DOE Office of Science Funding Opportunities in Biology

Todd Anderson
Biological Systems Science Division
Office of Biological and Environmental Research (BER)

Gail McLean
Chemical Sciences, Geosciences and Biosciences Division
Office of Basic Energy Sciences (BES)

U.S. DEPARTMENT OF ENERGY | Office of Science

Energy.gov/science

U.S. DEPARTMENT OF ENERGY | Office of Science

The nation's largest supporter of basic research in the physical sciences

Principal roles:

- Direct support of scientific research
- Direct support of the development, construction, and operation of unique, open-access scientific user facilities available for use by external researchers

U.S. DEPARTMENT OF ENERGY | Office of Science

Our Mission:

Deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States.

More than **34,000 r**esearchers supported at more than **300** institutions and **17** DOE national laboratories

Steward **10** of the 17 DOE national laboratories

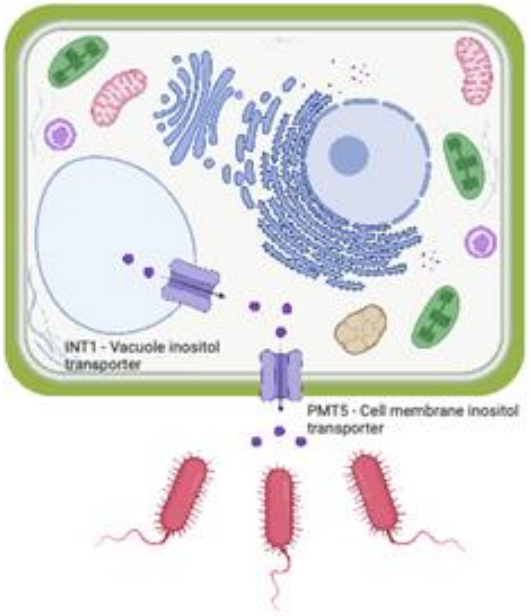
More than **37,000** users of **28** Office of Science scientific user facilities

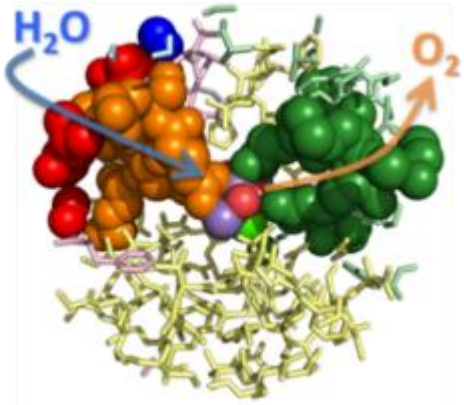
$8.1B (FY 23 enacted)

Office of Science Research Portfolio

Advanced Scientific Computing Research	• Delivering world leading computational and networking capabilities to extend the frontiers of science and technology
Basic Energy Sciences	• Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels
Biological and Environmental Research	• Understanding complex biological, earth, and environmental systems
Fusion Energy Sciences	• Supporting the development of a fusion energy source and supporting research in plasma science
High Energy Physics	• Understanding how the universe works at its most fundamental level
Nuclear Physics	• Discovering, exploring, and understanding all forms of nuclear matter
Isotope R&D and Production	• Supporting isotope research, development, production, processing and distribution to meet the needs of the Nation
Accelerator R&D and Production	• Supporting new technologies for use in SC's scientific facilities and in commercial products

Biology research is supported by two programs offices in DOE's Office of Science (SC)





Biological and Environmental Research (BER)

- processes and interdependencies among genomics, plants, ecosystems, watersheds, regional climate, and the earth system

Basic Energy Sciences (BES)

- fundamental mechanistic molecular-level understanding of biological and biochemical processes related to energy capture, conversion and storage

DOE Office of Science

Biological and Environmental Research

Dorothy Koch, Associate Director

Todd Anderson, Director

Biological Systems Science

- Genomic Science
  - ➢ Bioenergy Research Centers
- Biomolecular Characterization and Imaging Science
- Facilities & Infrastructure
  - ➢ Joint Genome Institute

Gary Geernaert, Director

Earth & Environmental Systems Science

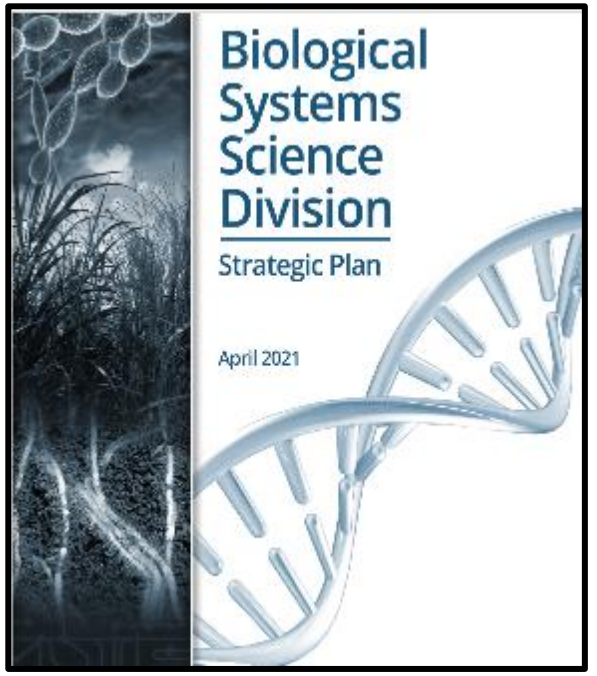
- Atmospheric System Research
- Environmental System Science
- Climate & Earth System Modeling
- Facilities & Infrastructure
  - ➢ Environmental Molec. Sciences Lab
  - ➢ ARM Climate Research Facility

Strategic Directions for Biological Systems Science

Overarching Goal

Provide the necessary fundamental science to understand, predict, manipulate, and design biological processes that underpin innovations for bioenergy and bioproduct production and to enhance the understanding of natural environmental processes relevant to DOE.

- What information is encoded in the genome sequence and how does this information explain the functional characteristics of cells, organisms, and whole biological systems?
- How do interactions among cells regulate the functional behavior of living systems and how can those interactions be understood dynamically and predictively?
- How do plants, microbes, and communities of organisms adapt and respond to changing environmental conditions (e.g., temperature, water and nutrient availability, and ecological interactions), and how can their behavior be manipulated toward desired outcomes?
- What organizing biological principles need to be understood to facilitate the design and engineering of new biological systems for beneficial purposes



BSSD Strategic Plan - April 2021

Biological System Science Division (BSSD) Portfolio Elements

Main Research Topics*

Bioenergy Research

Bioenergy Research Centers
Sustainable Bioenergy
Plant Genomics
Microbial Conversion
Biopreparedness (BRaVE)

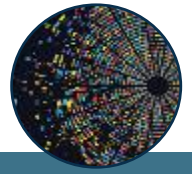
Biosystems Design

Biosystems Design
Secure Biosystems Design

Environmental Research

Microbiome Science
Energy Earthshot Research

Enabling Capabilities



Computational Biology

Academic Research
KBase
NMDC
PDB

Biomolecular Characterization and Imaging Science

Classical Bioimaging
Quantum Bioimaging
Structural Biology

User Facilities

Joint Genome Institute

*New Cross-cutting research efforts in FY22 and 23 : RENEW, FAIR and Accelerate efforts

Bioenergy Research

Goal: Provide the basic science needed to convert renewable biomass to a range of fuels chemicals, and other bioproducts in support of a burgeoning bioeconomy.

