

**DEPARTMENT OF ENERGY (DOE)
OFFICE OF SCIENCE (SC)**



EARLY CAREER RESEARCH PROGRAM (ECRP)

**FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER:
DE-FOA-0003176**

**FOA TYPE: AMENDMENT 000001
CFDA NUMBER: 81.049**

FOA Issue Date:	December 15, 2023
Submission Deadline for Pre-Applications:	January 30, 2024 at 5:00 PM Eastern Time A Pre-Application is required Pre-Applications must be submitted by an authorized institutional representative.
Pre-Application Response Date:	March 14, 2024 at 11:59 PM Eastern Time
Submission Deadline for Applications:	April 25, 2024 at 11:59 PM Eastern Time

Amendment 000001 has been issued to update the Notice on page 11 and to change the Program Manager on page 45.

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UPDATES AND REMINDERS

RECOMMENDATION

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

INFORMATIONAL WEBINAR

SC plans to hold an informational webinar about this FOA during the week of January 8, 2024. Registration instructions and other details will be posted at <https://science.osti.gov/early-career> and at <https://science.osti.gov/grants/FOAs/Open>.

PROMOTING INCLUSIVE AND EQUITABLE RESEARCH (PIER) PLAN

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

INTERAGENCY FORMATS FOR CURRENT AND PENDING SUPPORT AND BIOGRAPHICAL SKETCHES

Interagency common instructions for preparing current and pending support and biographical sketches are being developed. The Science Experts Network Curriculum Vitae (SciENCv) system at <https://www.ncbi.nlm.nih.gov/sciencv/> will be updated to support the forthcoming common instructions and formats. The fillable PDFs provided by the National Science Foundation at <https://nsf.gov/bfa/dias/policy/nsfapprovedformats/> are no longer available. When interagency common formats and instructions are promulgated, their use will be required. SC strongly encourages all researchers to use the online SciENCv system to ensure that their documents are prepared in the appropriate format with the least inconvenience.

INDIVIDUALS WHO SHOULD NOT SERVE AS MERIT REVIEWERS

Follow the updated instructions in [Section VIII](#) and consider the use of the Collaborator Template available at <https://science.osti.gov/grants/Policy-and-Guidance/Agreement-Forms>. Do not include this list as part of the biographical sketch.

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.

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>.

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 FOA may be reviewed by a Committee of Visitors.

PORTABLE DOCUMENT FORMAT (PDF) GENERATION

The project narrative in an application must be one single machine-readable PDF file that contains the DOE Title Page, project narrative, all required appendices, and other attachments. This single PDF file may not be scanned from a printed document and must be 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. 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 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.

Checklist for Avoiding Common Errors:

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 and appendices - Biographical sketches - Data Management Plans (DMPs) - Promoting Inclusive and Equitable Research (PIER) Plan - Letter(s) of Collaboration or Access, if any
Personally Identifiable Information	None present in the application

Item	Issue
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.
Institutions capable of being funded through the DOE Field Work System	If National Laboratories and/or DOE sites are permitted to submit under this FOA: - Do not create new institutions in the PAMS website. - Submit applications in Grants.gov using the name of the laboratory or site in Field 5 of the SF-424(R&R) application form, not the contractor operating the laboratory or site. Submissions under this FOA will be evaluated for technical merit, but any resulting funding, work, or awards will be made under the laboratory or site's contract with DOE. No separate financial assistance awards will be made. No administrative provisions of this FOA will apply to the laboratory or any laboratory subcontractor.

Section I – FUNDING OPPORTUNITY DESCRIPTION

GENERAL INQUIRIES ABOUT THIS FOA SHOULD BE DIRECTED TO:

Technical/Scientific Program Contact:

Questions regarding the specific program areas/technical requirements can be directed to the program managers/technical contacts listed for each program within the FOA.

Administrative Contact (questions about budgets and eligibility):

Questions about program rules should be sent to SC.Early@science.doe.gov

STATUTORY AUTHORITY

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

APPLICABLE 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

SUMMARY

DOE SC hereby invites applications for support under the ECRP in the following program areas: Advanced Scientific Computing Research (ASCR); Basic Energy Sciences (BES); Biological and Environmental Research (BER); Fusion Energy Sciences (FES); High Energy Physics (HEP); Nuclear Physics (NP); Isotope Research and Development (R&D) and Production (DOE IP); and Accelerator R&D and Production (ARDAP). The purpose of this program is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by SC.

SC's mission is to deliver the 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.

RESEARCH OPPORTUNITIES

ECRP opportunities exist in the following SC research programs. Additional details about each program, websites, and technical points of contacts are provided in the materials that follow.

Advanced Scientific Computing Research (ASCR)

Extreme-Scale Algorithms for Scientific Computing

Multiscale Mathematics for the Modeling and Simulation of Complex Systems

Data Management, Visualization, and Analytics

Quantum Computing

Emerging Computing Technologies

Basic Energy Sciences (BES)

Materials Chemistry

Biomolecular Materials

Synthesis and Processing Science

Experimental Condensed Matter Physics

Theoretical Condensed Matter Physics

Physical Behavior of Materials

Mechanical Behavior and Radiation Effects

Quantum Information Science in Materials Sciences and Engineering (QIS-MSE)

X-ray Scattering

Neutron Scattering

Electron and Scanning Probe Microscopies

Atomic, Molecular, and Optical Sciences (AMOS)

Gas Phase Chemical Physics (GPCP)

Computational and Theoretical Chemistry

Condensed Phase and Interfacial Molecular Science (CPIMS)

Quantum Information Science Research in Chemical Sciences, Geosciences, and

Biosciences (QIS-CSGB)

Catalysis Science

Separation Science (SEP)

Heavy Element Chemistry (HEC)

[Geosciences \(GEO\)](#)
[Solar Photochemistry](#)
[Photosynthetic Systems](#)
[Physical Biosciences](#)
[Accelerator and Detector Research](#)
[Instrumentation and Technique Development for BES User Facilities](#)
[Biological and Environmental Research \(BER\)](#)
[Systems Biology Enabled Microbiome Research to Facilitate Predictions of Interactions and Behavior in the Environment](#)
[Southeast U.S. Atmospheric Processes through use of Observations from the Third Atmospheric Radiation Measurement \(ARM\) Mobile Facility \(AMF3\) Bankhead National Forest \(BNF\) Atmospheric Observatory](#)
[Fusion Energy Sciences \(FES\)](#)
[Advanced and Long Pulse Tokamak Research](#)
[Spherical Tokamak Research](#)
[Stellarator Research in Magnetic Fusion Energy Sciences](#)
[Magnetic Fusion Energy Science Theory and Simulation](#)
[Measurement Innovation](#)
[High-Energy-Density Plasma Science / Inertial Fusion Energy](#)
[General Plasma Science Experiment and Theory](#)
[Fusion Nuclear Science, Materials Research, and Enabling R&D Programs for Fusion](#)
[Technical Contact for Materials Research, Fusion Nuclear Science, and Enabling R&D](#)
[Artificial Intelligence and Machine Learning for Fusion Energy Sciences](#)
[High Energy Physics \(HEP\)](#)
[Experimental Research at the Energy Frontier in High Energy Physics](#)
[Experimental Research at the Intensity Frontier in High Energy Physics](#)
[Experimental Research at the Cosmic Frontier in High Energy Physics](#)
[Theoretical Research in High Energy Physics](#)
[Accelerator Science and Technology Research & Development in High Energy Physics](#)
[Detector Research and Development in High Energy Physics](#)
[Computational Research in High Energy Physics](#)
[Quantum Information Science in High Energy Physics \(HEP-QIS\)](#)
[Nuclear Physics \(NP\)](#)
[Medium Energy Nuclear Physics](#)
[Heavy Ion Nuclear Physics](#)
[Nuclear Structure and Astrophysics](#)
[Fundamental Symmetries](#)
[Nuclear Theory](#)
[Nuclear Theory Computing](#)
[Nuclear Data](#)
[Accelerator Research and Development for Current and Future Nuclear Physics Facilities](#)
[NP - Quantum Information Science \(QIS\)](#)
[Isotope R&D and Production \(DOE IP\); and](#)
[Targetry and Isotope Production Research](#)
[Nuclear and Radiochemical Separation, Purification, and Radiochemical Synthesis](#)
[Biological Tracers, Imaging and Therapeutics](#)

[Isotopic Enrichment Technology
Accelerator R&D and Production \(ARDAP\)](#)

The research topics for this FOA are indicated by numbers (1, 2, 3, etc.) under each Program Office name (A, B, C, etc.). For example, under ASCR, the first topic (1) is “Extreme-Scale Algorithms for Scientific Computing.”

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

ASCR’s mission is to advance applied mathematics and computer science; deliver the most advanced 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 ASCR program gives the science and technology community, including U.S. industry, access to world-class supercomputers and the tools to use them for science and engineering. ASCR accomplishes this by developing and maintaining world-class computing and network facilities for science; and advancing research in applied mathematics, computer science, and advanced networking.

The computing resources and high-speed networks required to meet the scientific needs of the future exceed the state-of-the-art by a significant margin. Furthermore, the algorithms, software tools, the software libraries and the distributed software environments needed to accelerate scientific discovery through modeling and simulation are 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, and a high-speed network, and implements a broad base research portfolio to solve complex problems on computational resources that are on a trajectory to reach well beyond hundreds and thousands of petaflops within a few years.

Proposed research under ASCR for the Early Career Research Program must be responsive to one of the specific topic areas below:

APPLIED MATHEMATICS

This program supports basic research leading to fundamental mathematical advances and computational breakthroughs across DOE and SC missions. Applied Mathematics efforts span a range of research in scalable high-performance solvers, adaptive multiscale mathematical models, and coupled scientific data analysis, statistical methodologies, and algorithms. These research developments are the foundation for enabling predictive models, simulations, and analysis of DOE-relevant science and engineering applications. The specific topic areas of interest are:

1. Extreme-Scale Algorithms for Scientific Computing
Technical Contact: Steven Lee, Steven.Lee@science.doe.gov

The scientific computing research community faces a broad array of challenges in the development of high-performance algorithms and solvers for emerging computing architectures. Because algorithms, solvers, and decision support methods can dominate the overall execution time of computational and data science applications, research in developing efficient, robust, resilient, and portable techniques is essential for scientific advances over the next decade [5, 6].

Research areas of interest include novel approaches for addressing grand challenges such as:

- High computational and communication complexity and the development of efficient algorithms,
- Better algorithm scalability for low-power, high-performance computing,
- Reduced ill-conditioning and sensitivity for inverse problems, and
- Improved algorithm reliability and robustness to noise on future architectures where extreme parallelism, data placement and movement, resilience, and extreme heterogeneity may be significant considerations [4].

The ASCR workshop report on “Randomized Algorithms for Scientific Computing” includes the types of algorithms and research directions that are in scope for this topic area [2].

Topics and research areas that are out of scope for sub-topic (1) include:

- Pre-applications that do not address one or more of the four grand challenges described above.
- Pre-applications and applications that do not address research for creating a body of knowledge and understanding that will inform future advances in extreme scale science;
- Pre-applications that do not clearly articulate the main scientific motivations and barriers to progress, the technical basis for overcoming those barriers, and the key insights or novel approaches for addressing the scientific and technical challenges; and
- Research in cryptography or quantum computing algorithms.

2. Multiscale Mathematics for the Modeling and Simulation of Complex Systems

Technical Contact: William Spatz, William.Spatz@science.doe.gov

Innovative mathematics research is needed to improve the fidelity and predictability of continuous and/or distributed complex systems that accurately capture the physics and/or subcomponent interactions across vastly different time and length scales. This topic area is focused on the challenges of accurately coupling different multi-physics systems, the rigorous development of hybrid or hierarchical mathematical models that incorporate machine learning or reduced order models, and other approaches that bring together multiple facets of more realistic, predictive modeling and simulation [7, 8] and [3, see PRD #5]. Topics and research areas that are out of scope include:

- Pre-applications and applications that do not address problems that span time and length scales of multiple orders of magnitude;
- Pre-applications and applications that do not address innovation in coupling or multifaceted mathematical models.

Topics and research areas that are out of scope for Applied Mathematics include:

- Approaches for specific scientific or engineering problems that are not applicable to a broader class of problems,
- Approaches with a primary emphasis on tailoring, or the implementation of, existing numerical methods for specific scientific problems,
- Computational implementation or frameworks for scientific or engineering problems that are primarily based on specific programming models or architecture,
- Research that results in incremental improvements to the existing state of practice.

Important note for encourage and discourage decisions: Pre-applications must clearly articulate the main scientific motivations and barriers to progress, the technical basis for overcoming those barriers, and the key insights or novel approaches for addressing the scientific and technical challenges. The lack of such details is sufficient for discouragement of the proposed research.

See [Section IV.B](#) for details regarding the pre-application submission and review process.

References:

- [1] Workshop report on Data Reduction for Science, <https://doi.org/10.2172/1770192>
- [2] Workshop report on Randomized Algorithms for Scientific Computing, <https://www.osti.gov/servlets/purl/1807223/>
- [3] Basic Research Needs for Scientific Machine Learning: Core Technologies for Artificial Intelligence, <https://www.osti.gov/servlets/purl/1478744/>
- [4] 2018 Basic Research Needs Workshop on Extreme Heterogeneity, <https://doi.org/10.2172/1473756>
- [5] Report on Applied Mathematics Research for Exascale Computing, <https://doi.org/10.2172/1149042>
- [6] Report on the Extreme Scale Solvers Workshop <https://science.osti.gov/-/media/ascr/pdf/program-documents/docs/reportExtremeScaleSolvers2012.pdf>
- [7] Report on A Multifaceted Mathematical Approach for Complex Systems https://science.osti.gov/-/media/ascr/pdf/program-documents/docs/Multifaceted_Mathematical_Approach_for_Complex_Systems.pdf
- [8] DOE Workshop Report on Multiphysics Simulations <https://science.osti.gov/-/media/ascr/pdf/programdocuments/docs/MultiPhysics-Simulations-Report.pdf>

COMPUTER SCIENCE

This program supports research that enables computing and networking at extreme scales and the understanding of extreme scale and 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.

Topics of interest for this FOA are focused on the following key core computer science research areas:

3. Systems

Technical Contact: Hal Finkel, Hal.Finkel@science.doe.gov

- a. **Programming Models and Environments:** 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. 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.
- b. **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.
- c. **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.

Applications are not restricted to a single Systems topic above and may span all of them, provided the scope of work remains appropriate for the program.

4. Data Management, Visualization, and Analytics

Technical Contact: Margaret Lentz, Margaret.Lentz@science.doe.gov

- a. **Data Management** approaches for managing and analyzing large and complex data (multidimensional, multimodal, etc.) from scientific experiments and simulations are of interest as highlighted recent ASCR Workshop on the Management and Storage of Scientific Data, building on the outcomes of prior community activities, including Storage Systems and I/O: Organizing, Storing, and Accessing Data for Scientific Discovery and the Office of Science Roundtable on Data for AI. Areas of interest include:
 - 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.

- Innovative methods to design scientific-data-management services for state-of-the-art storage and networking devices, including those providing computational capabilities.

b. **Analytic Methods and Environments** includes approaches to improve visual exploration and understanding of petabyte to exabyte multi-scale, multi-physics scientific data sets from simulations and/or experimental platforms; to support efficient analysis of data across federated resources; to support interactivity with simulation and/or real-time steering of experiments, including remote interactions; and to help answer scientifically relevant questions from the data about, for example, uncertainty, sensitivity analysis, causality, and the debugging of codes and methods. As appropriate, applicants are encouraged to consider evaluation methods for new visualization tools and techniques resulting from the proposed research. These areas highlighted in the recent ASCR Workshop on Visualization for Scientific Discovery, Decision-Making, and Communication. Areas of interest include:

- Advancing Theory and Techniques for Visualization to Support the Analysis and Understanding of Complex Scientific Data
- Introducing Interoperable and Adaptable Visualization to Support Diverse Scientific Workflows Across All Scales
- Harnessing Technology Innovations to Accelerate Science through Visualization
- Developing Intelligent Approaches for Adaptive, Context-Aware Visualization of Scientific Data and AI

The primary focus of the proposed work for either topic A or B must be on innovative computer-science techniques, which may include explainable machine learning and AI techniques to help address the aforementioned areas of data management, visualization, and analytics.

Topics that are out of scope include:

- Pre-applications and applications that do not address the specific Computer Science topics described above,
- Pre-applications and applications that do not explain/describe their relevance to current and future high performance computing platforms and/or data-centric science as well as their relevance to the mission of SC and ASCR,
- Pre-applications and applications that focus primarily on the development or application of data-reduction techniques (see Applied Mathematics Topic on Scientific Machine Learning, Data Analysis and Reduction),
- Pre-applications and applications that are primarily focused on the mathematics of AI (see Applied Mathematics Topic on Scientific Machine Learning, Data Analysis and Reduction),
- Pre-applications and applications with primary emphasis on computer hardware design, fabrication, or integration; materials science; and computing devices and/or device/circuit design and/or manufacturing,
- Research primarily focused on advancing discipline-specific research or capabilities without also proposing a generalization of this research to other SC priority mission areas,
- Research primarily focused on advancing Virtual Reality and Augmented Reality

technologies,

- Research focused on the World Wide Web and/or Internet,
- Research that is only applicable to hand-held, tablets, laptops, portable, desktop, embedded or cloud computing, and
- Research focused on quantum computing.

References:

1. DOE Workshop report: Reimagining Codesign. <https://www.osti.gov/biblio/1822199/>
2. DOE Workshop report: The Management and Storage of Scientific Data. United States, 2023. <https://www.osti.gov/biblio/1845707/>
3. DOE Workshop report: Management, Analysis and Visualization of Experimental and Observational Data: The Convergence of Data and Computing <https://www.osti.gov/biblio/1440647>
4. DOE Workshop report: Crosscut Report: Exascale Requirements Reviews, March 2017. <https://science.osti.gov/~media/ascr/pdf/programdocuments/docs/2018/DOE-ExascaleReport-CrossCut.pdf>
5. DOE Workshop report: Storage Systems and Input/Output: Organizing, Storing, and Accessing Data for Scientific Discovery. <https://www.osti.gov/biblio/1491994/>
6. DOE Workshop report: Data and Models: A Framework for Advancing AI in Science <https://www.osti.gov/biblio/1579323>
7. DOE Workshop brochure: Visualization for Scientific Discovery, Decision-Making, and Communication. <https://www.osti.gov/biblio/1845708>

ADVANCED COMPUTING TECHNOLOGIES

This activity supports Quantum efforts and Research and Evaluation Prototypes (REP). The Research and Evaluation Prototypes (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.

