contract) but does not include any form of assistance which is excluded from the definition of a grant, including the recipient's procurement of property or services needed to carry out the project or program. The term includes consortium agreements.
Subrecipient	*Subrecipient* means a non-Federal entity that receives a subaward from a pass-through entity to carry out part of a Federal program; but does not include an individual that is a beneficiary of such program. A sub-recipient may also be a recipient of other Federal awards directly from a Federal awarding agency.
Supplement	*Supplement* means a request for an increase in support during a current budget period for expansion of the project's scope or to meet increased costs unforeseen at the time of the new or renewal application. A supplement may increase support for future years in addition to the current year. Supplements require applications and are subject to administrative and merit review.
Terms and conditions of award	*Terms and conditions of award* means all legal requirements imposed on a grant by DOE, whether based on statute, regulation, policy, or other document referenced in the grant award, or specified by the grant award document itself. The award documents may include both standard and special conditions that are considered necessary to attain the grant's objectives, facilitate post-award administration of the grant, conserve grant funds, or otherwise protect the Federal government's interests.
UEI	*UEI* is the Unique Entity Identifier, a twelve-digit alphanumerical sequence established and assigned by the System for Award Management at https://www.SAM.gov to uniquely identify an entity.

Unallowable costs	*Unallowable costs* mean costs that cannot be charged, directly or indirectly, to Federal awards because the costs are prohibited by law, regulation (including applicable cost principles), or the terms and conditions of award. Costs that are not allowable, allocable, or reasonable are unallowable.
Unliquidated obligation	*Unliquidated obligations* mean, for financial reports prepared on a cash basis, obligations incurred by the non-Federal entity that have not been paid (liquidated). For reports prepared on an accrual expenditure basis, these are obligations incurred by the non-Federal entity for which an expenditure has not been recorded.
Unobligated balance	*Unobligated balance* means the amount of funds under a Federal award that the non-Federal entity has not obligated. The amount is computed by subtracting the cumulative amount of the non-Federal entity's unliquidated obligations and expenditures of funds under the Federal award from the cumulative amount of the funds that the Federal awarding agency or pass-through entity authorized the non-Federal entity to obligate.
Validate	In the context of the data management plan requirements, *validate* means to support, corroborate, verify, or otherwise determine the legitimacy of the research findings. Validation of research findings could be accomplished by reproducing the original experiment or analyses, comparing and contrasting the results against those of a new experiment or analyses, or by some other means.