- *Plant Genomics*

Subgoal: *Gain a genome-level understanding of plant metabolism, physiology, and growth to develop new bioenergy feedstocks with traits tailored for bioenergy and bioproduct production.*

- *Microbial Conversion*

Subgoal: *Develop an understanding of microbial and fungal metabolism necessary to design new strains, communities, or enzymes capable of converting plant biomass components into fuels, chemicals, and bioproducts.*

- *Sustainable Bioenergy*

Subgoal: *Understand the genomic properties of plants, microbes, and their interactions to enable the development of new approaches that improve the efficacy of bioenergy crop production on marginal lands with few or no agricultural inputs, while minimizing ecological impacts.*

Biosystems Design Research

Goal: *Advance fundamental understanding of genome biology and develop the genome-scale engineering technologies needed to design, build, and control plants and microbes for desired beneficial purposes.*

Secure Biosystems Design

Subgoal: *Build on advances in genome science and synthetic biology to design and engineer DOE-relevant biological systems with built-in biocontainment measures and develop strategies to address risks of unintended consequences, while enabling a sustainable bioeconomy.*

Environmental Microbiome Research

Goal: *Develop a process-level understanding of microbiome function and be able to predict ecosystem impacts on the cycling of materials (carbon, nutrients, and contaminants) in the environment.*

Enabling Capabilities and User Facilities

*relevant to BSSD science

Joint Genome Institute (JGI)

Provides the global research community with access to the most advanced integrative genome science capabilities for advancing solutions to bioenergy & environmental grand challenges

National Microbiome Data Collaborative (NMDC)

Supports microbiome data exploration through a sustainable data discovery platform that promotes open science and shared-ownership across a broad and diverse community of researchers.

DOE Systems Biology Knowledgebase (KBase)

Empowers scientists via an open, FAIR biological data science platform to collaboratively drive discovery, for prediction, control and design of function in plants, microbes and their communities.

BER Structural Biology and Imaging Resources

Enables scientists to understand the relationships between plant and microbial genomes, protein structure and function, and environmental interactions using techniques available only at DOE User facilities.

Environmental Molecular Sciences Lab (EMSL)

Provides access to premier multimodal molecular science instruments, data analytics, production computing, and multiscale modeling to study biotic and abiotic process to under their function in a systems context.

Recent Workshops

Overcoming Barriers in Plant Transformation: A Focus on Bioenergy Crops

September 18-20, 2023 (draft report in prep)

- Basic science needs for advancing plant transformation techniques
- Capabilities needed to expand genomic editing of plant functional traits

Artificial Intelligence & Machine Learning (AI/ML) for BioEnergy Research Opportunities and Challenges (AMBER)

August 23-25, 2022 (Joint with EERE-BETO)

- What are the possibilities for incorporating AI/ML techniques into Biological Research?
- How could AI/ML techniques be more integral with experimentation and automation in the Laboratory?

Genomes to Structure and Function Workshop

October 27-28, 2021, December 15-16, 2021, January 26-27, 2022

- Understand the needs of the BER research community to combine genomic, functional, and structural approaches to advance their research
- Three sessions:
  - Molecular Structures
  - Intracellular Organization and Material Synthesis and Decomposition
  - Imaging the Rhizosphere and Cellular Organization

Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe and Secure American Bioeconomy

September 12, 2022


Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy

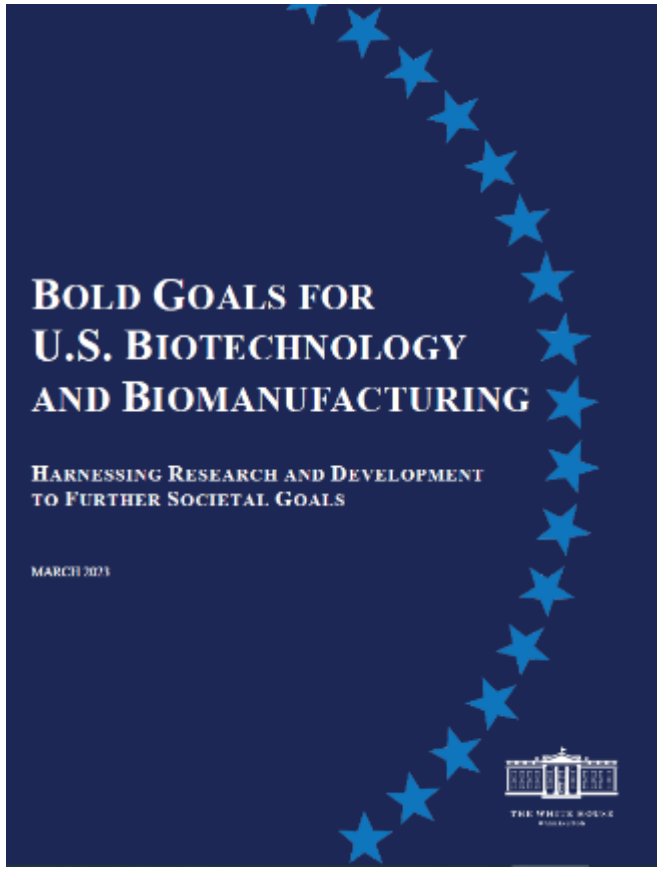
[Executive Order 9-12-2022]


MARCH 22, 2022

FACT SHEET: Biden-Harris Administration Announces New Bold Goals and Priorities to Advance American Biotechnology and Biomanufacturing

OSTP › NEWS & UPDATES › PRESS RELEASES

[March 22-2023 fact-sheet-biden-harris-administration-announces-new-bold-goals-and-priorities-to-advance-american-biotechnology-and-biomanufacturing/]

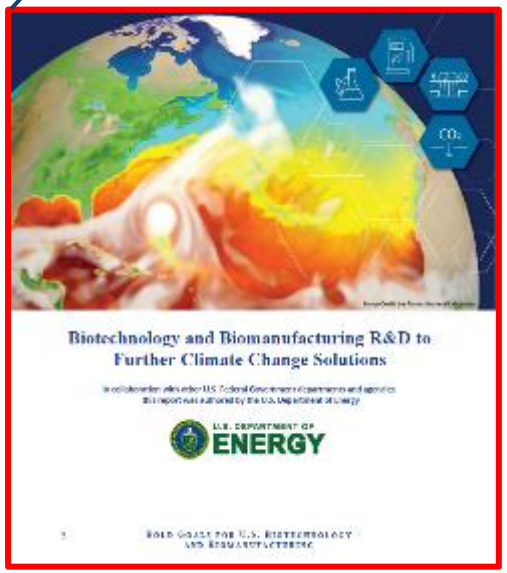


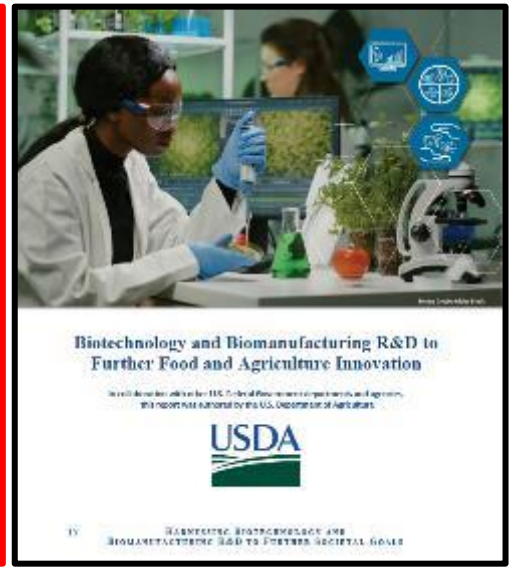
[Bold-Goals-for-U.S.-Biotechnology-and-Biomanufacturing-Harnessing-Research-and-Development-To-Further-Societal-Goals-FINAL.pdf]