5. Quantum Computing

Technical Contact: Claire Cramer, Claire.Cramer@science.doe.gov

- **Noise Modeling, Characterization, and Control:** Research to develop scalable, hardware-aware methods for modeling real-world noise in quantum processors; and characterization, verification, validation, and control of real-world quantum processors from the gate level through circuit compilation, routing, and execution. Methods should account for realistic noise sources, including non-Markovian noise, and seek to understand, quantify, and reduce the impact of errors introduced via device imperfections and in low levels of the software stack. Research should be backed by rigorous theory and connect metrics for device performance to low-level physical parameters as well as application performance where possible and as appropriate. Characterization, verification, validation, and control of

approaches to quantum computing beyond binary logic (e.g., qudits) and use of more than two qubits in a single logic operation (e.g., multi-qubit gates) are in scope.

Topics that are out of scope include:

- Pre-applications and applications that do not address the specific REP topics described above,
- Development of quantum algorithms,
- Development of new candidate qubit systems or improvements to physical qubits in isolation,
- Quantum transduction,
- Quantum communication, networking, and key distribution,
- Cryptography and cryptanalysis,
- Research solely relevant to large-scale, high-fidelity, fault-tolerant machines, and
- Projects that are duplicative of or competitive with industry.

References:

- (1) ASCR Report on Quantum Computing for Science, February 2015.
<https://science.osti.gov/-/media/ascr/pdf/programdocuments/docs/ASCRQuantumReport-final.pdf>
- (2) ASCR Report on a Quantum Computing Testbed for Science, February 2017.
<https://science.osti.gov/-/media/ascr/pdf/programdocuments/docs/2017/QTSWReport.pdf>

6. Emerging Computing Technologies

Technical Contact: Robinson Pino, Robinson.Pino@science.doe.gov

Neuromorphic Computing: Specific to the modeling and simulation, or emulation of neuromorphic computing architectures for generalizable applications emphasizing analog approaches and energy efficiency. Applications must address state-of-the-art and propose to investigate basic research approaches beyond the state-of-the-art. In addition, pre-applications and applications must clearly articulate a neuroscience-based justification and rationale to the proposed research approach.

Topics that are out of scope include:

- Pre-applications and applications that do not address the specific topics described above;
- Pre-applications and applications that do not explain/describe their relevance to current and future high performance computing platforms and/or research-centric science as well as their relevance to the mission of SC and ASCR;
- Pre-applications and applications with primary emphasis on materials science, devices, circuits; sensors; cross-bar arrays;
- Research primarily focused on advancing discipline-specific research or capabilities without also proposing a generalization of this research to other SC priority mission areas;
- Research primarily focused on advancing Virtual Reality and Augmented Reality technologies;
- Research focused on the world wide web and/or internet; social networks; reservoir

computing; statistical-based approaches; probabilistic approaches, authentication; firewall; cryptography; cryptanalysis; encryption; propose to change, modify and/or alter application's code; blockchain; Internet of Things (IoT);

- Research that is only applicable to hand-held, tablets, laptops, mobile phones, or desktops;
- Pre-applications and applications with a primary focus on development or deployment activities; or that suggest incremental upgrades to existing computer or network architectures, protocols, tools, or services.

***Notice:** This year, Emerging Computing Technologies will focus on Neuromorphic Computing. Applications focusing on Microelectronics and Advanced Wireless are not responsive to this FOA, but these topics may be responsive to a future FOA.*

References:

- (1) DOE Workshop report: Neuromorphic Computing – Architectures, Models, and Applications, June 2016. https://science.osti.gov/-/media/ascr/pdf/programdocuments/docs/Post-Workshop_Report_2016_Neuromorphic_Computing.pdf
- (2) DOE Workshop report: Neuromorphic Computing – From Materials Research to Systems Architecture, https://science.osti.gov/-/media/ascr/pdf/programdocuments/docs/Neuromorphic-Computing-Report_FNLBLP.pdf

Basic Energy Sciences (BES)

Program Website: <http://science.osti.gov/bes/>

BES's mission is to support fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support DOE missions in energy, environment, and national security. The portfolio supports work in the natural sciences by emphasizing fundamental research in materials sciences, chemistry, geosciences, and biosciences. BES-supported scientific facilities provide specialized instrumentation and expertise that enable scientists to carry out experiments not possible at individual laboratories.

More detailed information about BES sponsored research can be found at the BES website listed above. There you will find BES-sponsored workshop reports that address the current status and possible future directions of some important research areas. Also, PI Meetings Reports contain abstracts of BES supported research in topical areas associated with Division-sponsored technical conferences. Finally, the websites of individual BES Divisions may also be helpful.

The following web pages are listed for convenience:

1. BES Workshop Reports: <http://science.osti.gov/bes/community-resources/reports/>
2. Materials Sciences and Engineering Division PI Meetings: <http://science.osti.gov/bes/mse/principal-investigators-meetings/>
3. Chemical Sciences, Geosciences, & Biosciences Division PI Meetings: <http://science.osti.gov/bes/csgb/principal-investigators-meetings/>
4. 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 below. Many of the core research areas limit early career Applications to a subset of topics within their regular research activities. In those cases, the intention is to rotate topics on an annual basis. Overarching research priorities for BES that are relevant to multiple core research areas are described in the bulleted list below. The individual program descriptions further define research directions relevant to these priorities.

- **Clean Energy:** Research to provide understanding and scientific foundations for clean energy, including electrical and thermal energy storage; direct air capture of carbon dioxide; hydrogen production, storage, and use; solar energy conversion to electricity and fuels; and subsurface science.
- **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 Manufacturing:** 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, processes, and products for functionality and use.
- **Artificial Intelligence and Machine Learning (AI/ML):** Research to advance the approaches and use of 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.

1. Materials Chemistry

Technical Contact: Craig Henderson, Craig.Henderson@science.doe.gov (Select Craig Henderson in PAMS) and Christopher Chervin, Christopher.Chervin@science.doe.gov

This program supports scientific research on materials with a focus on the *chemical synthesis, chemical control, and chemical dynamics* of material composition and structure and a view to elucidating fundamental chemical aspects of materials' structure-property relationships and resulting functionality. The major programmatic focus is on the discovery, design and synthesis of novel, energy-relevant materials with an emphasis on understanding the *chemistry* and *chemical* control of composition, structure, and processes across the length scales of materials beyond molecular, from which the consequent materials properties and functionalities emerge. The desired outcome is fundamental knowledge of the chemistry of materials, which may be widely applied to the development of next-generation, energy-relevant materials while contributing to one or more of the four BES priority areas previously listed.

Applications **MUST** propose hypothesis-driven research leading to scientific understanding of chemical phenomena observed to play a role in the synthesis, function, or degradation of energy-relevant materials. Further, to be considered for this year's Early Career Research Program applications must propose basic research in one of these four (4) topical areas:

- **Applied Materials Theory** – New theoretical approaches incorporating data science to predict chemistry-related materials properties and functionality

- **Materials Chemistry Dynamics** – Understand the evolution and control of the composition, structure, and/or properties of materials in operating environments
- **Chemical Synthetic Methodology** – Emphasis on new chemical synthesis of energy-relevant materials necessary for experimental validation of untested theory
- **Porous Materials** – Synthesis-structure-properties of novel classes of porous solids beyond MOFs and similar framework materials

For any of these topics, applications that propose materials chemistry research aimed primarily at electrochemical energy storage technologies will not be supported this year. Applications that focus on varying parameters to identify which factors affect a material's performance or on quantifying structure-property relationships for materials as the basis for predictive design rules without impacting the understanding of why such relationships exist or should exist will not be supported. Similarly, the program will NOT support applications aimed primarily at improvement or optimization of material properties for any application.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at that laboratory.

2. Biomolecular Materials

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

This activity supports basic research in the discovery, design and synthesis of functional materials and complex structures based on principles and concepts of biology. Biology provides a blueprint for translating atomic and nanoscale phenomena into mesoscale materials that display complex yet well-coordinated collective behavior. The major programmatic direction is on the science-driven creation of resilient 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.

Biomolecular Materials research activity seeks fundamental knowledge needed for co-design and scalable synthesis of materials that coherently manage and self-regulate 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 with transformative impacts on carbon dioxide removal, advanced manufacturing, and energy transfer and storage technologies. An area of emphasis will be activities to understand and control assembly mechanisms to seamlessly integrate capabilities developed over 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.

For the Early Career Research Program, two separate topics (A and B shown below) are planned for alternate fiscal years in pursuit of these goals. Science-driven coupling of theory and experiment to achieve Topic objectives are encouraged. **For this announcement, only applications focused on Topic B will be considered.**

- **Topic A (Alternate years):** The specific focus will be on fundamental science underpinning

design and scalable creation of next-generation materials and systems that incorporate low-energy mechanisms for electrical energy, thermal energy, ion and fluid transport with programmable selectivity based on biological gating and pumping functions.

- **Topic B (This year):** The focus will be control of fundamental mechanisms for precise synthesis and assembly, including self-replication approaches, of multiscale and multicomponent materials and systems that self-regulate structure repair and rebuild functions and/or energy transfer, transport, and communication pathways.

For both of these topics, bio-centric research **will be de-emphasized**, including activities focused on understanding of underlying biological synthesis or assembly processes, or creation of bio-hybrid materials. 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, biological research, or biomedical research.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

3. Synthesis and Processing Science

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

This program supports basic scientific research on materials to understand the physical principles that underpin materials synthesis and processing including diffusion, nucleation, and phase transitions, often using *in situ* diagnostics and new techniques. An important element of this activity is the use of real-time monitoring tools that probe the dynamic environment and the progression of structure and properties as a material is formed. This information is essential to the physical understanding of the underlying mechanisms that help gain atomic level control in materials synthesis and processing. Recent BES Basic Research Needs (and other) workshops and reports, particularly the reports on [Synthesis Science](#) and [Transformative Manufacturing](#), have identified the needs and challenges in synthesis and processing science that are most relevant to clean energy technologies.

For this year's Early Career Research Program, proposed research must focus on hypothesis driven research that pursues new fundamental understanding and creative approaches that underpin the scientific foundation for synthesis science. Proposed research must address one or more of the following subtopics:

- Large scale single crystal synthesis; and/or
- Understanding the mechanistic process for transformative manufacturing

AND must also address one or more of the following:

- Computational method development for synthesis and processing science related to the proposed subtopic;
- Chemical transformation pathways for complex (multicomponent) materials; and/or
- Real-time in situ characterization development.

Applications that integrate a creative experimental methodology with a theoretical-based approach to accelerate progress in understanding unifying principles for synthesis and/or

processing of clean energy technologies are of particular interest. The focus of this activity on materials discovery and design by physical means is complementary to the BES Materials Chemistry and Biomolecular Materials research activities, which emphasize chemical and bio-inspired approaches.

The program will not support applications that involve biological materials or that are aimed at optimization of material properties for specific applications. In addition, the program will not support applications with a primary goal of engineering development, device fabrication, nanoparticle synthesis, tribology, fluid dynamics, or projects using advanced manufacturing techniques without emphasizing the potential advances in fundamental science.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

4. Experimental Condensed Matter Physics

Technical Contact: Claudia Cantoni, Claudia.Cantoni@science.doe.gov (Select Claudia Cantoni in PAMS) and Tim Mewes, Tim.Mewes@science.doe.gov

The Experimental Condensed Matter Physics (ECMP) program supports research that will advance our fundamental understanding of the relationships between intrinsic electronic structure and the properties of complex materials.

This year the Early Career FOA in ECMP will focus on quantum materials in the form of 1D and 2D nanostructures, wherein fundamental electronic, lattice, spin, and valley excitations are investigated and controlled to add functionality. Examples of material forms of interest are deposited or exfoliated monolayers, heterostructures comprising few-layer systems (bilayers or trilayers), and nanowires, nanodots, and their combination with 2D structures. Bulk materials, single crystals, and layered or van der Waals materials in the form of 3D crystals or polycrystals will NOT be considered responsive to this year's call but are anticipated to be the focus of next year's call. Of particular interest are topics related to 1) two-dimensional magnetism and frustrated magnetism; 2) flat band systems and unconventional superconductivity; and 3) quantum phononics and magnonics for quantum technologies and dissipation-less energy transfer. Applications focusing on synthesis and characterization of bulk permanent magnets with reduced critical elements will NOT be considered responsive to this year's FOA.

The ECMP Program does not support applications on electrochemistry, thermoelectric materials, or photovoltaic materials; nor does it support projects aimed at materials optimization, device development, or metrology. In addition, the ECMP Early Career Program will NOT accept applications on topics in the following areas: conventional semiconductors, heavy fermion (non-topological) superconductivity, quantum Hall physics in compound semiconductor materials, cuprate superconductivity, and cold atom physics.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

5. Theoretical Condensed Matter Physics

Technical Contacts: Matthias Graf, matthias.graf@science.doe.gov (Select Matthias Graf in PAMS) and Claudia Mewes, claudia.mewes@science.doe.gov

This program supports research in theoretical condensed matter physics developing quantum methods and techniques for quantum materials, materials discovery and design, out-of-equilibrium quantum dynamics, and materials theory related to clean energy technologies. Research spans from analytical to computational approaches, including data-driven and physics-guided AI, with a strong emphasis on theory, methods, and technique development, as well as prediction and interpretation of novel quantum phenomena.

For this year's Early Career FOA, applications are sought only in two targeted areas:

- **Critical Materials/Minerals (CMM) for functional materials:** Development of novel methods to understand and predict many electron effects and fundamental spin interactions of rare earth and platinum group elements bridging the atomic to meso-scale.
- **Quantum Materials (QM) with emergent behavior:** Development of novel methods to understand, predict, and control emergent behavior including entanglement and coherence.

For next year's FOA, the plan is to invite applications in the following two areas (applications in these two areas will NOT be considered responsive to this year's FOA): Development of novel physics-guided AI approaches for materials discovery, and theory and methods development to provide understanding and scientific foundations for clean energy relevant to solar conversion to electricity and electrical energy storage.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

6. Physical Behavior of Materials

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

This program broadly supports fundamental research on the physical behavior of materials. This year, the program invites Early Career applications focused on fundamental interactions and transport of charge, spin, and phonons in electronic and spintronic materials. The program will also consider applications for research that are relevant to the fields of Quantum Photonics. The application should heavily emphasize the impactful and fundamental science aspects of the projects and be centered on hypothesis driven basic science that is transformative. This program also supports research that involves theory, modeling, simulation and data science, especially projects that combine theoretical and experimental research. The program **does not** support projects aimed at optimization of materials properties for any applications, device fabrication, or conventional sensor development.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

7. Mechanical Behavior and Radiation Effects

Technical Contact: John Vetrano, john.vetrano@science.doe.gov

This program supports hypothesis-driven basic research to understand defects in materials and their effects on the properties of 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. Topics include fundamental studies of deformation of nanostructured materials and intelligent microstructural design for understanding mechanisms dictating strength, formability, and fracture in energy relevant materials. The goals are to develop the scientific underpinning for predictive design of materials having superior mechanical properties. These fundamental science efforts will impact Clean Energy topics in general, and may also impact Fundamental Science to Transform Manufacturing or Artificial Intelligence/Machine Learning.

For this year's Early Career FOA the emphasis is on mechanical behavior of materials, with the plan to alternate this topic with an emphasis on radiation effects annually. Within the area of mechanical behavior, applications should focus on research opportunities in one of the following two areas:

- Fundamental understanding of mechanical behavior related to the general areas of self-assembly, physical behavior, and behavior under extreme environments (temperature, stress, strain, corrosion) of structural materials.
- Fundamental understanding of novel mechanisms of deformation and failure of other materials used in energy systems (e.g., polymers, membranes, coating materials, electrodes).

Applications taking advantage of advanced synthesis methods to create tailored structures in order to better isolate mechanisms, utilizing AI/ML to uncover novel mechanisms, and those utilizing advanced characterization techniques such as neutron or x-ray scattering, are of particular interest. The topics of wear, bioinspired materials, and high-strain rate deformation **will not** be explored in this program at this time. Applications emphasizing mechanics of materials and simple structure-property correlations, rather than fundamental materials science mechanisms, **will not** be considered responsive.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

8. Quantum Information Science in Materials Sciences and Engineering (QIS-MSE)

Technical Contact: Athena Sefat, athena.sefat@science.doe.gov

This activity supports research in Materials Sciences and Engineering (MSE) to advance fundamental understanding of quantum phenomena relevant for quantum information science (QIS) 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 QIS topics as noted 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 use or development of cutting-edge techniques to measure quantum phenomena, with the goal of advancing QIS.

Applications must propose fundamental research, based on a specific QIS-inspired research topic, with a potential transformative technological impact. Early Career 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 FOA. This program will not fund applications that are solely based on engineering, manufacturing of prototypes/devices, or optimization of hardware/software.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

9. X-ray Scattering

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

This activity 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. The main emphasis is on x-ray scattering, spectroscopy, and imaging research, primarily at major BES-supported user facilities. Instrumentation development and experimental research directed at the study of ultrafast physical phenomena in materials is an integral part of the portfolio. Based on programmatic priorities, this activity **will not** support ultra-fast source development, but will focus on the application of ultra-fast probe interactions with materials and the resulting connection to materials dynamics.

Advances in x-ray scattering and ultrafast sciences will continue to be driven by scientific opportunities presented by improved source performance and optimized instrumentation. The x-ray scattering activity will continue to fully develop and extend the capabilities at the DOE facilities by providing support for novel instrumentation, techniques, and research. 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 also focus on research that uses radiation sources associated with BES facilities and beam lines. 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 (XFEL) and ultrafast electron diffraction (UED) 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 clean 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 computational devices is the in-place study of the evolution of quantum coherence and evolving transient quantum 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.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

10. Neutron Scattering

Technical Contact: Michael Fitzsimmons, michael.fitzsimmons@science.doe.gov

This activity supports research on the fundamental interactions of neutrons with matter to achieve an understanding of the atomic and magnetic structures and excitations of materials and their relationship to macroscopic properties. The program emphasis is transformative research on materials and phenomena using neutron scattering, coupled with the advancement of neutron scattering techniques primarily at the BES user facilities. A continuing theme of this program is that integration of neutron scattering measurements on high quality samples with theory and data science is vital for an in-depth understanding of the relationship between structure, dynamics, and macroscopic properties.