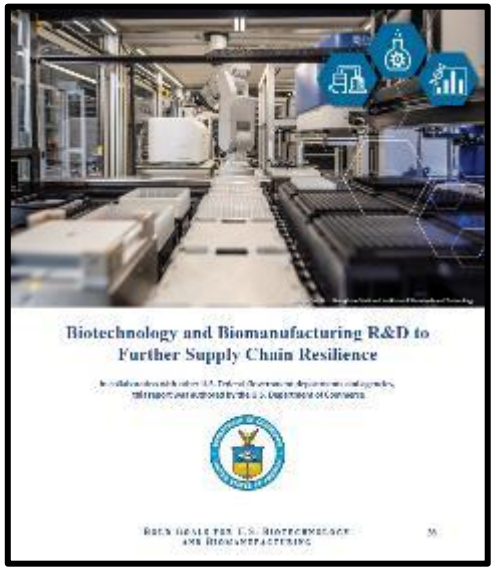
Executive Order acknowledges advances in biotechnology and seeks to establish US leadership in a very competitive global bioeconomy

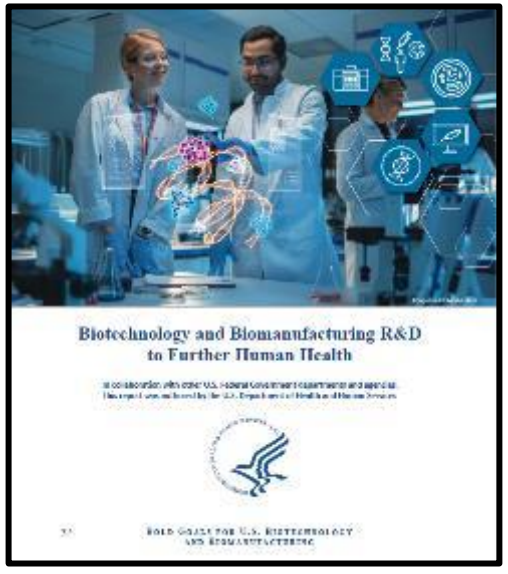
E.O. Reports: A Compilation of Five Reports Addressing:

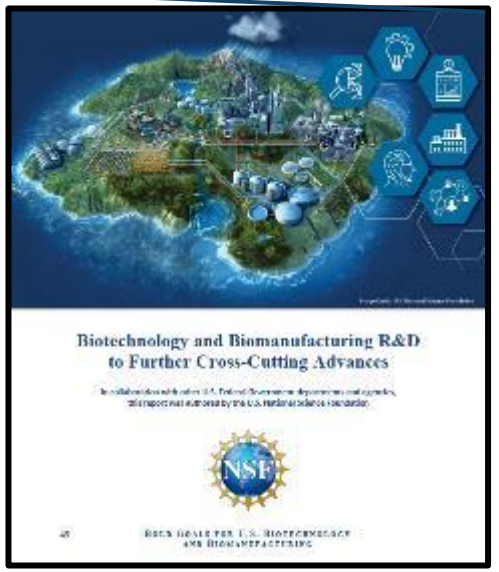
Climate Change Solutions
Food and Agricultural Innovation
Supply Chain Resilience
Human Health
Cross-Cutting Advances











DOE led the Climate Change Solutions Report with SC-BER EERE-BETO, USDA

ENERGY earthshots
U.S. DEPARTMENT OF ENERGY

Hydrogen Shot

Long Duration Storage Shot

Carbon Negative Shot

Clean Fuels and Products Shot

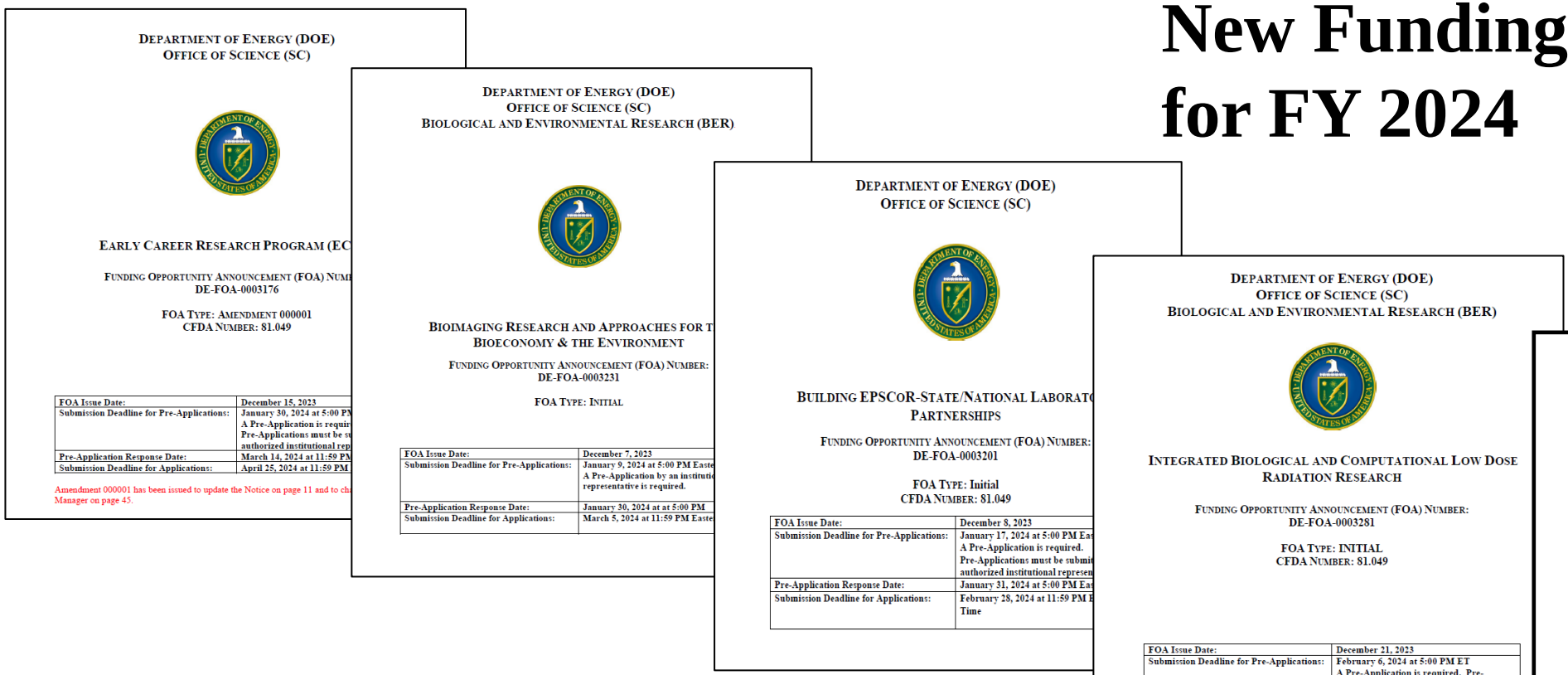
Enhanced Geothermal Shot

Industrial Heat Shot

Floating Offshore Wind Shot

Affordable Home Energy Shot

New Funding Opportunities for FY 2024



Microbial Systems Biology Research

(TBD – Pending FY24 Appropriation)

- Early Career Research Program (DE-FOA-0003176)
- Bioimaging Research Approaches to Bioenergy & the Environment (DE-FOA -0003231)
- EPSCoR (DE-FOA-0003201)
- Low Dose Radiation Research (DE-FOA-0003281)

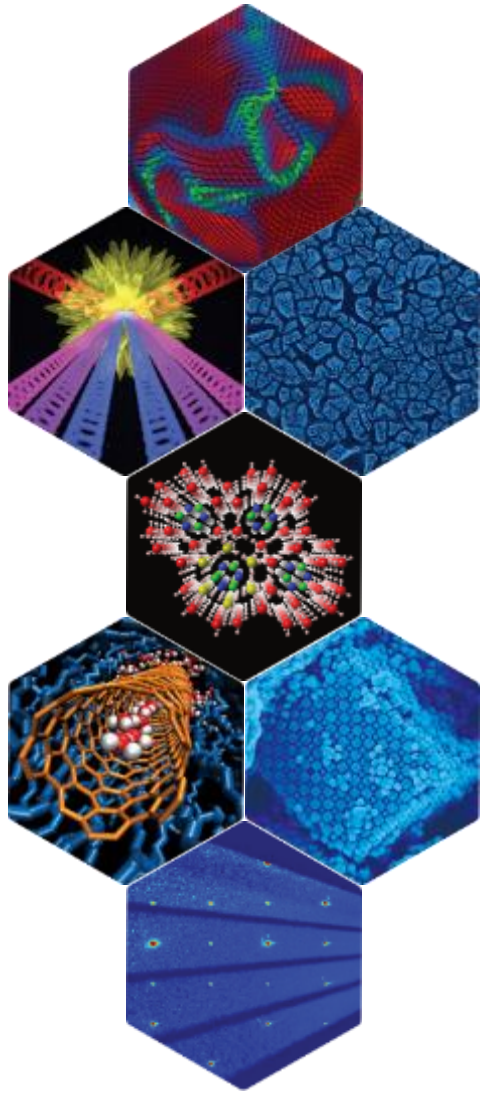
- Microbial Systems Biology FOA – TBD
- RENEW and FAIR FOAs - TBD

[BER Funding Opportunities | U.S. DOE Office of Science (SC) (osti.gov)]

Basic Energy Sciences (BES): Understanding Matter and Energy at Electronic, Atomic, and Molecular Levels

BES fulfills its mission through:

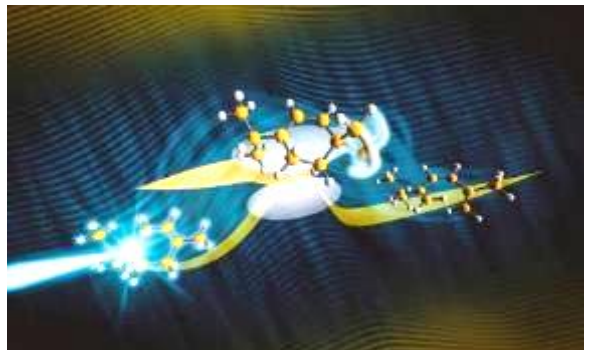
- Supporting **basic research**
  - "Grand Challenge" science
  - Discovery and design of materials and chemical processes that underpin a broad range of energy technologies
- Ensuring **broad participation** in the research portfolio
- Operating **world-class scientific user facilities** in X-ray, neutron, and nanoscale science
- Managing **construction and upgrade projects** to maintain **world-leading** scientific user facilities



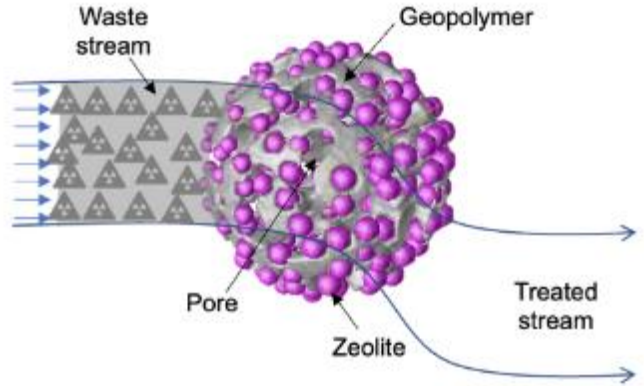
Fundamental Research is Supported in Each of the Major BES Research Modalities

Increasing scope and size

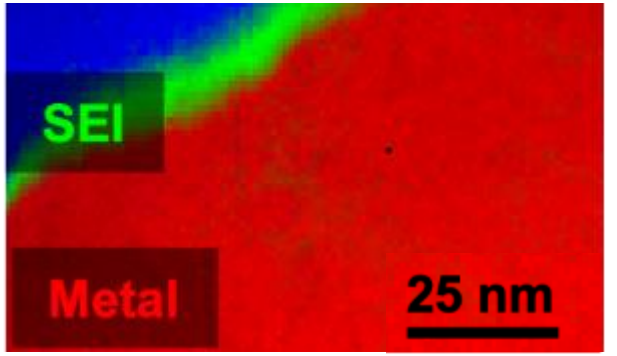
Core Research
Fundamental materials & chemical sciences research. Supports single investigators (~$150K+/year) & small groups ($500K-$2M/yr, 3-yr).



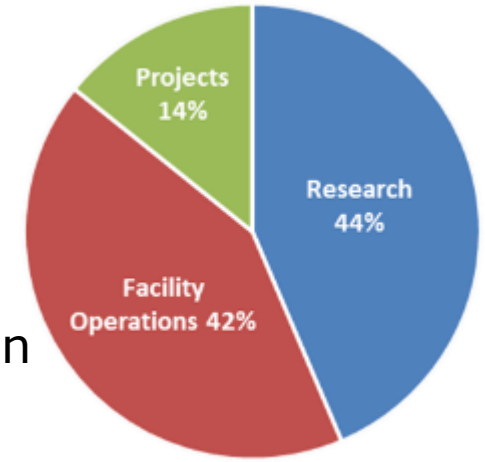
Energy Frontier & Energy Earthshot Research Centers, Computational Science Centers
Fundamental, use-inspired research per Basic Research Needs Workshop reports. Supports larger teams ($2-4M/yr, 4-yr).



Energy Storage & Fuels from Sunlight Energy Innovation Hubs; Quantum Information Sciences Centers
Fundamental research on topics that have proven challenging for traditional funding modalities. Large-team research awards ($8-25M/yr, 5-yr). Have defined research goals, milestones, and management.



Basic Energy Sciences – Organization



FY 2023 Appropriation $2.5 B

Office of Basic Energy Sciences
Linda Horton
Associate Director

Materials Sciences and Engineering Division
Andy Schwartz, Director

- Materials Discovery, Design and Synthesis
- Condensed Matter and Materials Physics
- Scattering and Instrumentation Sciences

Scientific User Facilities Division
Linda Horton, Acting Director

- Operations
- Construction

Chemical Sciences, Geosciences and Biosciences Division
Gail McLean, Director

- Fundamental Interactions
- Photochemistry and Biochemistry
- Chemical Transformations

Collaborative Research Division
Andy Schwartz, Acting Director

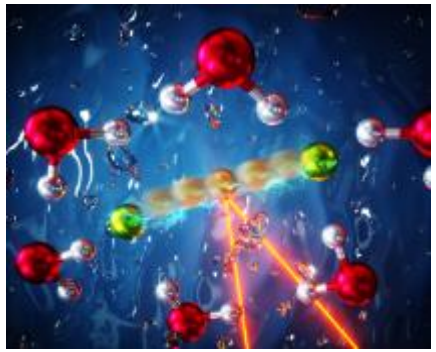
- Energy Frontier Research Centers
- Energy Innovation Hubs
- Energy Earthshot Research Centers
- Cross-SC Coordination

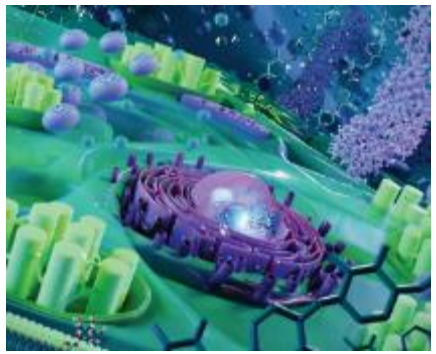
Research grouped by scientific topics, each impacting many energy technologies

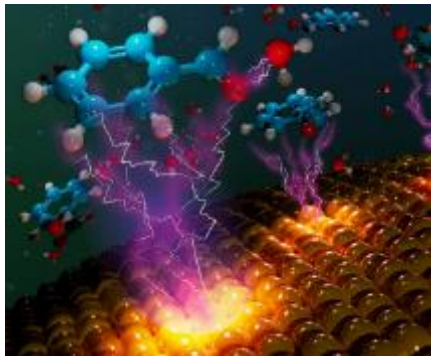
https://science.osti.gov/bes/About (See Organization Chart)