The focus for this year’s Early Career FOA is on fundamental research on materials that exhibit novel emergent phenomena or unique properties while out of equilibrium (or non-quiescent). Characterizing and controlling such emergent behavior are keys to optimizing and exploiting a wide range of materials’ performance and functionality. *In situ* and *operando* characterizations can measure structure and dynamics of materials in the appropriate environment and at realistic conditions, yielding data for comparison to predictions. The program will develop novel measurement techniques that exploit the unique aspects of neutron scattering for materials research. AI/ML and data science approaches could enable development of data analysis tools for better utilization of the large amount of scattering data from the BES facilities.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

11. Electron and Scanning Probe Microscopies

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

This activity supports basic research in materials sciences using microscopy and spectroscopy techniques. The research includes experiments and theory to understand the atomic, electronic, and magnetic structures and properties of materials. This activity also supports the development of new instrumentation and techniques, including ultrafast diffraction and imaging techniques, to advance basic science and materials characterizations for clean energy applications. The goal is

to develop a fundamental understanding of materials through advanced microscopy and spectroscopy.

This year's Early Career FOA invites applicants to submit hypothesis driven applications that present fundamental understanding of quantum materials and phenomena using innovative electron and scanning probe microscopy approaches. New methods and approaches could provide an array of opportunities for groundbreaking science that will accelerate discovery and technological deployment of advanced materials. These include understanding and controlling quantum systems, nano- or meso-scale inhomogeneity, and the interplay between charge, orbital, spin and lattice degrees of freedom. Research opportunities also include characterization and manipulation of individual atoms in matter at the atomic scale or controlled introduction and manipulation of complex defect systems, combined with atomic and nanometer scale measurements of quantum behavior or machine learning/artificial intelligence/data science methods in microscopy.

Based on programmatic priorities, projects aimed at technique development without science goals **will not be** considered.

For DOE national laboratory applicants, the proposed research must fit within the BES Materials Sciences and Engineering (MSE) Division funded programs at the laboratory of the applicant.

12. Atomic, Molecular, and Optical Sciences (AMOS)

Technical Contact: Tom Settersten, thomas.settersten@science.doe.gov

The DOE AMOS 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 control of quantum coherence/decoherence and entanglement in molecular systems.

The AMOS activity will continue to support science that advances DOE and BES mission priorities, including research that contributes to the BES priority on Clean Energy by developing 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 supports 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 ECRP

applications that could advance Quantum Information Science by focusing on fundamental research aimed towards understanding and control of quantum coherence/decoherence and entanglement 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 atoms and 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, diffraction and harmonic generation from aligned molecules, inner-shell photoionization of atoms and molecules, and probing and control of 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 AMOS program **is not** accepting applications in the areas of plasma physics, nanoscience, and science of ultracold systems.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

13. Gas Phase Chemical Physics (GPCP)

Technical Contact: Wade Sisk, wade.sisk@science.doe.gov

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 gas phase and/or gas/surface chemical systems in which 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 reactions included in a 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*. Research applications will be accepted from only a subset of the selected five research thrusts in response to each year's FOA, with the remaining thrusts

offered in alternate years. For this FOA, only applications focused on thrusts **1, 2** and **5** will be considered (designated as OPEN). Research applications for thrusts **3** and **4** will not be considered this year (designated as CLOSED), but considered in alternate years.

1. *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 loss of coherence and entanglement. 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 in systems that could be used for quantum information science. (OPEN)
2. *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. (OPEN)
3. *Gas-Particle Interconversions* 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. (CLOSED)
4. *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. (CLOSED)
5. *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. (OPEN)

The GPCP program **does not** support research in the following areas: non-reacting fluid dynamics and spray dynamics, reacting and non-reacting turbulent flow, data-sharing software development, end-use combustion device development, and characterization or optimization of end-use combustion devices.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

14. Computational and Theoretical Chemistry

Technical Contact: Aaron Holder, aaron.holder@science.doe.gov

Computational and Theoretical Chemistry (CTC) emphasizes sustained development and integration 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 BES mission. 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 with the research and goals of BES and provide theories and computational approaches to advance the fundamental science of at least one of the four overarching research priorities for BES in FY 2024 listed in the BES program description in Section B. (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 resonant, coherent and dissipative processes as well as rare events. Development of novel theories and simulation capabilities for the theory-guided control of externally driven electronic and spin-dependent processes in real environments is encouraged.

The CTC focus for this year's Early Career FOA is on the innovation of novel, 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-chemically informed 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, (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-electron and/or multi-photon governed chemical transformation and energy transduction processes in non-equilibrium, field-driven complex open quantum systems.

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. Methods for, or applications to, systems that do not explicitly consider rearrangements of quantum-mechanical degrees of freedom are not supported.

The CTC program has had a recent emphasis in polariton chemistry, building a position of leadership. While the program is interested in maintaining this position, during fiscal year 2024 this emphasis will be reduced.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

15. Condensed Phase and Interfacial Molecular Science (CPIMS)

Technical Contact: Gregory Fiechtner, gregory.fiechtner@science.doe.gov

The CPIMS 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 clean energy, catalytic and separation processes, energy storage, chemical synthesis and manufacturing, and microelectronics. The CPIMS program also supports efforts related to BES 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.

For fiscal year 2024, 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 a renewed emphasis on chemistry at the boundaries of condensed matter physics including interfacial chemistry of topological materials, and interfacial reactivity and charge transfer at interfaces of van der Waals materials. The CPIMS program also anticipates a growing emphasis in the molecular origins of rare chemical events, including examples such as nucleation, or instances of accelerated reaction rates in microdroplet chemistry.

The CPIMS program has had a recent emphasis in polariton chemistry, building a position of leadership. While the program is interested in maintaining this position, during fiscal year 2024 this emphasis will be reduced.

The CPIMS program does not fund research in mechanics or dynamics of bulk fluids, technological applications, nor device development.

A more extensive description of program evolution can be found at the link:

<https://science.osti.gov/bes/csgb/Research-Areas/Condensed-Phase-and-Interfacial-Molecular-Sciences>.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

16. Quantum Information Science Research in Chemical Sciences, Geosciences, and Biosciences (QIS-CSGB)

Technical Contact: Tom Settersten, thomas.settersten@science.doe.gov

This activity supports fundamental experimental and theoretical research in chemical sciences, geosciences, and biosciences (CSGB) to advance our understanding and control of quantum phenomena in natural and artificial systems that can be used for quantum information science (QIS), and the development and use of algorithms and simulations that exploit quantum hardware to advance the domain sciences supported by the CSGB Division of BES.

BES held two community Roundtables to define priority research opportunities for fundamental research relevant to QIS. The reports of these Roundtables are available here:

- [Basic Energy Sciences Roundtable: Opportunities for Basic Research for Next-Generation Quantum Systems](#)
- [Basic Energy Sciences Roundtable on Opportunities for Quantum Computing in Chemical and Materials Sciences](#)

The priority research opportunities (PROs) described in these two reports form the basis for the core QIS research supported across BES. Applicants may also find useful discussions of fundamental science at the intersection of Chemistry and QIS contained in the 2023 report published by the National Academy of Sciences entitled, “Advancing Chemistry and Quantum Information Science.”

The CSGB-QIS activity on Next Generation Quantum Systems supports basic research on the discovery and characterization of quantum phenomena in chemical and biological systems that can enable the design and discovery of novel quantum information systems. Applicable topics include synthesis of molecular assemblies for the development of quantum coherent systems; mechanistic understanding of quantum phenomena in natural and artificial systems, including creation and control of coherent phenomena for improved understanding of entanglement, enhanced coherence lifetimes, and other quantum phenomena; coherence entanglement over increasing distances and across interfaces; and transduction of quantum coherent states between disparate physical systems (light, charge, spin) with high fidelity. Applications will also be considered for fundamental research on quantum-based systems and phenomena for quantum computing and for quantum sensing and control to enable precise measurements, specifically for probing processes relevant to the CSGB Division.

The activity on Quantum Computing in CSGB supports theoretical research using quantum computation and simulation to solve scientific problems in the CSGB domain sciences, and relevant experimental research required to validate the computational data. Areas of research include understanding and controlling the quantum dynamics of non-equilibrium systems; unraveling the physics and chemistry of strongly correlated systems; developing algorithms for embedding quantum hardware in classical frameworks; and bridging the classical–quantum computing divide. Applications must focus on fundamental research that will target computations addressing scientific questions relevant to BES CSGB priorities using quantum computers that are available today or in the near term (<10 years).

Applications must address domain science that is aligned with one or more CSGB core research areas and address one or more of the Priority Research Opportunities identified in the Basic Energy Sciences Roundtable Reports referenced above. The application must clearly articulate how the proposed research aligns with the domain science in a specific core research area(s) and address a specific Roundtable PRO(s).

Applications that emphasize engineering, device optimization, or designing/building quantum computers will be deemed non-responsive and may be declined without review.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

17. Catalysis Science

Technical Contacts: Viviane Schwartz, viviane.schwartz@science.doe.gov and Chris Bradley, chris.bradley@science.doe.gov

This program supports basic research pursuing novel catalyst design and quantum- 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* comprise the central component of the program. This year's Early Career FOA requires hypothesis-driven applications in fundamental catalysis science restricted to atom and energy efficient catalytic production of fuels and chemicals from renewable or recyclable feedstocks such as biomass and used plastics and from carbon-containing greenhouse gases such as carbon oxides and methane.

Strategies that are emphasized this year to achieve the formerly mentioned feedstocks and catalytic transformations are:

- Research to investigate thermal or electro-catalysis mediated by Earth-abundant metals or mediated by catalytic sites designed with reduced precious metal loadings.
- Fundamental catalysis science underpinning sustainable chemical manufacturing, including circular processing and development of transformational operando

characterization tools and methods for examination of catalytic processes and dynamics of catalysts.

- Advanced theory, modeling, data-science and artificial intelligence/machine learning approaches to mechanism identification, catalyst discovery and development, and benchmarking of catalytic properties.

This program does not support: (1) the study of transformations appropriate for pharmaceutical synthesis; (2) studies where the primary focus is photochemistry or photophysics; (3) non-catalytic stoichiometric reactions; (4) whole cell or organismal catalysis; (5) studies primarily focused on process or reactor design and optimization; or (6) device development or optimization.

Examples of research funded in catalysis can be found in Catalysis Science Program Meeting Reports on the ‘Chemical Sciences, Geosciences, & Biosciences Division PI Meetings’ webpage (<https://science.osti.gov/bes/csgb/Principal-Investigators-Meetings>). A 2017 BESAC-sponsored workshop, [Basic Research Needs for Catalysis Science](#), outlining the current challenges and needs in this field, can also be found on the ‘Basic Research Needs Reports’ webpage as well as a 2019 BES roundtable report on [Chemical Upcycling of Polymers](#), discussing the challenges of polymer deconstruction and redesign (<https://science.osti.gov/bes/Community-Resources/Reports>).

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

18. Separation Science (SEP)

Technical Contact: Raul Miranda, raul.miranda@science.doe.gov

This program supports hypothesis-driven experimental and computational research to discover, understand, predict, and control 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 including decarbonization towards a net-zero scenario, availability of critical elements to support a clean energy infrastructure, and avoidance or mitigation of associated environmental impacts. The practical needs include, for example, efficient capture of very dilute CO₂ directly from air or from oceans; expanded supply and recycling of critical elements such as rare earths, lithium, cobalt, nickel, or platinum group metals; and separation and reprocessing of radioactive elements. Basic research in these areas relies on understanding chemical and physical properties at multiple scales, quantum through macroscopic, and molecular interactions and energy exchanges that determine the efficiency of chemical separations.

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

- elucidating factors that cause a separation system to approach mass transfer limitation in the source phase;
- 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 that is enriched in the target species, and (c) emergent phenomena that result from correlation and amplification of individual atomic or molecular effects;

- enabling and enhancing strategies for: critical materials recovery from natural and unconventional feedstocks; water and environmental management of heavy elements and nuclear waste; and carbon removal from low-concentration sources;
- understanding non-thermal mechanisms that have the potential to drive efficient and selective energy-relevant separations, such as magnetic, mechanic, electromagnetic, electrochemical, and other means to affect transport and bonding approaches;
- designing separation systems that have high selectivity, capacity, and throughput;
- understanding temporal changes in separation systems, such as degradation.

The above topics are agnostic to the separation system and 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. Development and application of AI/ML and data science to further separation science is encouraged.

This activity **does not** support engineering design or scale-up, development of narrowly defined processes or devices, established desalination approaches, microfluidics, 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* (<https://www.nap.edu/catalog/25421/a-research-agenda-for-transforming-separation-science>) and *Foundational Science for Carbon Dioxide Removal Technologies* (https://science.osti.gov/-/media/bes/pdf/brochures/2022/CDR_RT_Brochure.pdf). Applicants should also examine the [DOE Earthshots Initiative](#) for inspiration, as they contain multiple chemical separation challenges that this program will help tackle over the next decades.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

19. Heavy Element Chemistry (HEC)

Technical Contact: Philip Wilk, philip.wilk@science.doe.gov

This activity supports actinide and transactinide fundamental chemical research that underpins the DOE missions in energy, environment, and national security. 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, such as coherence and entanglement. 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. Theoretical applications are considered that integrate closely with experimental research or otherwise demonstrate impact outside the theory community. The HEC program does not fund code development.

The role of $5f$ electrons in bond formation remains the fundamental topic in actinide chemistry and is an overarching emphasis for this program. Theory and experiment show that $5f$ 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 is of current interest to this program, if the project yields insight into f -electron behavior and is not better aligned with the BES Catalysis Science program described in section (17). Exotic catalytic and redox behavior exhibited by actinides in extreme environments, such as the legacy nuclear waste tanks or molten salts, is also of particular interest to this program. Also of particular interest is the exploitation of the unique electronic properties of the f -elements for quantum information science (QIS) purposes (e.g., actinide qubits or the synthesis and investigation of strongly correlated multidimensional lattices).

The inclusion of machine learning, artificial intelligence, and quantum computing methods are particularly desirable and aligned with current BES priorities. Applications that will further our understanding and provide scientific foundations for clean energy are also desirable and aligned with BES priorities. 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 would be better aligned with the BES Separation Science (SEP) program, which is described in section (18). More information about the Heavy Element Chemistry program can be found at <https://science.osti.gov/bes/csgb/Research-Areas/Heavy-Element-Chemistry>.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

20. Geosciences (GEO)

Technical Contact: Philip Wilk, philip.wilk@science.doe.gov

The Geosciences program supports basic experimental, theoretical, and computational research in geochemistry and geophysics that have clear connections to clean energy (including

geothermal energy, hydrogen, and carbon capture and storage via mineralization) 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/isotope 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 and CO₂ mineralization and storage.

Applicants should look at the geosciences-aligned priority research directions and opportunities discussed in the [BES workshop and roundtable reports](#). The reports that contain particularly topical geosciences topics include *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). Recent examples of projects in the program have focused on (1) understanding mechanisms of enhanced carbon mineralization, (2) molecular-level reading of the rock record preserved in shales and biogenic carbonates, (3) molecular-level insights into the behavior of rare earth elements (REEs) in hydrothermal fluids and at the mineral/solution interface, (4) atomistic-level understanding of the distribution and coordination environment of REEs and platinum group elements (PGEs) in secondary host phases, and (5) multiscale aspects of the structure and dynamics of fracture systems in field and laboratory environments, particularly as revealed by novel data science techniques applied to acoustic/seismic emissions. Applicants should also look to the [DOE Earthshots Initiative](#) for inspiration, as they contain many Geosciences-aligned challenges that the Geosciences program will help address during the next decade.

The inclusion of machine learning, artificial intelligence, and quantum computing methods are particularly desirable and aligned with current BES priorities. While it is necessary that the work have a well-defined connection to clean energy/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 solar energy conversion to electricity and fuels; and fundamental properties and occurrences of critical elements to enhance understanding/prediction of resource distributions and/or improve separation and extraction processes from naturally occurring host phases. Applicants must make a strong case for (i) the relevance of the work to clean energy or critical materials/minerals and (ii) the fundamental mechanistic nature of the work (i.e., why the work belongs in Basic Energy Sciences). Preapplications that do not make a strong case for both will be discouraged. Modeling-focused applications that do not clearly indicate direct engagement with novel and compelling data sets will also be discouraged.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

21. Solar Photochemistry

Technical Contacts: Chris Fecko, Christopher.Fecko@science.doe.gov (Select Chris Fecko in PAMS) and Jennifer Roizen, Jennifer.Roizen@science.doe.gov

This activity 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 coherence in artificial 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 H₂O, CO₂, or N₂. 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 CO₂ and/or N₂ 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.

Another regime of chemistry initiated through creation of high-energy excited states is highly 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.

Among many topics, fundamental research is of interest in areas that have a long-term impact upon the understanding of radiolytic degradation of nuclear tank waste, the reactivity of solid surfaces in reactor coolant systems, and the chemistry of reagents used in separations processes in nuclear cycles.

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

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

22. Photosynthetic Systems

Technical Contact: Stephen Herbert, stephen.herbert@science.doe.gov

This activity 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, chemical reduction of carbon dioxide to organic compounds, and the self-assembly and self-repair of photosynthetic proteins, complexes, and membranes. The goal of the program is to foster greater knowledge of the useful chemistry exhibited by the diverse photosynthetic systems found in nature. Examples include capture of CO₂ by carboxylase enzymes and bicarbonate transport systems, light-driven production of H₂ by hydrogenase enzymes, prolonged coherence at room temperature exhibited by energy transfers in photosystems, oxidation of water to provide electrons for synthesis of energy-rich carbon compounds, and the protein-protein interactions that drive self-assembly and self-repair of the complex molecular components of photosynthesis.

All submitted applications must clearly state the relevance of the proposed basic research for clean energy research. Photosynthetic Systems does not fund: 1) development or optimization of 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 or other “omic” data acquisition that does not test specific hypotheses relevant to the program; and 5) projects that are primarily computational in nature.

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

23. Physical Biosciences

Technical Contact: Katherine Brown, Katherine.Brown@science.doe.gov

This activity supports basic research that combines physical science techniques with biochemical, biophysical, chemical, and molecular biological approaches to discover the underlying physical and chemical principles that govern how plants and non-medical microbes capture, convert, and store energy. Fundamental research supported by the program includes studies that will provide a better understanding of the structure/function, mechanistic and electrochemical properties of enzymes that catalyze complex multielectron redox reactions (especially those involved in the interconversion of CO₂/CH₄, N₂/NH₃, and H⁺/H₂), determine how the complex metallocofactors at the active sites of these enzymes are synthesized, and understand how the potential of these cofactors can be “tuned” using ligand coordination to reduce overpotential and better enable catalysis using earth-abundant metals. The program also funds mechanistic studies on electron bifurcation and catalytic bias in enzyme systems and identifies the factors that direct and regulate the flow of electrons through energy-relevant metabolic pathways on larger spatial and temporal scales.

The fundamental research supported by this program can provide foundational knowledge for clean energy and critical materials. For example, a mechanistic understanding of the processes and unique structure-function relationships in biological systems can guide design of highly

selective and efficient bioinspired catalysts and chemical pathways from earth abundant materials for direct air capture of carbon dioxide, hydrogen production and use, and solar energy conversion into fuels.

Physical Biosciences **does not** fund research in: 1) animal systems; 2) prokaryotic systems related to human/animal health or disease; 3) development and/or optimization of devices and/or processes; 4) development and/or optimization of microbial strains or plant varieties for biofuel/biomass production; 5) cell wall breakdown or deconstruction; 6) transcriptional or translational regulatory mechanisms and/or processes; and 7) environmental remediation and/or identification of environmental hazards. Projects should ideally be hypothesis-driven; projects that develop or rely primarily on high-throughput screening approaches **will not** be supported nor will projects that are primarily computational in nature.

All submitted applications must clearly state the energy relevance of the proposed research: How will the knowledge gained from the proposed project better our understanding of the structure, function, and/or mechanistic aspects of energy-relevant biological redox reactions at the molecular level?

For DOE national laboratory applicants, the proposed research must fit within the BES Chemical Sciences, Geosciences, and Biosciences (CSGB) Division funded programs at the laboratory of the applicant.

24. Accelerator and Detector Research

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

This program supports work that advances the instruments, techniques, and capabilities of the existing and/or future BES Scientific User Facilities (SUFs). This program will not support applications to establish new, unrelated types of facilities or to develop techniques that do not relate to the missions of the BES light source and neutron scattering user facilities.

For high-repetition rate x-ray FELs, emphasis is on research for production of photon beams with increased average flux and brightness: terawatt power radiation, source-generated THz beams, and “beam on demand” techniques for multiple, simultaneous beamlines. Also sought are developments in superconducting undulator technologies to produce better and brighter x-ray beams, and developments to eliminate or to reduce the use of liquid helium.

Future detectors require higher computational capabilities per pixel, improved readout rates, radiation hardness, and better energy and temporal resolutions. Additionally, research is required to produce ultrafast beam instrumentation capable of measuring accurately femto- and atto-second bunch lengths. Higher neutron-flux capabilities at the Spallation Neutron Source will demand high-intensity H^- currents, requiring tight control of beam losses, and detectors designed for advanced neutron imaging with very high throughput. Artificial intelligence and machine-learning algorithms and methods are needed to efficiently search large, complex parameter spaces in real time and to predict the health and failure of instruments. Such capabilities will dramatically reduce facility tuning time and downtime, improve facility performance, and maximize their productivity.

References: Accelerator physics needs for light sources: *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Volume 618, Issues 1-3*. Opportunities for future neutron and photon detector development: [BES Workshop on Neutron and X-ray Detectors](#) report. AI/ML for User facilities: [Basic Energy Sciences Roundtable on Producing and Managing Large Scientific Data with Artificial Intelligence and Machine Learning](#) report.

For DOE national laboratory applicants, the proposed research must fit within the BES Scientific User Facilities (SUF) Division funded programs at the laboratory of the applicant.

25. Instrumentation and Technique Development for BES User Facilities

Technical Contact: Dava Keavney, Dava.Keavney@science.doe.gov (select Dava Keavney in PAMS) and Misha Zhernenkov, mikhail.zhernenkov@science.doe.gov

The program is open to national laboratory applications only. University PIs interested in x-ray, neutron, or nanoscale instrumentation technique development should consider the topics discussed above under (9) X-ray Scattering, (10) Neutron Scattering, or (11) Electron and Scanning Probe Microscopy.

This program supports work that advances the instruments, techniques, and capabilities of the existing and/or contributes to capabilities of future BES-supported light source, neutron, and nanoscale science research facilities. This program **will not** support applications to establish new, unrelated types of facilities or to develop techniques not applicable to BES user facilities. In addition, the program **will not** support research considered “mature use” of existing instruments. Also, applications focused primarily on development of neutron polarization techniques will be discouraged.

In order to fully exploit the wide range of advanced capabilities at the BES user facilities, this program emphasizes the development of novel concepts for new types of x-ray, neutron, and nanoscale science characterization and synthesis instrumentation and technique development for existing instruments. Priorities include development of novel techniques for innovative discovery and use-inspired research that underpins energy technologies, transformational manufacturing processes, microelectronics, quantum materials, and biopreparedness. Also of interest are artificial intelligence and machine learning (AI/ML) and data science that can guide, augment, and accelerate materials/molecular discovery as well as enable automated experimental and analytical approaches to collect and interpret large data sets, design experiments, and accelerate the realization of the full potential of current and next-generation user facilities.

The proposed research must fit within the BES Scientific User Facilities Division funded programs at the laboratory of the applicant.

Biological and Environmental Research (BER)

Program Website: <https://science.osti.gov/ber>

BER's mission is to support transformative science and scientific user facilities to achieve a predictive understanding of complex biological, earth, and environmental systems for energy and infrastructure security and resilience.

BIOLOGICAL SYSTEMS SCIENCE

The Biological Systems Science Division (BSSD) within BER supports fundamental systems biology research to understand, predict, manipulate, and design biological processes that underpin innovations for bioenergy and bioproduct research, and to enhance our understanding of natural environmental processes relevant to DOE. The Division's goals include integrative, basic research to elucidate fundamental principles that advance our understanding of regulatory, metabolic, and signaling networks among microbes or in microbe-plant interactions, the cycling and long-term storage of soil carbon, and the biogeochemical conversion of other elements, including nutrients, particularly as they relate to rapidly changing environmental conditions.

BER is seeking Biological Systems Science research only in the following area:

1. Systems Biology Enabled Microbiome Research to Facilitate Predictions of Interactions and Behavior in the Environment

Technical Contact: Pablo Rabinowicz, pablo.rabinowicz@science.doe.gov

Applications are requested for holistic, systems biology and 'omics-driven basic research on the contribution of microbial communities to biogeochemical cycling in terrestrial soil environments. Applications should focus on innovative approaches to understand regulatory, metabolic, and/or signaling networks of environmental microbes and microbiomes to enhance our ability to understand microbial interactions dynamically and predictively, from the molecular to the ecosystem scale. Research that iterates between laboratory and natural ecosystems to move beyond the characterization of microbial and genetic diversity, and facilitates realistic recapitulations of microbiome function in their natural habitat is encouraged. Leveraging high-throughput cultivation and reconstruction of microbial communities to reconcile observed environmental community behavior are also welcome. Of particular interest are projects that will provide insights into microbial processes that enhance the long-term storage of carbon in soils, thereby leading to net carbon removal from the atmosphere. Proposed research should include a strong computational foundation and advance our understanding of the way microbial interactions, metabolic handoffs, and physiological dependencies lead to microbial function, behavior, and evolution in the environment. Aims of proposed studies may include but are not limited to *i*) understand the rate and magnitude of the role of microbes in biogeochemical cycles (*e.g.*, carbon, nitrogen, phosphorus, sulfur, and other relevant elements) to develop fundamental ecological principles that allow scaling and modeling of processes beyond the molecular realm; *ii*) provide insight into the mechanisms of microbial interactions with other microbes and with plants, signaling, resource sharing, and communication at the molecular, cellular, and community scales; *iii*) develop frameworks and technologies to manipulate environmental microbiomes to understand and predict their behavior; *iv*) develop novel environmental high-throughput and/or omics-based techniques (*e.g.*, community-scale -omics, isotope tracing, visualization and quantification of activities, etc.) for the interrogation of microbial communities involved in BER-relevant processes.

BER encourages the submission of innovative “high-risk/high-reward” research applications that address critical knowledge gaps and have the potential for high impact. The probability of success and the risk/reward balance will be considered when making funding decisions.

The following topics are NOT within the scope of the BSSD research area: model organisms or communities that are of limited relevance to understand large-scale biogeochemical cycles; marine, estuarine, sediment, or coastal wetland environments; ice, glaciers, or snow microbiomes; agroecosystems other than bioenergy crops; urban environments; bioremediation; macro-eukaryotes (insects, worms, etc.) unless their study is a minor component of the application.

Applications for research that would result in incremental technological or scientific advances are not encouraged. Applications that are solely focused on technology development are not encouraged. Applications primarily focused on metagenomic sequencing are not encouraged and should instead be directed to the DOE Joint Genome Institute’s (JGI) Community Sequencing Program (<https://jgi.doe.gov/user-programs/program-info/csp-overview/>).

DOE User Facilities and other specialized resources: Applicants are encouraged to consider the use of resources provided by DOE Scientific User Facilities and Community Resources. These include the DOE Systems Biology Knowledgebase (KBase; <https://www.kbase.us>), the National Microbiome Data Collaborative (NMDC; <https://microbiomedata.org/>), the DOE Environmental Molecular Sciences Laboratory (EMSL; <https://www.emsl.pnnl.gov/emslweb/>), the National Energy Research Scientific Computing Center (NERSC; <https://www.nersc.gov>), the BER Structural Biology and Imaging Resources (<https://berstructuralbiportal.org>), and the DOE Joint Genome Institute (JGI; <https://jgi.doe.gov>). **Awarded projects will receive prioritized consideration for use of JGI capabilities through the Biological and Environmental Research Support Science (BERSS) user program** (<https://jgi.doe.gov/user-programs/other-programs/>). **To determine the feasibility of the planned work to be done by JGI, applicants should contact JGI before submitting their application.**

Annual Principal Investigator (PI) meeting: if an award is made, at least one project participant will be expected to attend an annual investigator meeting each year of funding. Reasonable travel expenses may be included as part of the project budget.

EARTH AND ENVIRONMENTAL SYSTEMS SCIENCES

The [Earth and Environmental Systems Sciences \(EESS\) subprogram](#) supports fundamental science and research capabilities that enable major scientific developments in earth system-relevant atmospheric and ecosystem process and modeling research in support of DOE’s mission goals for transformative science for energy and national security. There are five grand challenges that frame the subprogram and investments: (a) advancing the understanding of the integrated water cycle by studying relevant processes involving the atmospheric, terrestrial, oceanic, and human system components and their interactions and feedbacks across local, regional, and global scales, thereby improving the predictability of the water cycle and reducing associated uncertainties in response to short- and long-term perturbations; (b) advancing a robust, predictive

understanding of coupled biogeochemical processes and cycles across spatial and temporal scales by investigating natural and anthropogenic interactions and feedbacks and their associated uncertainties within Earth and environmental systems; (c) understanding and quantifying the drivers, interactions, and feedbacks both among the high-latitude components and between the high latitudes and the global system to reduce uncertainties and improve predictive understanding of high-latitude systems and their global impacts; (d) advancing next-generation understanding of Earth system drivers and their effects on the integrated Earth-energy-human system; and (e) developing a broad range of interconnected infrastructure capabilities and tools that support the integration and management of models, experiments, and observations across a hierarchy of scales and complexity to address EESS scientific grand challenges.

BER is seeking Earth and Environmental Systems Sciences research in the following area:

1. Southeast U.S. Atmospheric Processes through use of Observations from the Third Atmospheric Radiation Measurement (ARM) Mobile Facility (AMF3) Bankhead National Forest (BNF) Atmospheric Observatory

Technical Contact: Shaima Nasiri, Shaima.Nasiri@science.doe.gov

Atmospheric research within BER is focused on improving understanding of the key cloud, aerosol, precipitation, and radiation processes that affect the Earth's radiative balance and hydrological cycle, especially processes that limit the predictive ability of regional and global models (<https://asr.science.energy.gov/>). Applications are sought that will improve fundamental understanding of cloud, aerosol, land-atmosphere interactions, precipitation, and radiative transfer processes in the Southeast U.S. through analysis of BER observational data from the ARM User Facility's (<https://www.arm.gov>) new Bankhead National Forest (BNF) observatory in Northern Alabama.

An [ARM mobile facility workshop](#) in August 2018 identified the Southeast U.S. as a priority region of interest for further study by ARM. The Southeast is a region with abundant atmospheric convection, yet the land surface, boundary layer, vegetation, and aerosol properties are markedly different from those seen at ARM's fixed observatory in Oklahoma, allowing opportunities to explore new research questions. The approximately five-year deployment of the AMF3 to Bankhead National Forest will provide observations to improve process understanding and model representations of aerosol, cloud, and land-atmosphere interactions, together with key cross-coupling of those areas to quantify land-atmosphere feedbacks and aerosol-cloud interactions.

The AMF3 deployment to the Southeast U.S. will be developed in phases. Phase 1, which consists of the core instruments at the AMF3 central facility, is expected to be operational by the end of 2023. Phase 2 is expected to consist of additional advanced instrumentation and supplemental measurement sites. Further information on ARM's BNF observatory, including planned timelines and instrumentation, is available at <https://arm.gov/capabilities/observatories/bnf>.

Applications must focus on one or more of the following atmospheric processes in the Southeast U.S.:

- i. **Aerosol processes** such as the formation and growth of new atmospheric particles; effects of aerosol composition, mixing state, and physical properties on growth, aging, and removal processes; processes and characteristics that influence the cloud nucleating properties of aerosol particles (including secondary organic aerosols); and processes and properties that drive aerosol direct and indirect radiative effects.
- ii. **Aerosol-cloud interactions** such as the influence of aerosol particles on cloud microphysics, dynamics, thermodynamics, radiative properties, macrophysics, and/or precipitation; the influence of clouds or precipitation on aerosol chemical properties and microphysical properties through aqueous-phase chemistry, vertical transport, and/or wet removal; aerosol-cloud-radiation interactions, and the influence of the land surface/biosphere on aerosol-cloud interactions.
- iii. **Convective processes** such as interactions between dynamics and cloud microphysics (such as condensate, precipitation, and/or aerosols); impacts of vertical transport within convective systems; initiation and organization of convective systems; precipitation formation and intensity; the transition from shallow to deep convection; and how soil moisture, surface fluxes, and aerosol properties are altered by convective precipitation events.
- iv. **Warm boundary-layer atmospheric processes** such as the effects on warm boundary-layer clouds of surface energy budget, land-atmosphere interactions, boundary layer structure, and entrainment; warm boundary-layer cloud microphysical, precipitation, and radiative transfer processes; and boundary-layer processes and land-atmosphere interactions that influence boundary layer structure, atmospheric composition, and vertical transport of energy and moisture.

Observations from the ARM BNF observatory must be integral to the proposed research. Applications must include discussion of error sources in observational data and how these uncertainties may impact the proposed analyses. Applicants may propose the use of process, regional, or global models, but must directly tie any modeling work to the observational analysis and to the improved understanding of specific Southeast U.S. atmospheric processes.

Principal Investigator (PI) Laboratory Data and Instrument Development

Complementary laboratory data may be used or proposed to augment ARM BNF observations in response to any of the Southeast U.S. processes listed above. However, PI laboratory data alone is not sufficient to meet the requirements for use of ARM BNF observations in response to this FOA.

Applicants may also include instrument development as part of their proposed research project. Any proposed instrument development must be clearly justified and tied to the overall science goals of the project. Applicants must include a clear timeline for deployment of the planned instrument in the laboratory or field by the end of the third year of the project, so that results from the new instrumentation can contribute to the research project.

PI Field Activities

Complementary small-scale field activities, including deployment of PI-owned instruments, in

the Southeast U.S. region may be included as part of the proposed work but must directly tie to planned use of ARM BNF observations. Any field activities proposed to be conducted at ARM sites are considered ARM field campaigns and require a separate application to the ARM facility (<https://www.arm.gov/research/campaigns>) that should be submitted to ARM by this FOA's deadline. As the ARM BNF observatory central facility and tower sites are operated under a U.S. Forest Service (USFS) special use permit, additional approvals may be required for field activities at these locations. Applicants planning to propose field activities, including guest instrument deployments, as part of this FOA are encouraged to contact ARM as soon as possible to understand the guidance and timelines for field activities at the BNF observatory. Further information is available at <https://arm.gov/publications/programdocs/doe-sc-arm-14-032.pdf#page=27>.

ARM tethered balloon system (TBS) missions are solicited under a separate annual call for applications (<https://www.arm.gov/guidance/campaign-guidelines/tbs>) and may not be approved by ARM by the time funding decisions are made for this FOA. Any applicant proposing analysis of ARM-supported TBS activities as part of their research activities under this FOA should include clear contingency plans.

Data and Data Management

Data generated in the course of the proposed research includes both new data collected in the laboratory or field, data generated from the analysis of previously collected data or the application of new algorithms, and model simulations. The ARM Data Center is the preferred data archive for research responding to this FOA topic. Applicants are encouraged to propose submission of their data to the ARM Data Center (<https://www.arm.gov/policies/datapolicies/data-product-registration-and-submission>) as part of their data management plan (DMP).

Applicants proposing field campaign activities or laboratory studies must include a plan for submitting their field campaign or laboratory data to the ARM data center as a PI data product as part of their DMP.

Applicants may use data from other sources that complement the ARM BNF observations, such as from other ARM observatories and/or campaigns, other observational sites or campaigns in the Southeast U.S., and/or satellite observations, but must clearly illustrate how the ARM BNF data are integral to the proposed work.

Restrictions

The program will not consider applications that: fail to demonstrate that ARM BNF observations are integral to the proposed research; focus primarily on model development without new process understanding; use ARM BNF observations only to drive, initialize, or validate a model simulation without any process analysis of the observations themselves; or focus primarily on air quality, health effects, satellite validation, or satellite algorithm development.