Chemical Sciences, Geosciences & Biosciences (CSGB) Research

Broad Portfolio of Grand Challenge and Energy Use-Inspired Fundamental Research







Fundamental Interactions:

Control chemical reactivity and dynamics in gas and condensed phases and at interfaces

Photochemistry and Biochemistry:

Molecular mechanisms of light energy capture and its conversion into chemical and electrical energy

Biology research is supported through 2 core Biosciences programs (Physical Biosciences and Photosynthetic Systems)

Chemical Transformations:

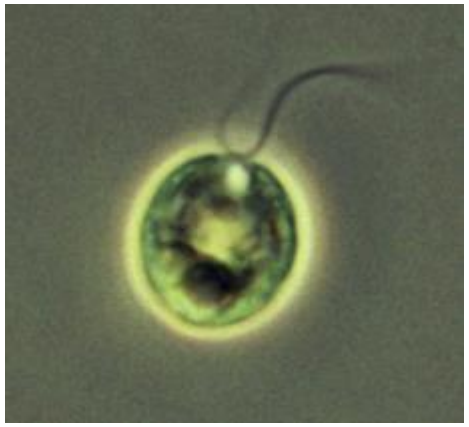
Chemical catalysis, synthesis, separation, stabilization, and transport processes, from atomic to geologic scales.

Crosscutting Research Themes:

Chemical Mechanisms for Clean Energy; Ultrafast Chemistry; Chemistry at Complex Interfaces; Charge Transport and Reactivity; Reaction Pathways in Diverse Environments; Chemistry in Aqueous Environments

BES Photosynthetic Systems

The Photosynthetic Systems program brings together biology, chemistry, and physics to understand capture of sunlight and its conversion to chemical energy by photosynthesis in nature.

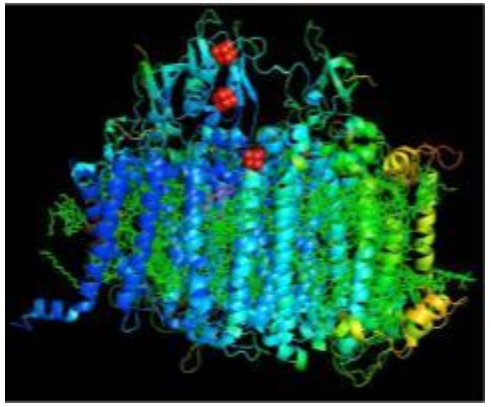


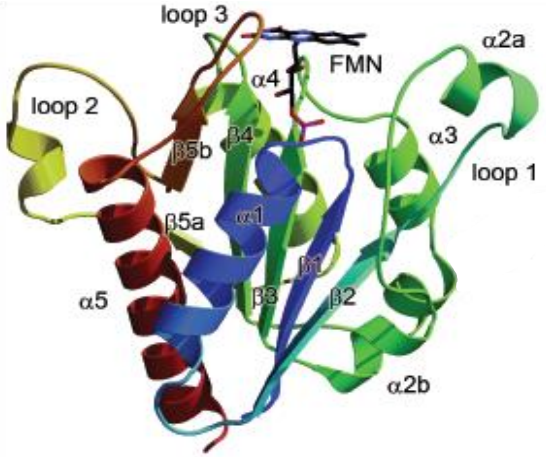
Photosynthetic Systems Programmatic Areas of Emphasis Include

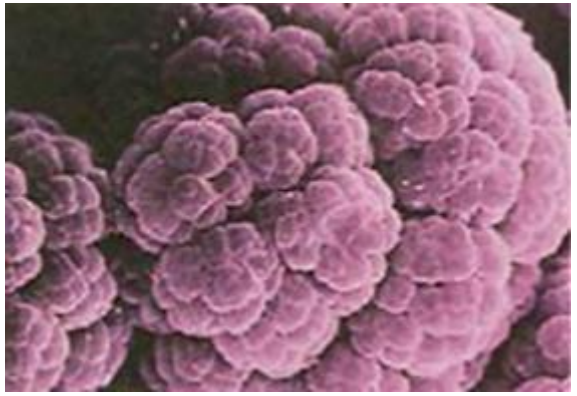
- Light harvesting by photosynthetic pigment antennae
- Charge separation, electron transport, and proton transport within and between photosynthetic complexes
- CO_2 fixation and related carbon metabolism in plants, algae, and photosynthetic bacteria
- Self-assembly and self-repair of photosynthetic proteins, complexes and membranes

BES Physical Biosciences

This research area combines experimental and computational tools from the physical sciences with biochemistry and molecular biology. The goal is to increase fundamental understanding of the complex processes that convert and store energy in living systems with an increasing emphasis on redox biochemistry.

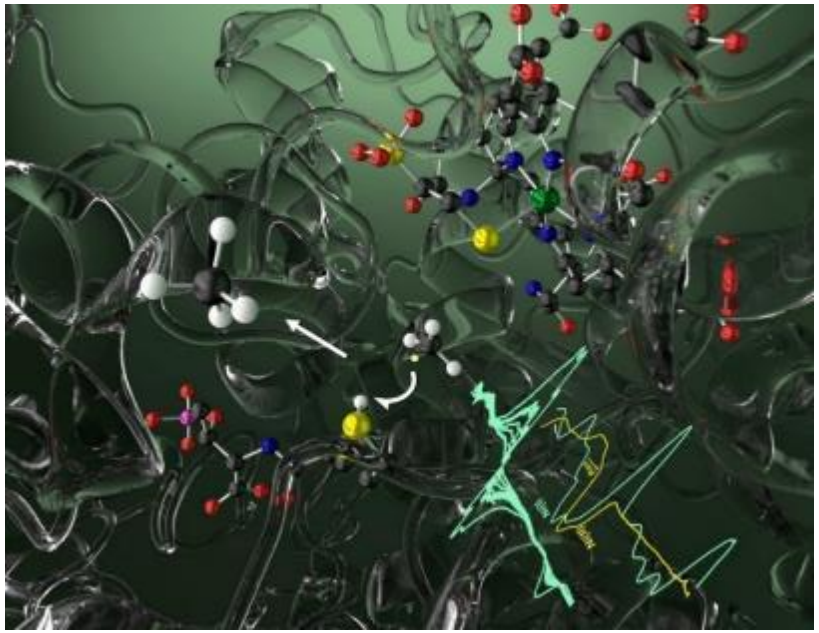






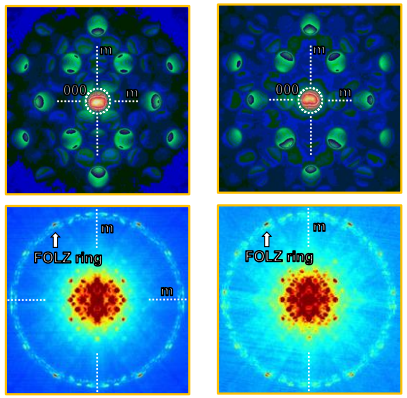
Physical Biosciences Programmatic Areas of Emphasis Include

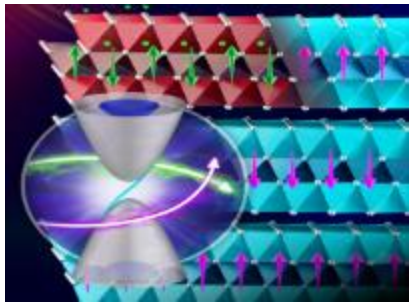
- Structure/function/mechanism studies and electrochemical properties of enzymes that catalyze multi-electron redox reactions
- Metallocofactor synthesis and assembly; “tuning” of redox potentials
- Electron bifurcation and catalytic bias
- Electron flow on larger spatial and temporal scales (“circuitry”) in biological systems
- Self-assembly and maintenance of energy transduction systems
- Plant lipid biosynthesis, cell wall biosynthesis & structure (chemistry focused; not deconstruction)