Pre-applications

Pre-applications for this topic must:

- identify the Southeast U.S. atmospheric process(es) from the list above to be investigated and state how the proposed work to improve process understanding is relevant to improving the predictive ability of regional and global models;
- identify the ARM BNF observational data to be used and make clear how the ARM observations are integral to the proposed research;
- outline any plans for development of new instrumentation;
- outline any plans for deployment of instruments for field activities and make clear how they tie in to existing or planned ARM BNF observations; and
- include enough information to enable evaluation of responsiveness to the terms of this announcement.

Annual Principal Investigator (PI) meeting: If an award is made, at least one project participant will be expected to attend the annual Joint ARM/ASR User Facility and Principal Investigator meeting for each year of funding. Reasonable travel expenses may be included as part of the project budget.

Fusion Energy Sciences (FES)

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

FES's mission 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.

Once developed, fusion will provide a clean energy source well-suited for on-demand, dispatchable electricity production, supplementing intermittent renewables and fission. Energy from fusion will be carbon-free, inherently safe, with a virtually limitless fuel supply, and without the production of long-lived radioactive waste.

To achieve its mission, 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, future blanket concepts and tritium fuel cycle, and innovation in measurement techniques. In addition, FES supports partnerships with the private fusion sector to enable commercially relevant Fusion Pilot Plant (FPP) designs.

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

Finally, FES invests in transformational technologies such as artificial intelligence and machine learning (AI/ML), fundamental science to transform advanced manufacturing, and quantum information science (QIS), that have the potential to accelerate progress in several mission areas.

References

FES research is guided by the 2021 Long-Range Plan “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](https://science.osti.gov/-/media/fes/fesac/pdf/2020/202012/FESAC_Report_2020_Powering_the_Future.pdf)

Additional resources include:

- a. A series of community engagement workshops (<https://science.osti.gov/fes/Community-Resources/Workshop-Reports>).
- b. National Academies reports such as:
 - i. the 2018 report on a [Strategic Plan for U.S. Burning Plasma Research](#)
 - ii. the 2018 report on [Opportunities in Intense Ultrafast Lasers](#)
 - iii. the [2020 Decadal Assessment of Plasma Science](#) report; and
 - iv. the 2021 report on “Bringing Fusion to the U.S. Grid,” <https://www.nap.edu/catalog/25991/bringing-fusion-to-the-us-grid>

The Fusion Energy Sciences program supports research on the specific topics below:

1. Advanced and Long Pulse Tokamak Research

Technical Contact: Matthew Lanctot, Matthew.lanctot@science.doe.gov

The Advanced Tokamak (AT) and Long Pulse Tokamak program areas address gaps in the physics basis for the conventional tokamak approach to magnetic confinement fusion. The AT program develops methods that simultaneously obtain high plasma pressure, stationary plasma profiles, high plasma confinement, and adequate particle and power handling. The program includes domestic and international research including activities on the DIII-D SC user facility at General Atomics in San Diego, CA, small-scale advanced tokamak research conducted on university-scale tokamak devices, and R&D on international facilities with long pulse capabilities (e.g., KSTAR, EAST, JT-60SA, and WEST) that are not available in the U.S. domestic program. Applicants interested in activities on any other relevant facilities should engage with the technical contact before submitting an application.

The program supports a broad range of topics in fusion energy science and technology R&D as described in the 2021 Long-Range Plan “Powering the Future: Fusion and Plasmas” and the 2021 report on “Bringing Fusion to the U.S. Grid,” especially solving key issues in the areas of sustaining a burning plasma at high levels of fusion triple product, core-edge integration of a high fusion performance core with sustainable heat and particle exhaust solutions, actuator technology, and innovative divertor design and operation strategies.

Applications to this area must focus on experimental research and/or model validation pertaining to advanced tokamak plasmas.

2. Spherical Tokamak Research

Technical Contact: Josh King, josh.king@science.doe.gov

The Spherical Tokamak Research program seeks to utilize spherical tokamak research facilities with low aspect ratios to develop the physics knowledge needed to advance the FES energy mission. An improved understanding of the spherical tokamak magnetic confinement configuration is needed to establish the physics basis for next-step tokamak facilities, broaden the scientific understanding of plasma confinement for ITER, and maintain U.S. world leadership in spherical tokamak research capabilities. 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. The program includes both domestic and international facilities (i.e., National Spherical Torus Experiment Upgrade (NSTX-U) Mega Ampere Spherical Tokamak (MAST-U), ST40, Pegasus-III, and Kyushu University Experiment with Steady-State Spherical Tokamak (QUEST)). The largest domestic facility (i.e., NSTX-U) is currently down for an extended outage, so applications involving this facility will not be accepted. Research applications should be relevant to the Fusion Energy Sciences Long-Range Plan, the NASEM “Bringing Fusion to the U.S. Grid” report, and the Bold Decadal Vision.

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 to this area must focus on experimental research and/or model validation pertaining to spherical tokamak plasmas.

3. Stellarator Research in Magnetic Fusion Energy Sciences

Technical Contact: Samuel Barish, sam.barish@science.doe.gov

This program supports stellarator research on small-, medium-, and large-scale facilities, thereby enhancing the understanding of magnetically-confined plasmas. The stellarator offers attractive solutions to critical challenges to achieve fusion energy by providing a steady-state, disruption-free fusion reactor concept with minimal power requirements for plasma sustainment. Key issues include, but are not limited to, understanding and (if possible) reducing the level of turbulent transport, and improving the understanding of 3-D shaping in an integrated manner in plasmas with higher levels of performance.

Also of interest is stellarator research aimed at resolving magnetic-confinement fusion plasma science issues that will be faced in the next generation of machines, including ITER, and addressing new and unique scientific regimes that can be achieved with long-pulse superconducting international stellarators.

4. Magnetic Fusion Energy Science Theory and Simulation

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

The Magnetic Fusion Theory and Simulation program focuses on advancing the scientific understanding of the fundamental physical processes governing the behavior of magnetically

confined plasmas and contributes to the FES goal of developing the predictive capability needed for a sustainable fusion energy source. 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 and other transient or off-normal events;
- 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; and,
- The effect of multiscale and multi-physics processes at the plasma boundary, including the pedestal and scrape-off layer regions, on the plasma performance and on the interaction and interface of the hot plasma boundary with the material walls.

The efforts supported by this program provide the foundations for integrated whole-device modeling simulations 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 next-generation high performance computers. Applications focused on transformative approaches, such as fusion-relevant computing aspects of quantum information science (QIS), are also encouraged.

5. Measurement Innovation

Technical Contact: Curt Bolton, curt.bolton@science.doe.gov

This program element supports the development of innovative diagnostics to make detailed measurements of the behavior of plasmas. Advances are sought in diagnostic systems to achieve higher resolution or higher reliability, reduce complexity, and improve the ability to function in a burning plasma environment or provide access to previously unmeasured parameters. The proposed measurement innovations should seek to enable breakthroughs in scientific understanding, the linking of theory/computation with experiments, or active control of plasma properties to optimize device operation and plasma performance in a variety of device configurations.

6. High-Energy-Density Plasma Science / Inertial Fusion Energy

Technical Contact: Kramer Akli, kramer.akli@science.doe.gov

High-energy-density laboratory plasmas (HEDLP) physics is the study of ionized matter at extremely high density and temperature, specifically when matter is heated and compressed to a point that the stored energy in the matter reaches approximately 100 billion Joules per cubic meter. This corresponds to a pressure of approximately 1 million atmospheres or 1Mbar. Discovery-driven scientific explorations of HED states of matter are being supported in this

program. Topical examples being emphasized include (1) high-energy-density hydrodynamics, (2) nonlinear optics of plasmas and laser-plasma interactions, (3) relativistic HED plasmas and intense beam physics. Applications in inertial fusion energy sciences that address the priority research opportunities from the recent IFE Basic Research Needs Workshop are strongly encouraged. Applications that incorporate both experiments and simulations are encouraged.

<https://science.osti.gov/-/media/fes/pdf/workshop-reports/2023/IFE-Basic-Research-Needs-Final-Report.pdf>

7. General Plasma Science Experiment and Theory

Technical Contact: Nirmol Podder, nirmol.podder@science.doe.gov

The General Plasma Science (GPS) program is focused on research at the frontiers of basic and low temperature plasma science. Focus areas include: (1) dynamical processes in laboratory, magnetospheric, solar, and astrophysical plasma, such as magnetic reconnection, particle energization, plasma dynamo, shocks, turbulence cascade, coronal heating, energetic particles, structures, waves, flows and their interactions; (2) behavior of dusty plasma, non-neutral, single-component matter or anti-matter plasma, and ultra-cold neutral plasma; and (3) plasma chemistry and processes in low temperature plasma, interfacial plasma, microplasma, synthesis of nanomaterials, and interaction of plasma with surfaces, materials or biomaterials.

8. Fusion Nuclear Science, Materials Research, and Enabling R&D Programs for Fusion

Technical Contact for Materials Research, Fusion Nuclear Science, and Enabling R&D

Technical Contact: Guinevere Shaw, guinevere.shaw@science.doe.gov

Fusion science and technology has reached a level of maturity that calls for research to broaden from the plasma core of a fusion reactor toward an integrated fusion energy system. A Fusion Pilot Plant is one such system, and is expected to produce heat, particle, and neutron fluxes that significantly exceed those in present confinement facilities, requiring new approaches and materials to be developed and engineered for the anticipated extreme reactor conditions. Interlinked with this requirement are the key systems required to harness fusion power, breed fuel, and ensure the safe operation of a reactor. This research topic focuses on foundational fusion materials and technology research opportunities to enable a Fusion Pilot Plant. This includes a focus on both experimental and theory/modeling efforts (including machine learning and artificial intelligence) that support advancing technology readiness levels in the specific topical areas below:

- Development of plasma-facing materials and components
- Development of advanced structural and functional materials (including diagnostic materials)
- Advanced and additive manufacturing approaches relevant to fusion needs
- Advancing the development of components and subcomponents required to power, fuel, and cool a FPP and maintain an efficient balance of plant
- Advancing capabilities in fusion accident scenarios, material activation, and waste management

For more information, please refer to the 2021 FESAC Long-Range Plan and the following community reports: the 2012 Fusion Energy Sciences Advisory Committee (FESAC) report titled Opportunities for Fusion Materials Science and Technology Research Now and During the ITER Era (<https://science.osti.gov/-/media/fes/pdf/workshop-reports/20120309/FESAC-Materials-Science-final-report.pdf>), the 2015 workshop Report on Science Challenges and Research Opportunities in Plasma Materials Interactions https://science.osti.gov/-/media/fes/pdf/workshop-reports/2016/PMI_fullreport_21Aug2015.pdf), and most recently, the 2018 FESAC report on Transformative Enabling Capabilities for Efficient Advance Towards Fusion Energy (https://science.osti.gov/-/media/fes/fesac/pdf/2018/TEC_Report_15Feb2018.pdf).

9. Artificial Intelligence and Machine Learning for Fusion Energy Sciences

Technical Contact: Michael Halfmoon, Michael.halfmoon@science.doe.gov

The objective of the FES Artificial Intelligence and Machine Learning (AI/ML) activity is to support research on the development and application of AI/ML techniques that can have a transformative impact on FES mission areas. Among the areas supported are prediction of key plasma phenomena and plant states; plasma optimization and active plasma control augmented by AI/ML; plasma diagnostics enhanced by AI/ML methods; extraction of models from experimental and simulation data; and extreme data algorithms able to handle the amount and rate of data generated by fusion simulations and experiments at both existing and planned fusion user facilities. Supported activities span the full range of other FES program areas. Applications submitted to this topic should seek to advance not only a specific FES area through the application of existing AI/ML techniques but should also further develop AI/ML techniques so they are adequate for fusion energy applications. Activities include the development of fusion data resources and frameworks.

High Energy Physics (HEP)

Program Website: <https://science.osti.gov/hep/>

The mission of the HEP program is to understand how the universe works at its most fundamental level, which is done 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 Particle Physics Project Prioritization Plan (P5), available at: https://science.osti.gov/~media/hep/hepap/pdf/May-2014/FINAL_P5_Report_Interactive_060214.pdf.

The HEP program focuses on three (3) experimental scientific frontiers:

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; and

The Cosmic Frontier - where non-accelerator-based experiments use measurements of naturally occurring cosmic particles and observations of the universe 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.

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

Theoretical High Energy Physics, where the vision and mathematical framework for understanding and extending the knowledge of particles, forces, space-time, and the universe are developed;

Accelerator Science and Technology Research and Development, where the technologies and basic science needed to design, build, and operate the accelerator facilities essential for making new discoveries are developed; and

Detector Research and Development, where the basic science and technologies needed to design and build the High Energy Physics detectors essential for making new discoveries are developed. The three frontiers and the three crosscutting research areas are collectively the six core research subprograms supported by HEP. All applications should address specific research goals in one or more of the six research subprograms (as in the examples given below), explain how the proposed research or technology development supports the broad scientific objectives and mission of the HEP program, and aligns with its priorities. Applications where the investigator is proposing to conduct research across multiple HEP research subprograms during the project period will be considered, but PIs should note that in initial merit review of the applications, all applications are assigned to groups in one (and only one) subprogram area. In addition, applications that use modern data science approaches (e.g., artificial intelligence, machine learning, graph theory, uncertainty quantification, etc.) to accelerate scientific discovery of any of the HEP subprograms would be considered to be within the scope of that subprogram.

Additional information about the HEP research subprogram areas described above, and in areas one through six given below, may be found at <https://science.osti.gov/hep/research/>. Each of the research frontiers is described with a list of currently-supported experiments and facilities. PIs are encouraged to discuss their particular research interests, and how they relate to HEP's subprograms, with one of the technical contacts listed below.

Applications submitted to this FOA for support of *generic* (i.e., broadly applicable) HEP detector R&D efforts should be directed to the Detector Research and Development subprogram research area described below. However, applicants proposing physics studies and/or R&D efforts directed towards a *specific experiment* within an experimental frontier should submit their application to the relevant HEP scientific frontier subprogram research area.

HEP Research Subprogram Areas:

1. Experimental Research at the Energy Frontier in High Energy Physics

Technical Contact: Abid Patwa, Abid.Patwa@science.doe.gov

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 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, design, and pre-conceptual R&D directed towards specific future Energy Frontier collider experiments are also accepted. Support for heavy-ion physics research is not provided under this research area.

2. Experimental Research at the Intensity Frontier in High Energy Physics

Technical Contact: Brian Beckford, brian.beckford@science.doe.gov

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.

3. Experimental Research at the Cosmic Frontier in High Energy Physics

Technical Contact: Kathy Turner, kathy.turner@science.doe.gov;
Bryan Field (Cosmology and Dark Energy), bryan.field@science.doe.gov

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.

4. Theoretical Research in High Energy Physics

Technical Contact: William Kilgore, William.Kilgore@science.doe.gov

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; and the development of analytical and numerical techniques, including Quantum Information Science, 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.

5. Accelerator Science and Technology Research & Development in High Energy Physics

Technical Contact: Derun Li, derun.li@science.doe.gov

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 particle beams and long-range, early-stage exploratory research aimed at developing new concepts. This research area also provides graduate and postdoctoral research training, equipment for experiments 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 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. Also of interest are superconducting materials and conductor development; 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 are now coordinated through the Accelerator Stewardship program under the DOE SC Engineering and Technology Office and are outside the scope of this program.

6. Detector Research and Development in High Energy Physics

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

The Detector R&D subprogram develops the next generation of instrumentation for HEP and fosters the next generation of detector experts. It supports research leading to fundamental advances in the science of particle and radiation detection, and the development of new, HEP-relevant technologies and 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 strongly encouraged; this includes the development of Quantum Information Science-derived techniques for HEP experiments.

Topics studied in the Detector R&D research area include but are not limited to: low-mass, high channel density charged particle 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 ultralow-background experiments; and advanced electronics and data acquisition systems. 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.

7. Computational Research in High Energy Physics

Technical Contact: Jeremy Love, Jeremy.love@science.doe.gov

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 research and the development needed to realize the benefit to the HEP community.

8. Quantum Information Science in High Energy Physics (HEP-QIS)

Technical Contact: Glen Crawford, glen.crawford@science.doe.gov

The HEP QIS activity supports the “science first” approach of the National Quantum Strategy through National QIS Research Centers and individual research grants, applying HEP techniques to QIS and vice versa. The objectives are to support QIS research and technology development that extends the scientific reach of existing HEP programs well beyond what is currently achievable; or uses HEP experimental and theoretical techniques to improve the understanding of the theoretical and practical capabilities and limitations of complex quantum systems.

Applications are sought that are well aligned with the HEP program priorities. Research that advances the P5 science drivers, or development of new QIS-based technologies that have the potential to extend paths of investigation for HEP beyond what was considered in the P5 report, are encouraged. Applications of QIS techniques and technology that potentially benefit multiple HEP research areas are particularly sought; as are innovative approaches that can deliver significant advances to HEP or QIS experimental reach or theoretical understanding via interdisciplinary approaches. Research that exploits HEP theoretical understanding, experimental data, or simulations to provide important insights into general QIS methods and range of applicability are also encouraged. Topics include: implications of quantum entanglement for quantum gravity and other fundamental questions of HEP theory; quantum computing as applied to current research topics in HEP; quantum simulation for HEP theory and experiments; and development and deployment of ultrasensitive quantum sensor arrays for HEP science.

This subprogram does not support general quantum computing research, algorithms, or hardware; or quantum communications or networking R&D.

Nuclear Physics (NP)

Program Website: <https://science.osti.gov/np>

The mission of the Nuclear Physics (NP) program is to discover, explore, and understand all forms of nuclear matter.

One of the enduring mysteries of the universe is the nature of matter—what are its basic constituents and how do they interact to form the properties we observe? The largest contribution by far to the mass of the matter we are familiar with comes from protons 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 include the following:

- Understanding how nucleons—protons and neutrons—combine to form atomic nuclei and what are the limits of nuclear existence in nature.
- Understanding how heavy nuclei have emerged since the origin of the Universe and continue to be created via nucleosynthesis in cataclysmic cosmic events.
- Using particle accelerators to carry out tomography of the nucleon—the core building block of matter to understand how the quark and gluon fields inside the nucleon dynamically generate its properties including its mass and spin.
- Searching for undiscovered forms of nuclear matter.
- Searching for new physics via high precision, very high sensitivity measurements illuminating fundamental properties of the neutron and the neutrino as well as possible violations of well-established symmetries of nature.
- Conceiving, constructing, and operating national scientific user facilities and developing novel detector and accelerator instrumentation.

Within each of these priority areas, unique nuclear physics opportunities to advance or benefit from Artificial Intelligence or Machine Learning, and new developments in Microelectronics are also of NP programmatic interest. Applicants are encouraged to contact the relevant subprogram manager.

To carry out its mission and address these priorities, the NP program addresses three broad, yet tightly interrelated, scientific thrusts: Quantum Chromodynamics; Nuclei and Nuclear Astrophysics; and Fundamental Symmetries and Neutrinos. NP supports basic research in seven subprograms or areas: Medium Energy, Heavy Ion, Nuclear Structure and Astrophysics, Fundamental Symmetries, Nuclear Theory and Nuclear Theory Computing, and Nuclear Data (1 through 6). The program is also the steward of Accelerator Research and Development for Current and Future Nuclear Physics Facilities (7). A comparatively new initiative in Quantum Information Science (QIS) (8) has been established to support this priority initiative of SC and leverage opportunities for Nuclear Physics to benefit from advances in this topical area.

The NP subprograms and their objectives follow:

1. Medium Energy Nuclear Physics

Technical Contact: Gulshan Rai, gulshan.rai@science.doe.gov

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

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 Quantum Chromodynamics (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 what hadrons 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 structure of the nucleon, elucidate quark confinement and hadron excitations, and 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, and the origin of mass in mesons and baryons.

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 higher-mass “excited state” and exotic hadrons predicted by QCD, as well as studies of their various 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), and 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 the future Electron Ion Collider (EIC). Also of interest are R&D of concepts and emerging technologies in Machine Learning and Artificial Intelligence that go beyond the simple use case for available software packages.

2. Heavy Ion Nuclear Physics

Technical Contact: Kenneth Hicks, Kenneth.Hicks@science.doe.gov

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

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. Only two facilities in the world are capable of exploring the properties nuclear matter in these conditions, the U.S. 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 plasma, determining the speed of sound in the plasma, measuring the effect of the chiral magnetic force, understanding how quarks fragment and recombine to form hadronic matter (hadronization), and locating a possible critical point for the transition between the plasma and normal matter. Experimental research is carried out primarily using the RHIC facility, the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN).

Low Energy Nuclear Physics

The Low Energy subprogram has been separated into two distinct portfolios: that of Nuclear Structure and Astrophysics and Fundamental Symmetries.

3. Nuclear Structure and Astrophysics

Technical Contact: Sharon Stephenson, sharon.stephenson@science.doe.gov

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

Nuclear Structure and Astrophysics addresses frontiers identified in the 2015 Long Range Plan for Nuclear Science: Nuclear Structure and Reactions, and Nuclear Astrophysics.

The atomic nucleus is at the core of all visible matter and comprises 99.9% of its mass. Its relevance spans dimensions from the proton radius to objects as large as stars, and covers the evolutionary history of the universe from fractions of a second after the Big Bang to today, 13.8 billion years later. The subfield of nuclear structure and reactions strives to measure, explain, and use nuclei to meet society's scientific interests and needs. The research addresses the underlying nature of atomic nuclei and the limits of their existence. It also aims to describe dynamical processes such as nuclear reactions and fission. The ultimate 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.

Nuclear astrophysics addresses the role of nuclear physics in our universe. As a field at the interface of astrophysics and nuclear physics, it is concerned with 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. It is a broad discipline that can identify new observational signatures probing our universe. Nuclear astrophysics can identify the conditions at the very core of stars and provide a record of the violent history of the universe.

Major goals of this subprogram are to develop a comprehensive description of nuclei across the entire nuclear chart, 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 primarily using the Argonne Tandem Linac Accelerator System (ATLAS), a premier stable beam facility, as well as the Triangle Universities Nuclear Laboratory (TUNL), and the Texas A&M University Cyclotron Institute.

4. Fundamental Symmetries

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

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

This subprogram investigates aspects of the third thrust, Fundamental Symmetries and Neutrinos. Questions addressed in Fundamental Symmetries include: *What is the nature of the 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 2015 Long Range Plan for Nuclear Physics, *Reaching for the Horizon*: the implementation of a ton-scale neutrino-less double beta decay experiment to determine whether the neutrino is its own anti-particle.

5. Nuclear Theory

Technical Contact: Astrid Morreale, Astrid.Morreale@science.doe.gov ; Paul Sorensen, Paul.Sorensen@science.doe.gov

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

The Nuclear Theory subprogram provides the theoretical support needed to interpret the wide range of data obtained from the experimental nuclear science subprograms and to advance new ideas and hypotheses that identify potential areas for future 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, internal structure of nucleons and nuclei at sub-femtometer distance in terms of quarks and gluons and their dynamics, how the phenomenon of quark confinement arises, and what phases of nuclear matter occur at high densities and temperatures. In Nuclei 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 and Neutrinos, 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.

6. Nuclear Theory Computing

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

Website: <https://science.osti.gov/np/eseach/>

Nuclear Theory Computing supports research in nuclear physics with “extreme” computational requirements, which has been enabled by the advent of high-performance computing (HPC). Nuclear Physics Computing subprogram supports the ASCR partnership program of Scientific Discovery through Advanced Computation (SciDAC) and Nuclear Theory Topical Collaborations (TC). Both NP SciDAC and TC projects are five-year multi-institution collaborative projects, involving large-scale computations and are closely aligned with the NP experimental programs. They cover the large-scale simulations of astrophysics objects, nuclear

structure and nuclear interactions, fundamental symmetries, quark and gluon structure and dynamics. Nuclear Physics Computing program supports the Lattice QCD research programs jointly with High Energy Physics (HEP), developing Lattice QCD techniques that are critical to the understanding of nuclei, hadron structure, and the dynamics of strong interactions.

7. Nuclear Data

Technical Contact: Keith Jankowski, Keith.Jankowski@science.doe.gov

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

The mission of the United States Nuclear Data Program (USNDP) is to provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering. This is accomplished primarily through the compilation, evaluation, dissemination, and archiving of extensive nuclear datasets. The USNDP also addresses gaps in the data, through targeted experimental studies and the use of theoretical models. A continuing interagency program of experiments led by NP continues to address critical gaps in nuclear data and modernization of nuclear data curation by incorporating new tools such as AI/ML. The USNDP involves the efforts of ~ 50 nuclear physicists at ~ 15 national labs, research centers, institutes and universities, and is an important resource for workers in a wide range of pure and applied topics in nuclear physics. Research opportunities in Nuclear Data include both experimental and theoretical work in areas including, but not limited to: basic nuclear science, nuclear energy, and nuclear non-proliferation applications, as well as improvements to the nuclear data pipeline (data collection, curation, evaluation, and dissemination).

8. Accelerator Research and Development for Current and Future Nuclear Physics Facilities

Technical Contact: Manouchehr Farkhondeh, manouchehr.farkhondeh@science.doe.gov

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

The Nuclear Physics program 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 the Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC), with heavy ion and polarized proton beams; linear accelerators such as the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson National Accelerator Facility (TJNAF); development of devices and/or methods that would be useful in the generation of intense rare isotope beams for the Facility for Rare Isotope Beams (FRIB) currently under construction at Michigan State University and in the generation of stable isotope beams at the Argonne National Laboratory's Argonne Tandem Linac Accelerator System (ATLAS), and R&D in accelerator science and technology in support of next generation Nuclear Physics accelerator facilities such as an electron-ion collider (EIC). Also of interests are R&D in emerging technologies in Machine Learning and Artificial Intelligence with focus on increasing cost savings and operational efficiencies of NP accelerator user facilities and their experimental programs. Research aimed at transformative advances in ion sources, superconducting radiofrequency, and beam cooling is also encouraged.

9. NP - Quantum Information Science (QIS)

Technical Contact: Gulshan Rai, gulshan.rai@science.doe.gov

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

Quantum Horizons: QIS Research and Innovation for Nuclear Science is a new initiative to identify, prioritize, and coordinate emerging opportunities in both fundamental research and applied challenges at the interface of Nuclear Physics and Quantum Information Science and Technology (QIST). QIS is a rapidly developing interdisciplinary field and has been identified as an important cross-cutting topic and where continued leadership is critically important to our nation's national security and economic competitiveness. Emerging priority areas in QIS provide new opportunities to address challenges of enormous interest and complexity in NP.

NP's Quantum Horizons emphasizes the science-first approach and supports research that could, in the long-term, have a transformative impact on the NP mission area and/or advance QIS development enabled by NP-supported science, technologies, and laboratory infrastructure. Likewise, QIS technologies offer the ability to discover and probe the fundamental structure and behavior of Nature with unprecedented sensitivity and accuracy. Topics may include quantum computation, quantum simulations and simulators, quantum sensing, quantum-enhanced nuclear physics detectors, nuclear many-body problems, 'squeezed' quantum states, nuclear qubits, quantum entanglement, and implementation of NP theories on quantum hardware, as well as other novel areas of basic research and technologies. Topics and subject areas which are outside the scope of NP's Quantum Horizons initiative are listed in the Financial Assistance Opportunity (FOA) 0002514. This document may be accessed at: https://science.osti.gov/-/media/grants/pdf/foas/2021/SC_FOA_0002514.pdf.

This subprogram specifically encourages the exploitation of the interdisciplinary nature of Quantum Computing and QIST to expand the frontiers of the NP program and the national QIS enterprise through partnerships with Universities, National Laboratories and Industry. Prospective investigators are encouraged to contact the subprogram manager.

Isotope R&D and Production (DOE IP)

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

The mission of the DOE Isotope Program (DOE IP) is to produce and distribute critical radioactive and enriched stable isotopes that are in short supply or not produced in the U.S. The DOE IP ensures national preparedness for isotope production and distribution by maintaining the mission readiness of relevant national infrastructure and core competencies to ensure functionality even during times of national crisis; conducting advanced R&D to develop innovative technology and advanced radiochemical separations and purifications and mitigating U.S. dependence on foreign supplies of isotopes to ensure robust domestic supply chains. The DOE IP lies at the intersection of many scientific areas including, but not limited to nuclear and radiochemistry, nuclear physics, accelerator and nuclear reactor science, materials science and engineering, separations science, and nuclear data.

Isotopes are high-priority commodities of strategic importance for the Nation and are essential in medical diagnosis and treatment, discovery science, national security and preparedness,

industrial processes and advanced manufacturing, space exploration and communications, biology, archaeology, quantum science, clean energy, environmental science, and other fields. Isotopes can directly enable emerging technology and contribute to the economic, technical and scientific strength of the United States. Facilities utilized by the DOE IP include particle accelerators, nuclear research reactors, enrichment technologies, and radiochemical processing capabilities throughout the national laboratory complex and at universities. Isotope production capabilities are located at Brookhaven National Laboratory, Los Alamos National Laboratory, Argonne National Laboratory, Idaho National Laboratory, Pacific Northwest National Laboratory, Oak Ridge National Laboratory, University of Missouri, University of Washington, University of Wisconsin-Madison, Michigan State University, and University of Alabama-Birmingham.

DOE IP supports world-leading R&D associated with creating innovative and more efficient isotope production and processing techniques. Core research competencies associated with the DOE IP R&D portfolio include advanced targetry, artificial intelligence (AI) and machine learning (ML), robotics, automation and advanced manufacturing concepts. Research, development, and fabrication of equipment directed toward any DOE IP mission relevant topic may be proposed, but applications including extensive projects requiring detailed review of scope, budget, and schedule beyond the procedures for this announcement will not be considered. Applications should not attempt to bolster the case for facilities or major items of equipment not currently approved for funding or not expected to be available during the proposed work. Under this FOA, DOE IP does not support investigations into the development of particle accelerators or nuclear reactors for purposes outside the scope of the DOE IP topics listed below. It is also important to note that applications related to the production of Mo-99 and Pu-238 are specifically excluded from this solicitation, 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 released by the Nuclear Science Advisory Committee - Subcommittee on Isotopes (NSAC-I) which is currently guiding 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.*” The document may be accessed at:
https://science.osti.gov/~media/np/nsac/pdf/docs/2015/2015_NSACI_Report_to_NSAC_Final.pdf.

While not an exhaustive list, below are four broad topics of interest to the DOE IP research and development portfolio. These topics seek 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.

1. Targetry and Isotope Production Research

Technical Contact: Ethan Balkin, ethan.balkin@science.doe.gov

Applications to this topic should be focused on novel or improved capabilities for inducing transmutation of atoms in targets to create radioisotopes. This includes aspects of targetry and target fabrication in a variety of form factors and small batch sizes (e.g., 10 g or less), low-loss

advanced manufacturing techniques, as well as the development of innovative approaches, including integration of 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.

2. Nuclear and Radiochemical Separation, Purification, and Radiochemical Synthesis

Technical Contact: Ethan Balkin, ethan.balkin@science.doe.gov

Work in this topic is broadly applicable to the improvement and/or development of novel chemical and physical processes to recover and purify radioisotopes from activated targets. Applications proposing scopes of work dealing with isotopes 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) would also be considered responsive.

Additionally, 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, selective ion trapping ligands, chromatography resins, or other novel separation technologies) 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).

3. Biological Tracers, Imaging and Therapeutics

Technical Contact: Ethan Balkin, ethan.balkin@science.doe.gov

Work in this topic should be focused on 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 the appropriate isotope(s) would also be considered responsive. Included in this topic are the modification of existing agents, synthesis and development of: novel chelating agents or other ligands, pharmacokinetic modifying linkers, or other hydrodynamic volume altering compounds. Please note that the DOE IP funds only basic science R&D. Studies investigating the applications of isotopes will not be considered for funding.

4. Isotopic Enrichment Technology

Technical Contacts: April Gillens, april.gillens@science.doe.gov

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.

Applications should first be discussed with the cognizant Program Manager.

Accelerator R&D and Production (ARDAP)

Program Website: <https://science.osti.gov/ardap>

Administrative Contact (questions about eligibility, requirements, etc.):

Dr. Eric R. Colby, Eric.Colby@science.doe.gov

Technical Contact (questions about ARDAP research, facilities, and science):

Dr. Roark A. Marsh, Roark.Marsh@science.doe.gov

The mission of the Office of Accelerator R&D and Production (ARDAP) program is to ensure a robust pipeline of next-generation particle Accelerator Science & Technology to support scientific research while providing technology advances and industrial strength that position the U.S. to lead the world for decades to come. A key aspect of this mission is to develop a workforce with expertise in effective technology transfer of R&D and accelerator component engineering, including manufacturing risk reduction, cost reduction, and high-efficiency accelerator technologies.

ARDAP is particularly interested in early career scientists and engineers who can bridge the gap between basic research and industrial adoption and production of particle accelerator technology. In addition to strong accelerator science and engineering skills, closely-coupled expertise in design-for-manufacture practices, risk reduction in manufacturing, supply chain analysis, development of advanced manufacturing techniques, and application of data science techniques to improve accelerator component production are each of interest.

The successful applicant will be expected to work on cross-cutting R&D in particle accelerator science and technology that benefits multiple Office of Science programs, other Federal

accelerator facilities, and/or industrial or medical applications. In each case, the target application is a particle-accelerator-based instrument or facility, and the application must clearly identify how the proposed work will lead to new technology that enables or improves the application. A significant portion of the Early Career Award effort must be devoted to working closely with one or more domestic technology companies on collaborative R&D, technology transfer, and the eventual industrialization of the technology. Applications without integral strong partnering with industry are likely to be discouraged by ARDAP.

Particle accelerator technology areas of particular interest include but are not limited to:

- The manufacture of superconducting accelerator technologies, including SRF accelerators, high-field magnets, SC undulators, and cryogenic systems;
- The development of software that leverages high-performance computing architectures and data science techniques to design and control accelerators;
- The engineering and manufacture of high-brightness particle sources and high-power targets;
- The engineering and production of high-power, high-efficiency radiofrequency (RF) power sources and high average power ultrashort pulse laser systems;
- The development of advanced materials for particle accelerators (e.g., permanent magnet materials, superconducting materials, high-field insulating materials);
- The development of high-performance, multi-scale software capable of predicting the performance of macroscopic, realistic materials (e.g., high temperature superconductors, RF breakdown) based on first principles.

Applicants who seek to focus on particle accelerator science or engineering for a specific Office of Science accelerator facility or application should apply under that program's research topic.

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.

Opportunities for Early Stage Investigators

A vibrant research community must be able to train and employ the next generation of researchers. Applicants that are not degree-granting institutions of higher education must include in their application a description of how they will promote opportunities for early-stage investigators. This description must include:

- A statement detailing the institutional provision of training, coaching, mentoring, and advising to early-stage researchers, and

- A statement detailing the career pathways available to early-stage researchers, including if protections akin to academic tenure are extended.
- A statement detailing the institution's commitment to research of a basic and fundamental nature, not related to current commercial activity.

Applications from for-profit organizations that propose research related to current commercial activity may be declined without merit review.

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.
- Funding under this FOA can be used to support the principal investigator to engage in international collaborations.

All entities submitting applications to this FOA 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.export.gov>.

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 FOA 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.

Section II – AWARD INFORMATION

II.A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding grants and National Laboratory authorizations under this FOA.

Statement of Substantial Involvement

Not applicable.

II.B. ESTIMATED FUNDING

DOE anticipates that, subject to the availability of future year appropriations, a total of \$136 million in current and future fiscal year funds will be used to support awards under this FOA.

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

II.C. MAXIMUM AND MINIMUM AWARD SIZE

(See [B. Estimated Funding](#) above.)

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

The ceiling and floor specified below are for total costs, both direct and indirect costs.

Ceiling

Historically, the average award under this program for both Institutions of Higher Education and DOE National Laboratories has been close to the floor for each institutional type as described below. Requests for budget amounts larger than the historical average are possible with appropriate justification. Awards supporting PIs at SC User Facilities not at DOE Laboratories will be treated the same as DOE National Laboratories for the purposes of this FOA.