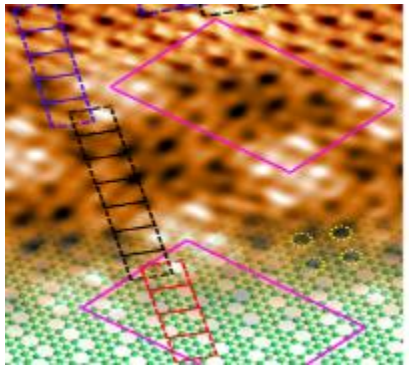


Materials Sciences and Engineering (MSE) Research

Broad Portfolio of Grand Challenge and Energy Use-Inspired Fundamental Research







Scattering and Instrumentation Sciences:
Investigation of photon, neutron, and electron interactions with matter to characterize structures, dynamics, and functionality

Condensed Matter and Materials Physics:
Exploration of phenomena in condensed matter, such as quantum behavior and response to environmental stimuli

Materials Discovery, Design, and Synthesis:
Understanding synthesis and materials dynamics to discover/design new materials via innovative physical, chemical, and *bio-molecular* routes

Includes the core program Biomolecular Materials

Crosscutting Research Themes:
Clean energy materials research; Quantum materials;
Theory, computation, data science; Materials synthesis;
Science across length and time scales; Non-equilibrium dynamics;
In-situ, operando, and multi-modal characterization

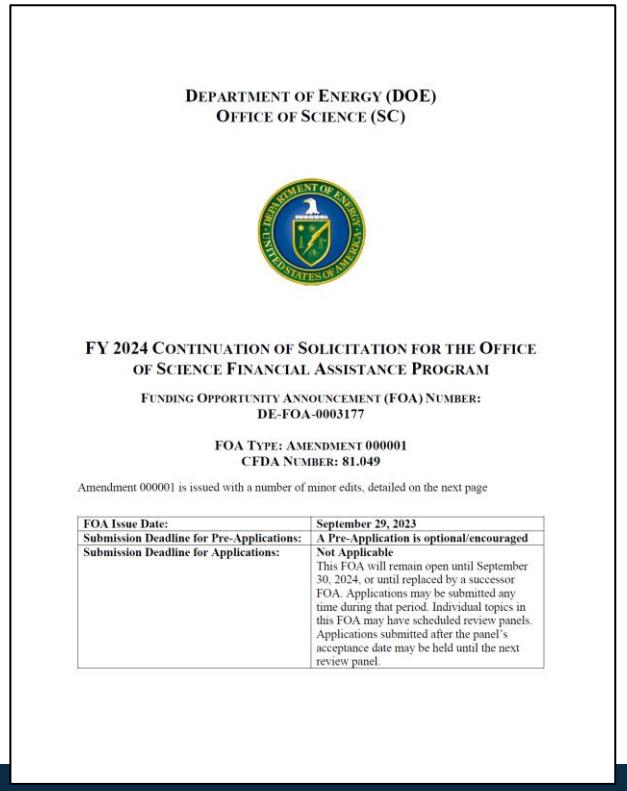
BES Biomolecular Materials

The Biomolecular Materials program supports fundamental materials science research for discovery, design and synthesis of functional materials and complex structures based on principles and concepts of biology.

- Creation of materials and multiscale systems that exhibit well-coordinated functionality and information content approaching that of biological materials but capable of functioning under extreme, non-biological environments
- Innovative fundamental science approaches for co-design and scalable synthesis of materials that coherently and actively manage multiple complex and simultaneous functions and tolerate abuse through autonomous repair and regrowth
- An *area of emphasis:* activities to understand and control assembly mechanisms to seamlessly integrate capabilities developed for one length scale across multiple length scales as the material is constructed
- Includes 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

BES Core Programs Use the "Continuation of Solicitation for the Office of Science Financial Assistance Program" (annual "Open Call")

- The annual, broad, open solicitation that covers all research areas in the Office of Science and is open throughout the Fiscal Year for university applicants (not DOE National Lab)
- For BES, the solicitation includes brief descriptions for all of the core research areas, with current priorities/areas of interest and contact information for program managers (contacting program managers is encouraged)
- New and renewal proposals are submitted to BES core programs through the "Open Call"
- For the Open Call, BES identifies the following "overarching research priorities" relevant to multiple core research areas:
  - Fundamental Science to Enable Clean Energy
  - Critical Materials/Minerals
  - Fundamental Science to Transform Manufacturing
  - Artificial Intelligence and Machine Learning (AI/ML)
  - Quantum Information Science (QIS)



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

FY 2024 CONTINUATION OF SOLICITATION FOR THE OFFICE OF SCIENCE FINANCIAL ASSISTANCE PROGRAM

FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER:
DE-FOA-0003177

FOA TYPE: AMENDMENT 000001
CFDA NUMBER: 81.049

Amendment 000001 is issued with a number of minor edits, detailed on the next page

FOA Issue Date:	**September 29, 2023**
Submission Deadline for Pre-Applications:	**A Pre-Application is optional/encouraged**
Submission Deadline for Applications:	**Not Applicable** This FOA will remain open until September 30, 2024, or until replaced by a successor FOA. Applications may be submitted any time during that period. Individual topics in this FOA may have scheduled review panels. Applications submitted after the panel's acceptance date may be held until the next review panel.

Office of Science Early Career Research Program

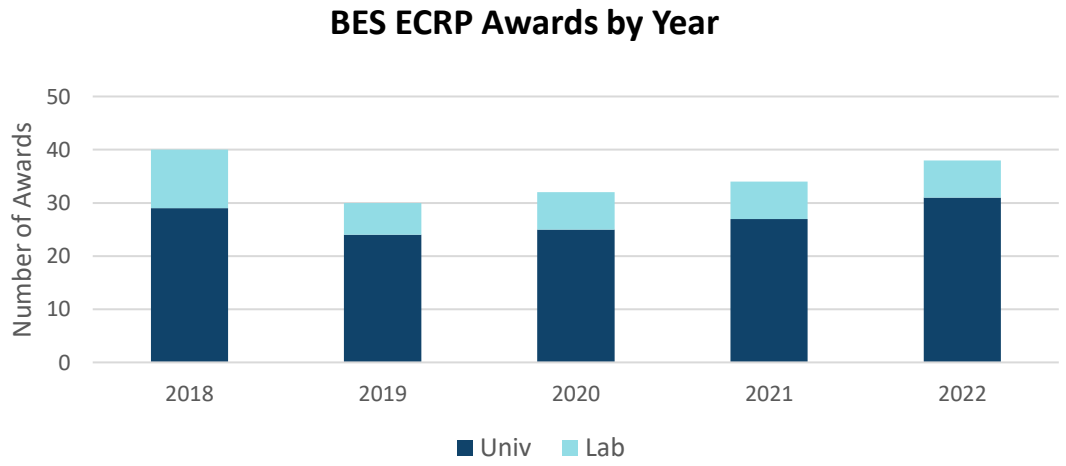
- Support development of individual research programs of outstanding scientists early in their careers and stimulate research careers in the areas supported by the Office of Science.
- All BES core research areas participate, including Scientific User Facilities
- Topics may alternate to maintain reasonable applicant pool, ease reviewer burden, and improve success.