Floor

The minimum request for awards to an Institution of Higher Education is approximately \$875,000 over five years and the minimum request for awards to a DOE National Laboratory is approximately \$2,750,000 over five years. The floor for Institution of Higher Education was raised in FY 2023 to encourage these institutions to increase graduate student stipends (see “Living Wages” section above under UPDATES and REMINDERS). DOE National Laboratories awards are encouraged to cover at least 50% of the PI salary. Amounts less than 50% should be as close to 50% as possible. Awards supporting PIs at SC User Facilities that do not fall under these two broad categories must use the floor for the DOE National Laboratories.

II.D. EXPECTED NUMBER OF AWARDS

(See [B. Estimated Funding](#) above.)

DOE anticipates up to 94 awards under this FOA. The exact number of awards will depend on the number of meritorious applications and the availability of appropriated funds.

II.E. ANTICIPATED AWARD SIZE

(See [B. Estimated Funding](#) above.)

DOE expects the typical award size will be in a narrow range around \$875,000 over five years for an Institution of Higher Education and around \$2,750,000 over five years for a DOE National Laboratory or SC User Facility.

II.F. PERIOD OF PERFORMANCE

(See [B. Estimated Funding](#) above.)

DOE anticipates making awards with a project period of five 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.

II.G. TYPE OF APPLICATION

DOE will only accept new applications under this FOA.

Section III – ELIGIBILITY INFORMATION

III.A. ELIGIBLE APPLICANTS

In accordance with 2 CFR 910.126, Competition, eligibility for award is restricted to U.S. Institutions of Higher Education, DOE National Laboratories (listed at <https://www.energy.gov/national-laboratories>), and institutions operating SC Scientific User Facilities (listed at <https://science.osti.gov/User-Facilities>).

III.A.1. Institution of Higher Education

U.S. academic institutions are eligible to submit applications under this FOA. An employee with a joint appointment between a university and a DOE national laboratory must apply through the institution that pays his or her salary and provides his or her benefits.

III.A.2. DOE/NNSA National Laboratories

DOE/NNSA National Laboratories are eligible to submit applications under this FOA. If recommended for funding as a lead applicant, funding will be provided through the DOE Field-Work Proposal System. If recommended for funding as a proposed subawardee, 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. Additional instructions for securing authorization from the cognizant Contracting Officer are found in [Section VIII](#) of this FOA.

Submission of a pre-application (in PAMS) or an application (in Grants.gov) by an authorized institutional representative is a confirmation that the proposed research idea fits within the scope of SC-funded programs at the national laboratory. Proposing research that falls within this category ensures that investigators have the opportunity to belong to or join, at the laboratory's discretion, funded research groups.

Investigators funded under this program are encouraged to charge at least 50% of their time to the award, allowing time to develop or maintain funded collaborations within the lab over the course of the award. Amounts less than 50% should be as close to 50% as possible. Making sure that investigators have potential connections with SC funded programs encourages the laboratory to actively plan to address funding transition issues that may arise when an award ends.

Applications from DOE National Laboratories should not (a) attempt to revive previously terminated research areas within the laboratory or (b) topically isolate investigators. Eligibility exemptions will not be granted.

III.A.3. SC Scientific User Facilities not at a DOE/NNSA National Laboratory

Institutions operating SC Scientific User Facilities are eligible to submit applications under this FOA. If recommended for funding as a lead applicant, funding will be provided as a financial assistance award to the non-Governmental entity operating the User Facility.

Eligibility is restricted to the above entities due to the requirement for an applicant institution to have already made a career commitment to individuals as exemplified by putting them on the tenure track or in a permanent position at a national laboratory or an SC Scientific User Facility. Non-tenure-track positions and fellowships lack the expected permanence required by the Early Career Research Program. Outside of DOE/NNSA National Laboratories and SC Scientific User Facilities, the most prestigious positions in the field are tenure track faculty positions at academic institutions, and tenure is a uniquely academic pursuit: No equivalent positions exist in industry or non-profit organizations.

Submission of a pre-application (in PAMS) or an application (in Grants.gov) by an authorized institutional representative is a confirmation that the proposed research idea fits within the scope of SC-funded programs at the User Facility. Proposing research that falls within this category ensures that investigators have the opportunity to belong to or join, at the facility's discretion, funded research groups.

Investigators funded under this program are encouraged to charge at least 50% of their time to the award, allowing time to develop or maintain funded collaborations within the facility over the course of the award. Amounts less than 50% should be as close to 50% as possible. Making sure that investigators have potential connections with SC funded programs encourages the facility to actively plan to address funding transition issues that may arise when an award ends.

Applications from SC Scientific User Facilities should not (a) attempt to revive previously terminated research areas within the facility or (b) topically isolate investigators.

Eligibility exemptions will not be granted.

Notes for applicants of all types:

This FOA 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.

Funding under this FOA can be used to support the principal investigator to engage in international collaborations.

III.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.

III.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 as well as individuals with disabilities are always encouraged to apply.

There can be no co-PIs. Applications including co-PIs may be declined without review.

PIs who have received awards previously under the SC Early Career Research Program are not eligible. PIs of early career awards funded by other agencies or entities are eligible, but the proposed research must have a scope different from that already funded by the other organization.

To address special circumstances and challenges due to the COVID-19 pandemic, SC is extending the eligibility window for this competition for a second year from 10 to 12 years for all applicants. No more than 12 years can have passed between the year the PI's Ph.D. was awarded and the calendar year in which this FOA is released. For the present competition, those who received doctorates on or after January 1, 2011, are eligible. If a PI has multiple doctorates, the discipline of the one they have earned within the 12-year eligibility window must be relevant to the proposed research. SC intends to revert to the original 10-year eligibility window in subsequent competitions.

Extensions to eligibility will be considered for individuals who have had a major life event requiring an extended absence (three months or longer) from the workplace, including but not limited to active military service, an absence due to personal disability, or an absence covered by the Family and Medical Leave Act. Requests for extended eligibility must be made by including in the pre-application a letter signed by the dean, research vice president, laboratory division director, or equivalent official stating that the proposed PI will have, as of the application deadline, no more than 12 years of full-time professional work experience in positions requiring a Ph.D. in the field in which the application will be submitted. The request for an eligibility extension will be evaluated as part of the pre-application assessment.

PIs from Institutions of Higher Education, DOE National Laboratories, and SC Scientific User Facilities must adhere to the respective eligibility standards below.

The eligibility requirements improve the quality of applications submitted and encourages those who are strong candidates to submit applications to the program.

1. PIs from Institution of Higher Education

The PI must be an untenured Assistant Professor on the tenure track or an untenured Associate Professor on the tenure track at a U.S. academic institution as of the deadline for the application. The PI must be employed in the eligible position as of the closing date for this FOA. If a PI has

multiple doctorates, the discipline of the one they have earned within the 12-year eligibility window should be relevant to the proposed research.

2. PIs from DOE National Laboratories

The PI must be a full-time, permanent, non-postdoctoral national laboratory employee as of the deadline for the application. If a PI has multiple doctorates, the discipline of the one they have earned within the 12-year eligibility window should be relevant to the proposed research.

3. PIs from SC Scientific User Facilities not at a DOE/NNSA National Laboratory

The PI must be a full-time, permanent, non-postdoctoral user facility employee as of the deadline for the application. If a PI has multiple doctorates, the discipline of the one they have earned within the 12-year eligibility window should be relevant to the proposed research.

III.D. LIMITATIONS ON SUBMISSIONS

While there is no limit on the number of pre-applications from a DOE national laboratory or an SC Scientific User Facility in a given year, each laboratory or user facility is responsible for ensuring that the research ideas submitted in its pre-applications fit within the scope of SC-funded programs at the national laboratory or the user facility.

Only one application on behalf of a PI may be submitted in any given SC Early Career Research Program competition. A PI may not participate in more than three SC Early Career Research Program competitions.

Participation in the competition is defined as submission of a full application that completed the review/decision process. In rare cases, it is necessary to withdraw an application; an application withdrawn prior to it being officially declined will not count as a submission. Likewise, an application declined without merit review by the DOE SC will not count as a submission.

Letters of recommendation and department chair letters are not allowed. Applications that include recommendation or department chair letters will be subject to elimination from consideration during DOE's initial review.

Section IV – APPLICATION AND SUBMISSION INFORMATION

IV.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) number (81.049) and/or the FOA number shown on the cover of this FOA. 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>.

IV.B. LETTER OF INTENT (LOI) AND PRE-APPLICATION

IV.B.1. Letter of Intent (LOI)

Not applicable.

IV.B.2. Pre-application

PRE-APPLICATION DUE DATE

The pre-application due date is printed on the cover of the FOA.

ENCOURAGE/DISCOURAGE DATE

The pre-application response date is printed on the cover of the FOA.

A pre-application is required and must be submitted by the date indicated on the cover of the FOA.

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

Applications that have not been encouraged by DOE will be declined without merit review.

The pre-application must include, at the top of the first page, the following information:

Title of Pre-application
Principal Investigator Name, Job Title
Institution
PI Phone Number, PI Email Address
Year Doctorate Awarded: XXXX
Number of Times Previously Applied†:

Topic Area*:
Eligibility Extension Requested: (Yes/No – see below**)
FOA Number: Include the FOA Number indicated on the cover of this FOA

† Indicate how many times the PI has previously submitted a full application in the SC Early Career Research Program. The program has been offered in fourteen previous years, FY 2010 – FY 2023. Participation in the competition is defined as submission of a full, formal application that was not withdrawn prior to official declination of the application. A PI who has participated in three past SC Early Career Research Program competitions is not eligible.

**Extensions to eligibility will be considered for individuals who have had a major life event requiring an extended absence (three months or longer) from the workplace, including active military service or an absence due to personal disability or covered by the Family Medical Leave Act, or other similar reasons. Requests for extended eligibility must be made by including in the pre-application a letter signed by the dean, research vice president, laboratory division director, or equivalent official stating that the proposed PI will have, as of the application deadline, no more than 12 years of full-time professional work experience in positions requiring a Ph.D. in the field in which the application will be submitted. The request for an eligibility extension will be evaluated as part of the pre-application assessment.

*The topic area descriptions can be found in Section I, Funding Opportunity Description of this FOA. For example, the topic area might be Synthesis and Processing Science or Magnetic Fusion Energy Science Theory and Simulation. Please select from the list in Section I.

The material listed here defines the required content of a cover page. Additional material is not allowed.

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 VIII](#) of this FOA. **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.

PRE-APPLICATION REVIEW

Program Managers may evaluate all or some portion of pre-applications to determine their competitiveness within a scientific topic.

Any review will be based on the following criteria:

1. Responsiveness to the objectives of the FOA as stated in Section I.
2. Scientific and technical merit.
3. Appropriateness of the proposed research approaches.
4. Likelihood of scientific impact.
5. Ensuring a diverse pool of applicants.

The decision to encourage or discourage the submission of an application may also be influenced by the following factors:

- Relevance of the proposed activity to SC priorities
- Ensuring an appropriate balance of activities within SC programs
- Promoting the diversity of supported investigators and institutions.
- Increasing participation of institutions historically underrepresented in the SC research portfolio.

Any such review will be conducted by no less than three federal program managers chosen for their topical knowledge and diversity of perspective.

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

Applicants with the highest rated pre-applications will be encouraged to submit applications; others will be discouraged from submitting applications.

Written feedback about pre-applications will be provided after the deadline for the receipt of applications.

Topics with comparatively few pre-applications may not make use of such pre-application reviews. The ratio of encourage/discourage results will differ between topical subjects.

SC is committed to ensuring that a sufficient number of applicants will be encouraged to submit applications to foster a competitive merit review of the applications. SC's intent in discouraging submission of certain applications is to save the time and effort of applicants in preparing and submitting applications with a low likelihood of success.

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

PRE-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 only be submitted by a user at the PI's institution with the "Submit to DOE" privilege in PAMS. A PI may draft a pre-application but will only be able to submit the pre-application for institutional countersignature.

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 VIII](#) of this FOA.

In addition to the standard instructions about pre-applications, pre-applications to the Early Career Research Program require that two additional questions be answered:

1. Is the PI PECASE eligible? [To be PECASE eligible, a PI must be a U.S. citizen, U.S. national or permanent resident as of the closing date of this FOA and may not have received a PECASE previously through any agency.]

2. Year Doctorate Awarded:

This information will be used to assist SC in assembling a preliminary list of potentially PECASE eligible investigators.

IV.C. GRANTS.GOV APPLICATION SUBMISSION AND RECEIPT PROCEDURES

Applications in response to this FOA must be submitted through Grants.gov. Detailed instructions for registering in and using Grants.gov are in [Section VIII](#) of this FOA.

IV.D. CONTENT AND APPLICATION FORMS

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 FOA.

All letters may be addressed "To Whom It May Concern:".

Letters of collaboration or access should be placed in Appendix 6 (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 DOE SC Early Career Research 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>

IV.D.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 Assurances¹. Applicants are bound by their representations and certifications in SAM.gov.

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

¹ No separate form or submission is required for the Certifications and Assurances.

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. Only new applications will be considered under this FOA.

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.

IV.D.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 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 that will not count toward the project narrative page limitation. 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:
- FOA Number: Include the FOA number printed on the cover of this FOA.
- DOE/SC Program Office (ASCR, BER, BES, FES, HEP, NP, DOE IP, or ARDAP):
- Topical Area*:
- DOE/SC Program Office Technical Contact:
- Year Doctorate Awarded:
- Eligibility Extension Included in Approved Pre-application: (yes or no)
- If at a University, is the PI in a tenure-track appointment? (yes or no)
- Does the PI have tenure: (Yes or No)?
- Number of Times Previously Applied†:
- PAMS Pre-application Number§:
- PECASE Eligible**: (Yes or No)?
- Proposal Contains Data Management Plan in Appendix 4: (Yes or No)?
- Proposal Contains PIER Plan in Appendix 5: (Yes or No)?

* The topical area can be found in Section I of this FOA. For example, the topic area might be Synthesis and Processing Science or Magnetic Fusion Energy Science Theory and Simulation. Please select from the list in Part I.

†Indicate how many times the PI has previously submitted a full application in the SC Early Career Research Program. The program has been offered in fourteen previous years, FY 2010 - FY 2023. Participation in the competition is defined as submission of a full, formal application that was not withdrawn from consideration prior to official declination of the application. A PI who has participated in three past SC Early Career Research Program competitions is not eligible.

** Presidential Early Career Award for Scientists and Engineers (PECASE): PECASE is the highest honor bestowed by the U.S. Government to outstanding scientists and engineers who are beginning their independent research careers and who show exceptional promise for leadership in science and technology. To be PECASE-eligible, a PI must be a U.S. citizen, U.S. national or permanent resident as of the closing date of this FOA and may not have received a PECASE previously through any agency. PECASE eligibility is not required for an award under this FOA.

PECASE Awards are coordinated by the White House Office of Science and Technology Policy (OSTP) within the Executive Office of the President. Each year, OSTP may ask federal agencies, including DOE, to nominate candidates for PECASE. As part of the DOE nominations process, SC nominates investigators from among the PECASE-eligible awardees of the SC Early Career Research Program. OSTP makes the final selection and announcement of awardees from candidates submitted by participating Federal Agencies. Additional information can be found online <https://science.osti.gov/About/Honors-and-Awards/PECASE>.

§ SC will decline without review any application without an encouraged pre-application and may decline without review any application without a data management plan.

The material listed here defines the required content of a title page. Additional material is not allowed.

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.

PROJECT NARRATIVE (FIELD 8 ON THE FORM)

The project narrative **must not exceed a page limit of 15 pages** of technical information, including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard letter-size (8.5-inch x 11-inch) paper with 1-inch margins (top, bottom, left, and right). The body text font of all main text must not be smaller than 11 point. Merit reviewers will only consider the number of pages specified in the first sentence of this paragraph. This page limit does not apply to the Title Page, Budget Page(s), Budget Justification, biographical material, publications and references, appendices, and an optional table of content, each of which may have its own page limit defined later in this FOA.

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 VIII](#) of this FOA 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.
- **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 FOA 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 VIII](#) of this FOA 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 VIII](#) of this FOA 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.

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.

- This appendix will not count in the project narrative page limitation.
- 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.

- This appendix will not count in the project narrative page limitation.
- 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.

- This appendix will not count in the project narrative page limitation.
- 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.

- This appendix should not exceed a page limit of two pages including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard letter-size (8.5-inch x 11-inch) paper with 1-inch margins (top, bottom, left, and right)
- Do not attach a separate file to Field 12 of the Research and Related Other Project Information form.
- This appendix will not count in the project narrative page limitation.

The standard requirements for a DMP may be found in [Section VIII](#) of this FOA.

In addition, the DMP should specifically address:

- How FAIR (Findable, Accessible, Interoperable, and Reusable)² principles will apply to the anticipated data sets, software³, and models⁴ 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

All new and renewal applications that are not for conference support must provide a Promoting

² 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>

³ 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>

⁴ 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>

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 intrinsic element to advancing scientific excellence in the research project within the context of the proposing institution and any associated research group(s). Plans may include, but are not limited to: strategies of your institution (and collaborating institutions, if applicable) for enhanced recruitment of undergraduate students, graduate students, and early-stage investigators (postdoctoral researchers, and others), including individuals from diverse backgrounds and groups historically underrepresented in the research community; strategies for creating and sustaining a positive, inclusive, safe, and professional research and training environment that fosters a sense of belonging among all research personnel; and/or training, mentoring, and professional development opportunities.⁵ Plans may incorporate or build upon existing diversity, equity, accessibility, and inclusion efforts of the project key personnel or applicant institution(s), but should not be a re-statement of standard institutional policies or broad principles. The complexity and detail of a PIER plan is expected to increase with the size of the research team and the number of personnel to be supported. Resources about PIER plans are available at <https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans>. Subject to the applicable cost principles, applications may request costs necessary for implementing the PIER Plan.

- Do not attach a separate file to Field 12 of the Research and Related Other Project Information form.
- 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). This appendix will not count in the project narrative page limitation.

APPENDIX 6: 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.
- This appendix will not count in the project narrative page limitation.

APPENDIX 7: DOE/NNSA NATIONAL LABORATORY “RENEWALS” OF ONGOING ACTIVITY

If a DOE/NNSA National Laboratory submits an application that seeks to extend the performance of current work being done at the Laboratory, provide a detailed listing of all publications and other products derived from the current work. The listing may be provided in any scholarly bibliographic format.