- **Eligible Applicants**: Untenured university professors on tenure track and DOE Lab Scientists, both within 12* years of PhD; each applicant may apply a maximum of three times; extension for major life events of at least 3 months

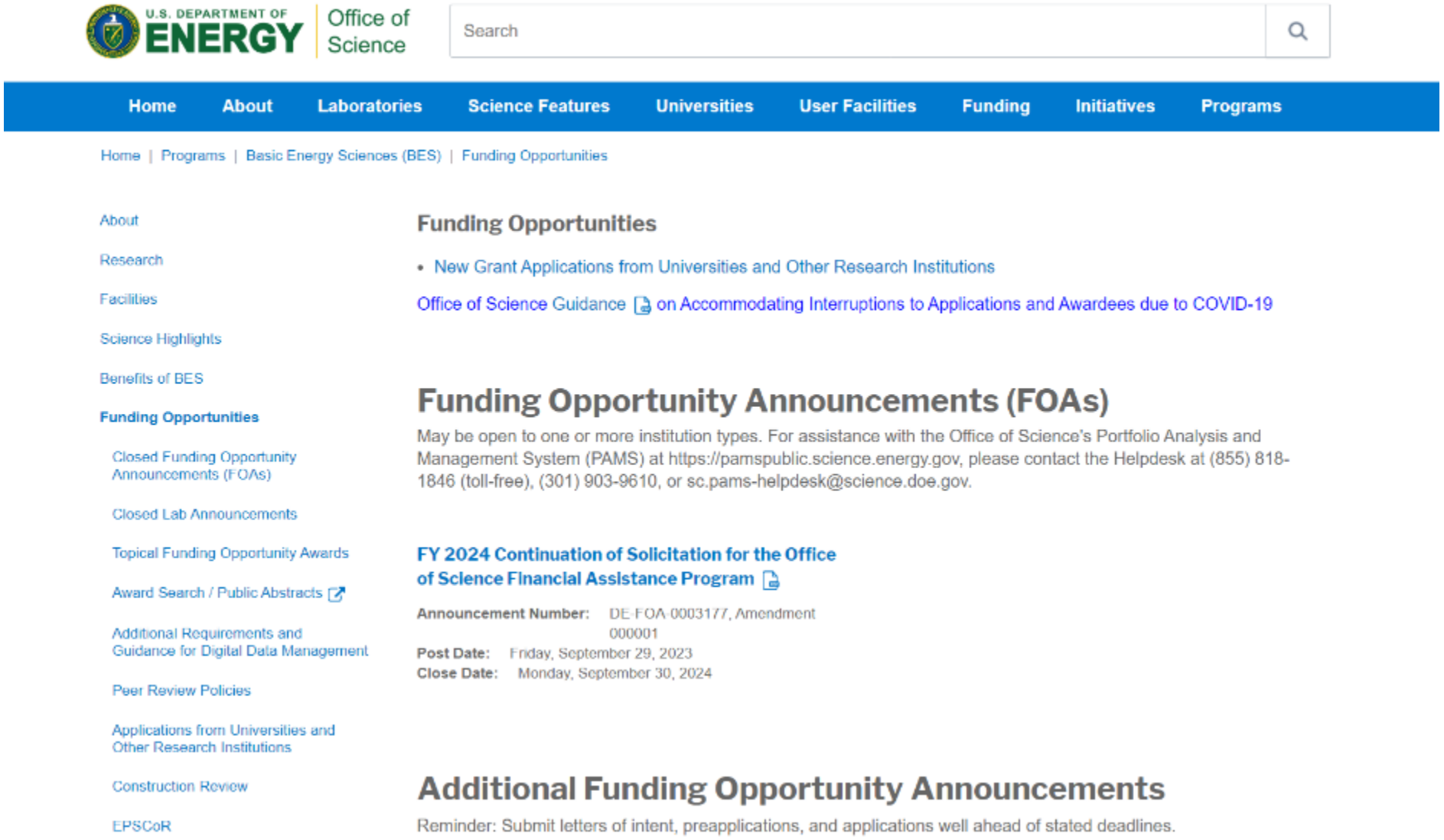
Typical funding: University: $175K/yr for 5 years
DOE Lab: $500K/yr for 5 years

Timeline: FOA typically released in Fall
Awards start in Summer

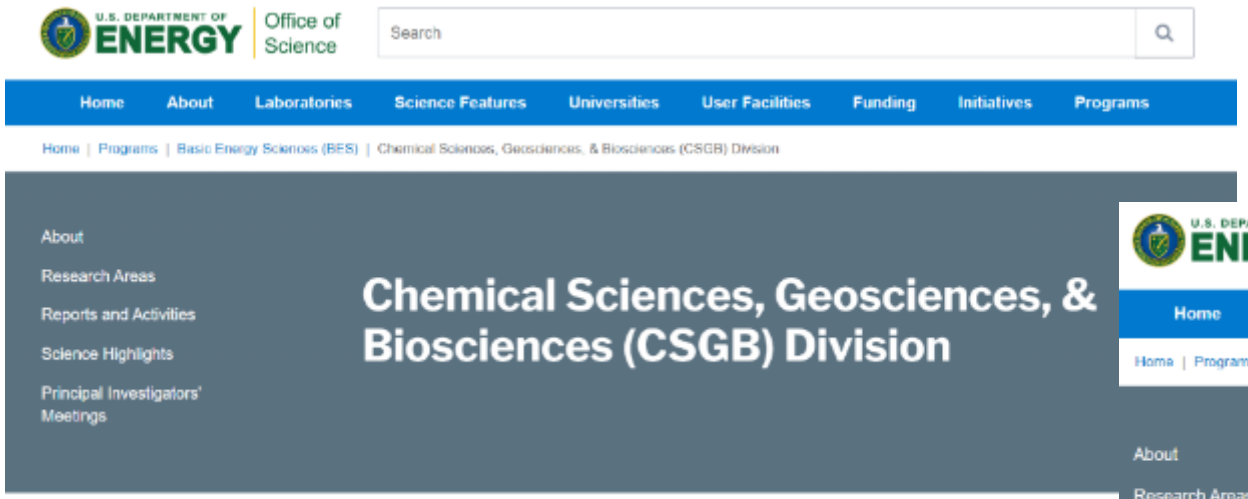
https://science.osti.gov/early-career

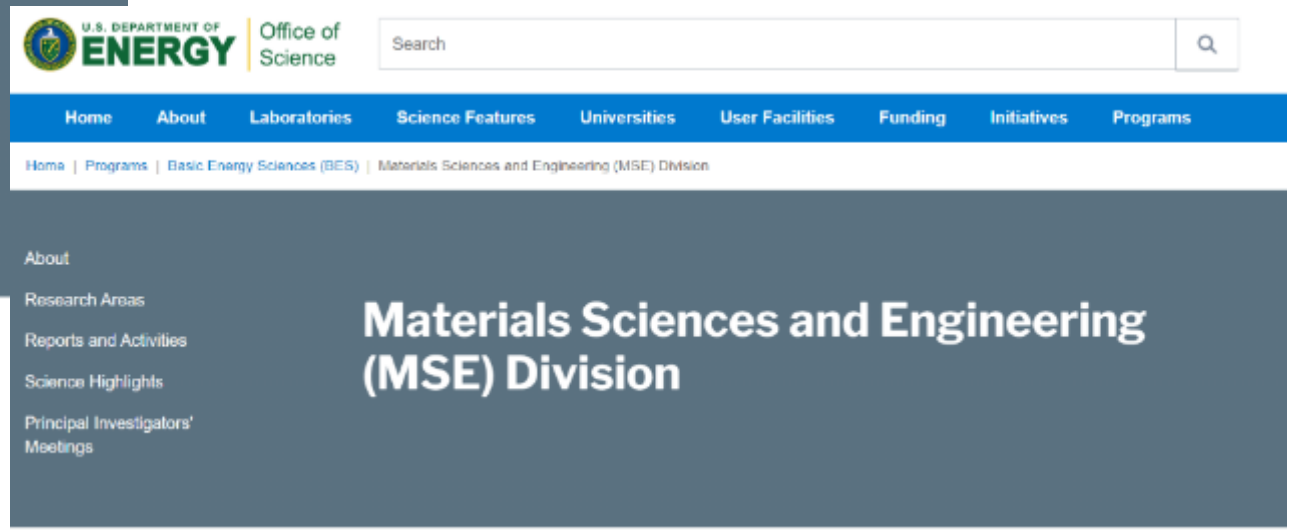


How to Find BES Funding Opportunity Announcements



BES CSGB and MSE Research Division Webpages



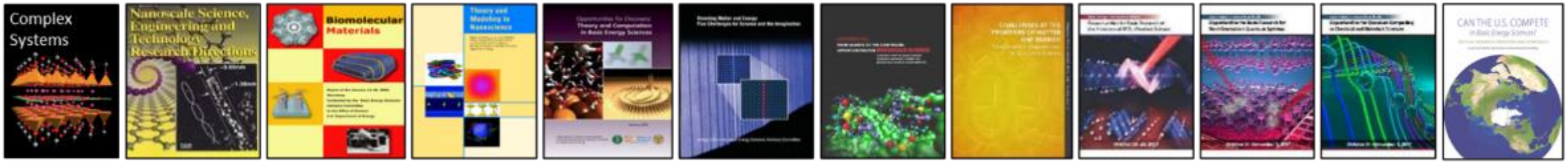


- Descriptions of all core research areas (funding programs)
- Abstract books from Principal Investigator Meetings
- Contact information for Program Managers