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

⁵ Please see additional information at <https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/Q-and-A#definitions>.

Information form.

- This appendix will not count in the project narrative page limitation.

REMINDERS REGARDING ALL APPENDICES

- **Follow the above instructions to include the information as appendices to the project narrative file.**
- **These appendices will not count toward the project narrative's page limitation.**
- **Do not attach any appendices to fields 9, 10, 11, or 12.**

IV.D.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 in instructions in [Section VIII](#) of this FOA for crafting a biographical sketch.
- Attach the person's current and pending support, following the instructions in [Section VIII](#) of this FOA 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.

IV.D.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 FOA.

Additional information is found in [Section VIII](#) of this FOA.

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 VIII](#) of this FOA.

IV.D.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.

IV.D.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 two-digit state code followed by a dash and a three-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.

IV.D.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.

IV.D.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 VIII](#) of this FOA. Attach this information to Field 12 of the Research and Related Other Project Information Form.

IV.D.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

IV.E. SUBMISSIONS FROM SUCCESSFUL APPLICANTS

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

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.

IV.F. SUBMISSION DATES AND TIMES

IV.F.1. Letter of Intent Due Date

Not applicable.

IV.F.2. Pre-application Due Date

The pre-application due date is printed on the cover of this FOA.

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

IV.F.3. Application Due Date

The application due date is printed on the cover of this FOA.

You are encouraged to submit your application well before the deadline. Applications may be submitted at any time between the publication of this FOA and the stated deadline.

IV.F.4. Late Submissions

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

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

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

Applicants must email SC.Early@science.doe.gov to discuss the option of a late submission. DOE notes that not all requests for late submission will be approved.

Section V - APPLICATION REVIEW INFORMATION

V.A. CRITERIA

V.A.1. Initial Review Criteria

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 FOA, including LOIs or pre-applications, has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the FOA; 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.

V.A.2. Merit Review Criteria

Applications will be subjected to scientific merit review (peer review) and will be evaluated against the following criteria 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;
- Quality and Efficacy of the Promoting Inclusive and Equitable Research (PIER) Plan.
- Relevance to the mission of the specific program (e.g., ASCR, BER, BES, FES, HEP, NP, DOE IP, or ARDAP) to which the application is submitted; and
- Potential for leadership within the scientific community

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:

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?

- Does the application specify at least one scientific hypothesis motivating the proposed work? Is the investigation of the specified hypothesis or hypotheses scientifically valuable?
- Is the Data Management Plan suitable for the proposed research? To what extent does it support the validation of research results? To what extent will research products, including data, be made available and reusable to advance the field of research?

APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH

- How logical and feasible are the research approaches?
- Does the proposed research employ innovative concepts or methods?
- Can the approach proposed concretely contribute to our understanding of the validity of the specified scientific hypothesis or hypotheses?
- 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 I of this FOA?

COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES

- What is the past performance and potential of the Principal Investigator (PI)?
- 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?

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?

QUALITY AND EFFICACY OF THE PROMOTING INCLUSIVE AND EQUITABLE RESEARCH PLAN

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

RELEVANCE TO THE MISSION OF THE SPECIFIC PROGRAM (E.G., ASCR, BER, BES, FES, HEP, NP, DOE IP, OR ARDAP) TO WHICH THE APPLICATION IS SUBMITTED

- How does the proposed research contribute to the mission of the program in which the application is being evaluated?
- Is the proposed research aligned with the program office's priorities as described in advisory committee reports?

POTENTIAL FOR LEADERSHIP WITHIN THE SCIENTIFIC COMMUNITY

- Scientific leadership can be defined very broadly and can include direct research contributions.
- How has the PI demonstrated the potential for scientific leadership and creative vision?
- How has the PI been recognized as a leader?

V.B. REVIEW AND SELECTION PROCESS

V.B.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/>.

V.B.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
- Ensuring a distribution of supported researchers at various early career stages
- Training the next generation of researchers
- Ensuring opportunities to investigators not currently supported by DOE
- Quality of international collaboration
- Commitment to sharing the results of research
- Promoting the diversity of supported investigators
- 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

V.B.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.

V.B.4. Review of Risk

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.

V.B.5. 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.

V.C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

It is anticipated that the award selection will be completed by July 2024. It is expected that awards will be made in Fiscal Year 2024.

Section VI – AWARD ADMINISTRATION INFORMATION

VI.A. AWARD NOTICES

VI.A.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.

VI.A.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.

VI.B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

Additional policy provisions applicable to this FOA are included in the list below. Awards made under this FOA are subject to the respective Administrative and National Policy Requirements.

The full text of each provision is in [Section VIII](#) of this FOA and may be accessed by navigating to the hyperlinks below:

- [1. Administrative Requirements](#)
- [2. Availability of Funds](#)
- [3. Buy America Requirement for Infrastructure Projects](#)
- [4. Conference Spending \(February 2015\)](#)
- [5. Commitment of Public Funds](#)
- [6. Corporate Felony Conviction and Federal Tax Liability Representations \(March 2014\)](#)
- [7. Environmental, Safety and Health \(ES&H\) Performance of Work at DOE Facilities](#)
- [8. Evaluation and Administration by Non-Federal Personnel](#)
- [9. Federal, State, and Local Requirements](#)
- [10. Funding Restrictions](#)
- [11. Government Right to Reject or Negotiate](#)
- [12. Intergovernmental Review](#)
- [13. Logos and Wordmarks](#)
- [14. Modifications](#)
- [15. National Environmental Policy Act \(NEPA\) Compliance](#)
- [16. Nondisclosure and Confidentiality Agreements Representations \(June 2015\)](#)
- [17. Notice Regarding Eligible/Ineligible Activities](#)
- [18. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment](#)
- [19. Prohibition on Discrimination and Harassment](#)
- [20. Prohibition on Lobbying Activity](#)
- [21. Prohibition Related to Foreign Government-Sponsored Talent Recruitment Programs](#)
- [22. Proprietary Application Information](#)
- [23. Publications](#)
- [24. Registration Requirements](#)
- [25. Research Misconduct](#)
- [26. Rights in Technical Data](#)
- [27. Subaward and Executive Reporting](#)
- [28. Title to Subject Inventions](#)
- [29. U.S. Competitiveness](#)

VI.C. 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.

VI.D. 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.

VI.E. INTERIM CONFLICT OF INTEREST POLICY FOR FINANCIAL ASSISTANCE

VI.E.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.

VI.E.2. SC Implementation

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

Section VII - QUESTIONS/AGENCY CONTACTS

VII.A. QUESTIONS

Questions relating to the Grants.gov registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@Grants.gov. DOE is not allowed to address/answer these questions under any circumstances. Please only contact the Grants.gov help desk for questions related to Grants.gov.

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, 9:00 AM – 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 FOA should reference the FOA number on the cover of this Announcement. Please contact the PAMS help desk for technological issues with the PAMS system.

Questions regarding the specific program areas and technical requirements may be directed to the technical contacts listed for each program within the FOA or below. Please contact the program staff with all questions not directly related to the Grants.gov or PAMS systems.

VII.B. AGENCY CONTACTS

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
Program Manager Scientific Contact	Questions regarding the specific program areas/technical requirements can be directed to the program managers / technical contacts listed for each program within the FOA.

Section VIII – SUPPLEMENTARY MATERIAL

VIII.A. 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 FOA, every application, or every institution.

VIII.A.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.

VIII.A.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.

VIII.A.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 FOA 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.

VIII.A.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 FOA, submit collaborative applications with each institution submitting its own application with an identical project narrative, resulting in multiple awards to the collaborating institutions.

VIII.A.5. How to Submit Letters of Intent

Do not submit an LOI unless an FOA 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 FOA 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 edit a previously submitted LOI in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

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.

VIII.A.6. How to Submit a Pre-Application

Do not submit a pre-application unless an FOA 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 FOA 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 edit a previously submitted pre-application in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

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.

VIII.A.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.

Complete organization registration instructions can be found on Grants.gov here:
<https://www.Grants.gov/web/grants/applicants/organization-registration.html>

- 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/web/grants/applicants/organization-registration.html>

- 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/web/grants/applicants/registration/add-profile.html>
- 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)⁶. The 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/web/grants/applicants/registration/authorize-roles.html>
- 5) *Track Role Status*: To track your role request, refer to:
<https://www.Grants.gov/web/grants/applicants/registration/track-role-status.html>

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

⁶ 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.

webforms within an application. For each FOA, you can create individual instances of a workspace.

Below is an overview of applying on Grants.gov. For access to complete instructions on how to apply for opportunities, refer to:

<https://www.Grants.gov/web/grants/applicants/apply-for-grants.html>

- 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/web/grants/applicants/adobe-software-compatibility.html>
- 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/web/grants/applicants/applicant-training.html>

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.

VIII.A.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 in [7.](#), [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 FOA. 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 FOA 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 FOA to request that it be withdrawn.

After an application is withdrawn, it may be resubmitted, if this FOA is still open for the submission of applications. Such resubmissions will only count as one submission if this FOA 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 FOA 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 FOA to permit the transfer of the award to a new institution, the new institution must apply under the then-available SC “annual” or “open” FOA.

VIII.A.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 at <https://nsf.gov/bfa/dias/policy/nsfapprovedformats/> are no longer available. If an interagency common format for a biographical sketch has been promulgated, that format must be used in an application. The use of a format required by another agency is

intended to reduce the administrative burden to researchers by promoting the use of common formats.

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.
- **Synergistic Activities:** List no more than five professional and scholarly activities related to the effort proposed.

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 Contributor ID (ORCID). 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.

VIII.A.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 FOA 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

VIII.A.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 at <https://nsf.gov/bfa/dias/policy/nsfapprovedformats/> are no longer available. If an interagency common format for current and pending support has been promulgated, that format must be used in an application. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats.

For every activity, list the following items:

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

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

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

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

VIII.A.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 proposal merit review process.

Applicants are encouraged to consult the SC website for further information and suggestions for how to structure a DMP: <https://science.osti.gov/funding-opportunities/digital-data-management>

VIII.A.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/>.

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.

VIII.A.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 FOA should reference the FOA number printed on the cover page.

VIII.A.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.

VIII.A.16. How to Register in Other Systems Before Submitting an Application

SYSTEMS TO REGISTER IN

Applicants must complete a series of registrations and enrollments to submit applications in response to this FOA. 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.

Do not use a SSN as a TIN.

Obtain a TIN from the IRS using the website listed above.

Applicants must register with FedConnect at www.FedConnect.net. The full, binding version of assistance agreements will be posted to FedConnect.

Recipients must register with the Federal Funding Accountability and Transparency Act Subaward Reporting System at <https://www.fsr.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.

VIII.B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

VIII.B.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).

VIII.B.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.

VIII.B.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 materials⁷ 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

⁷ 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 construction 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 waiver. DOE may reject or grant waivers in whole or in part depending on its review, analysis, and/or feedback from OMB or the public. DOE's 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 to 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.

VIII.B.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.

VIII.B.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.

VIII.B.6. Corporate Felony Conviction and Federal Tax Liability Representations (March 2014)

In submitting an application in response to this FOA 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.

VIII.B.7. 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.

VIII.B.8. 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.

VIII.B.9. 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.

VIII.B.10. 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 FOA 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.

VIII.B.11. Government Right to Reject or Negotiate

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

VIII.B.12. Intergovernmental Review

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

VIII.B.13. 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>.

VIII.B.14. Modifications

Notices of any modifications to this FOA will be posted on Grants.gov and the FedConnect portal. You can receive an email when a modification or an FOA message is posted by registering with FedConnect as an interested party for this FOA. It is recommended that you register as soon after release of the FOA as possible to ensure you receive timely notice of any modifications or other FOAs. More information is available at www.FedConnect.net.

VIII.B.15. 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.

VIII.B.16. Nondisclosure and Confidentiality Agreements Representations (June 2015)

By submitting an application in response to this FOA, 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 contractors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.
- (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.

VIII.B.17. 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.

VIII.B.18. 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.

VIII.B.19. 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 FOA 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).

VIII.B.20. 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.

VIII.B.21. 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 under this FOA. Should an award result from this FOA, 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.

VIII.B.22. 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 FOA. Applicants are advised to not include any critically sensitive proprietary detail.

If an application includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the 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.

VIII.B.23. Publications

The recipient is expected to publish or otherwise make publicly available the results of the work conducted under any award resulting from this FOA. Publications and other methods of public communication describing any work based on or developed under an award resulting from this FOA 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 FOA are subject to DOE's [Public Access Plan](#). Full-text versions of scientific publications must be made publicly accessible at no charge to readers.

VIII.B.24. 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.

VIII.B.25. 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 FOA 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>.

VIII.B.26. 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.

VIII.B.27. 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 FSRS database at <https://www.fsrs.gov> and report the required data on their first tier subrecipients. Prime recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

VIII.B.28. 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 FOA 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 FOA, 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 FOA shall include the U.S. Competitiveness Provision in accordance with [Section VIII](#) of this FOA. 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 DEC's prior to the issuance of awards under this FOA. 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 FOA 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 FOA shall include the U.S. Competitiveness Provision in accordance with [Section VIII](#) of this FOA. 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 FOA for any domestic large business that is a recipient, or subrecipient at any tier to this FOA 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).

VIII.B.29. 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 VIII](#).

VIII.C. REFERENCE MATERIAL

Glossary of Useful Grants and Cooperative Agreement terms

Acquisition cost	<i>Acquisition cost</i> 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	<i>Administrative requirements</i> 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	<i>Advance payment</i> 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	<i>Allocation</i> 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	<i>Allocability</i> 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	<i>Allowable cost</i> 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	<i>Application</i> 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	<i>Appropriation act</i> 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 <i>approved budget</i> 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	<i>Assurance</i> 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	<i>Authorized organizational representative</i> 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	<i>Award</i> 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	<i>Award documents</i> 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	<i>Bayh-Dole Act</i> 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	<i>Budget</i> 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	<i>Budget period</i> means the intervals of time (usually 12 months each) into which a project period is divided for budgetary and funding purposes.
Business officer	<i>Business officer</i> means the financial official of the recipient who has primary fiscal responsibility for the grant. Also known as authorized organizational representative.
Capital assets	<i>Capital assets</i> 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	<i>Carryover</i> 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	<i>Change in scope</i> 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	<i>Closeout</i> 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	<i>Competitive segment</i> means the initial project period recommended for support or each extension of a project period resulting from a renewal award.

Conference (domestic or international)	<i>Conference (domestic or international)</i> 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	<i>Consortium or sub-award agreement</i> 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	<i>Consultant</i> 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	<i>Continuation application/award</i> 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	<i>Contract</i> 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	<i>Contractor</i> means an entity that receives a contract as defined in 2 CFR 200.1 Contract.
Contracting (or Grants) Officer	<i>Contracting (or Grants) Officer</i> 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	<i>Contracting (or Grants Management) specialist</i> 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	<i>Cooperative agreement</i> 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	<i>Cost principles</i> 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	<i>Cost sharing or matching</i> 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	<i>Deadline</i> means the published date and/or time that a grant application is to be submitted to the funding agency.
Debarment and suspension	<i>Debarment and suspension</i> 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	<i>Direct costs</i> 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	<i>Disallowed costs</i> 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	<i>Domestic organization</i> 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	<i>Effort</i> 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	<i>Equipment</i> 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	<i>Expanded authorities</i> 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	<i>Expiration date</i> 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	<i>Facilities and administrative costs</i> 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	<i>Federal financial report</i> 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	<i>Financial assistance</i> 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	<i>Financial status report</i> means see Federal Financial Report.
Foreign travel	<i>Foreign travel</i> 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.
Funding opportunity announcement (FOA)	<i>Funding opportunity announcement (FOA)</i> 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. FOAs 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. FOAs can be found at www.Grants.gov . An FOA may also be known as a solicitation.
Grant agreement	<i>Grant agreement</i> 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	<i>Grant-supported project or activity</i> 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	<i>Grants.gov</i> (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)	<i>Indirect (F&A) costs</i> 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	<i>Institutional base salary</i> 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	<i>Matching or cost sharing</i> 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	<i>Merit (or peer) review</i> 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	<i>Monitoring</i> 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	<i>NEPA</i> 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	<i>No-cost extension</i> 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	<i>Non-Federal share</i> 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.
Obligations	<i>Obligations</i> , 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	<i>OMB circulars</i> are government-wide guidance issued to Heads of Federal agencies by the Director of the Office of Management and Budget.

Other significant contributors	<i>Other significant contributors</i> 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	<i>Program participants</i> 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	<i>Participant support costs</i> 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	<i>Person months</i> 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	<i>Pre-application or pre-proposal</i> 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	<i>Pre-award costs</i> 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	<i>Prior approval</i> means written approval from the designated Contracting Officer.
Program Director/ Principal Investigator	<i>Program Director/ Principal Investigator</i> 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	<i>Program income</i> 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 of 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	<i>Program Manager</i> 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	<i>Progress report</i> 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	<i>Project/ performance site</i> means location(s) of where the work described in the research plan will be conducted.
Project period	<i>Project period</i> 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	<i>Re-budgeting</i> means reallocation of funds available for spending between approved budget categories to allow best use of funds to accomplish the project goals.
Real Property	<i>Real property</i> means land, including land improvements, structures and appurtenances thereto, but excludes moveable machinery and equipment.
Recipient	<i>Recipient</i> 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	<i>Renewal application</i> 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	<i>Research</i> 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	<i>Research misconduct</i> 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	<i>SAM.gov</i> 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	<i>Scope of work</i> 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	<i>Senior/Key personnel</i> 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	<i>Significant re-budgeting</i> 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	<i>Small business concern</i> means a business that meets the regulatory and size requirements established by the SBA at 13 CFR 121.
Solicitation	See Funding Opportunity Announcement.
Subaward	<i>Subaward</i> 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	<i>Subrecipient</i> 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	<i>Supplement</i> 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	<i>Terms and conditions of award</i> 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	<i>UEI</i> is the Unique Entity Identifier, a twelve-digit alphanumeric sequence established and assigned by the System for Award Management at https://www.SAM.gov to uniquely identify an entity.

Unallowable costs	<i>Unallowable costs</i> 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	<i>Unliquidated obligations</i> 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	<i>Unobligated balance</i> 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, <i>validate</i> 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.