https://science.osti.gov/bes/mse
https://science.osti.gov/bes/csgb

Defining Research Priorities: Basic Research Needs Strategic Planning Workshops and Roundtables

Science for Discovery



Science for National Needs

National Scientific User Facilities, the 21st century tools of science

Possible Future Workshops and/or Roundtables: 2024 and Beyond

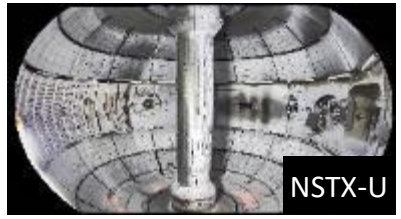
(As presented to BESAC in July 2023; in no particular order)

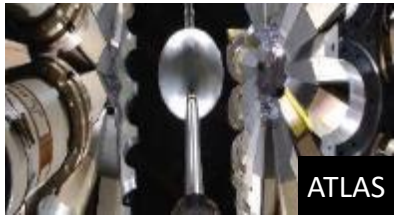
- Science Foundations for Critical Materials Sustainability
- Next-generation Fabrication for Microelectronics and QIS
- Basic Research Needs for the Subsurface
- Future BES Computational Sciences: Theory, Data, and AI/ML for Exascale and Beyond
- Bioinspired Chemical and Materials Sciences for Sustainable Energy and Products
- Materials and Chemistry in Extreme Environments (not radiation): Renewable Energy, Manufacturing, and End Use

Other Office of Science (SC) Opportunities

Office of Science User Facilities

FY 2023
28 scientific
user facilities
>37,000 users





U.S. DEPARTMENT OF ENERGY
Office of Science

Building a New Energy Workforce

SC Internship Programs and Opportunities

- Science Undergraduate Laboratory Internships Program
- The Community College Internships Program
- Office of Science Graduate Student Research
- Visiting Faculty Program

science.osti.gov/wdts

SC Initiatives and Programs to Broaden Participation

RENEW
Reaching a New Energy Sciences Workforce

FAIR
Funding for Accelerated, Inclusive Research

EPSCoR
DOE Established Program to Stimulate Competitive Research that promotes geographically inclusive and equitable research

Reaching a New Energy Sciences Workforce (RENEW)

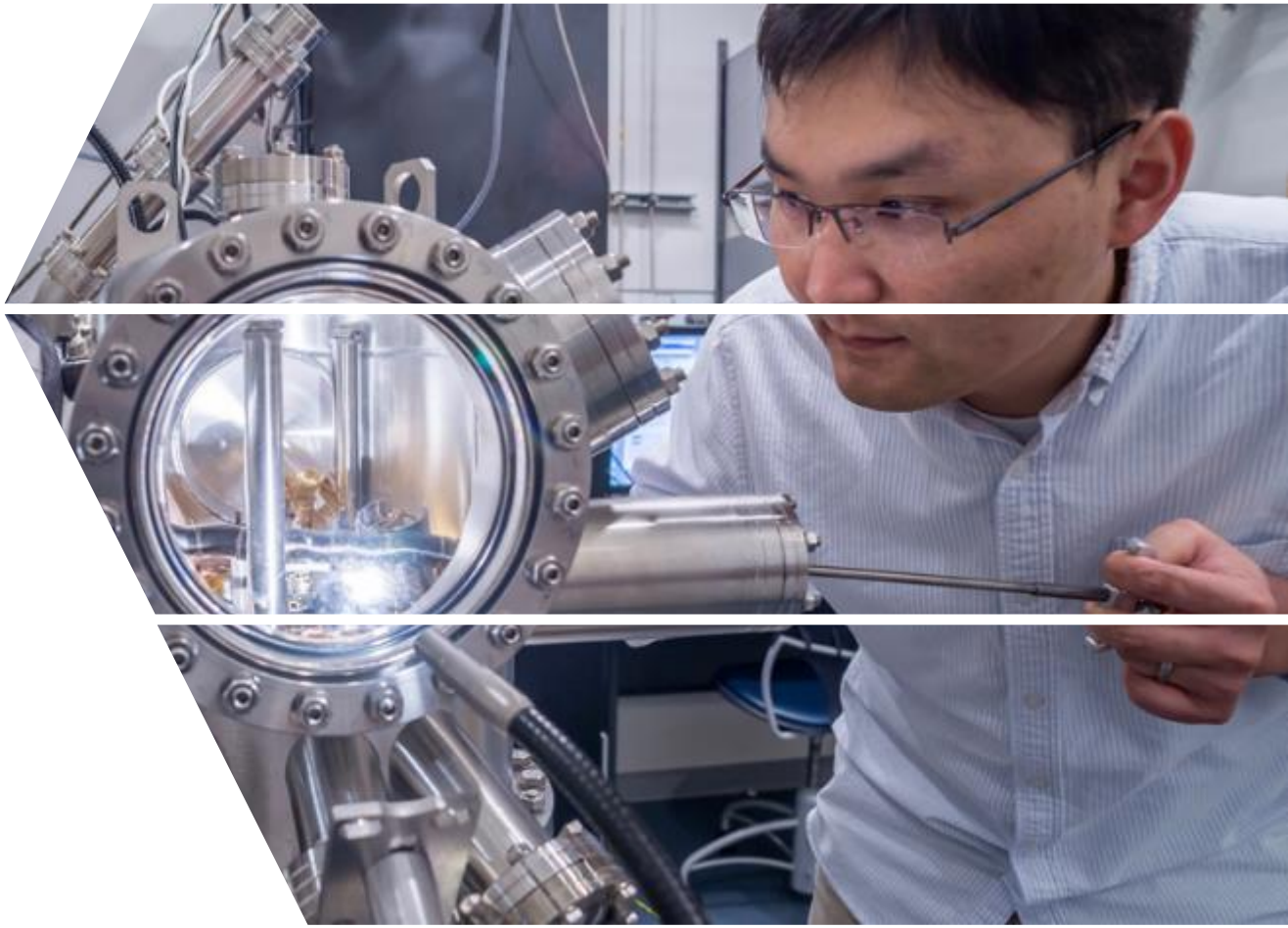
- Build foundations for students in Office of Science research
- Leverage our national laboratories, user facilities, and research infrastructure to provide training opportunities
- Participate in program research meetings and professional development events

Funding for Accelerated, Inclusive Research (FAIR)

- Building research capacity, infrastructure, and expertise at institutions historically underrepresented
- Includes minority serving institutions (MSIs) and emerging research institutions (ERIs)
- Supporting mutually beneficial relationships between MSIs and ERIs with partnering institutions

Promoting Inclusive and Equitable Research (PIER) Plan

- All new and renewal proposals are required to submit a PIER Plan
- The complexity and detail of the plan is expected to increase with the size of the research team
- The PIER Plan will be evaluated under a new merit review criterion as part of the peer review process



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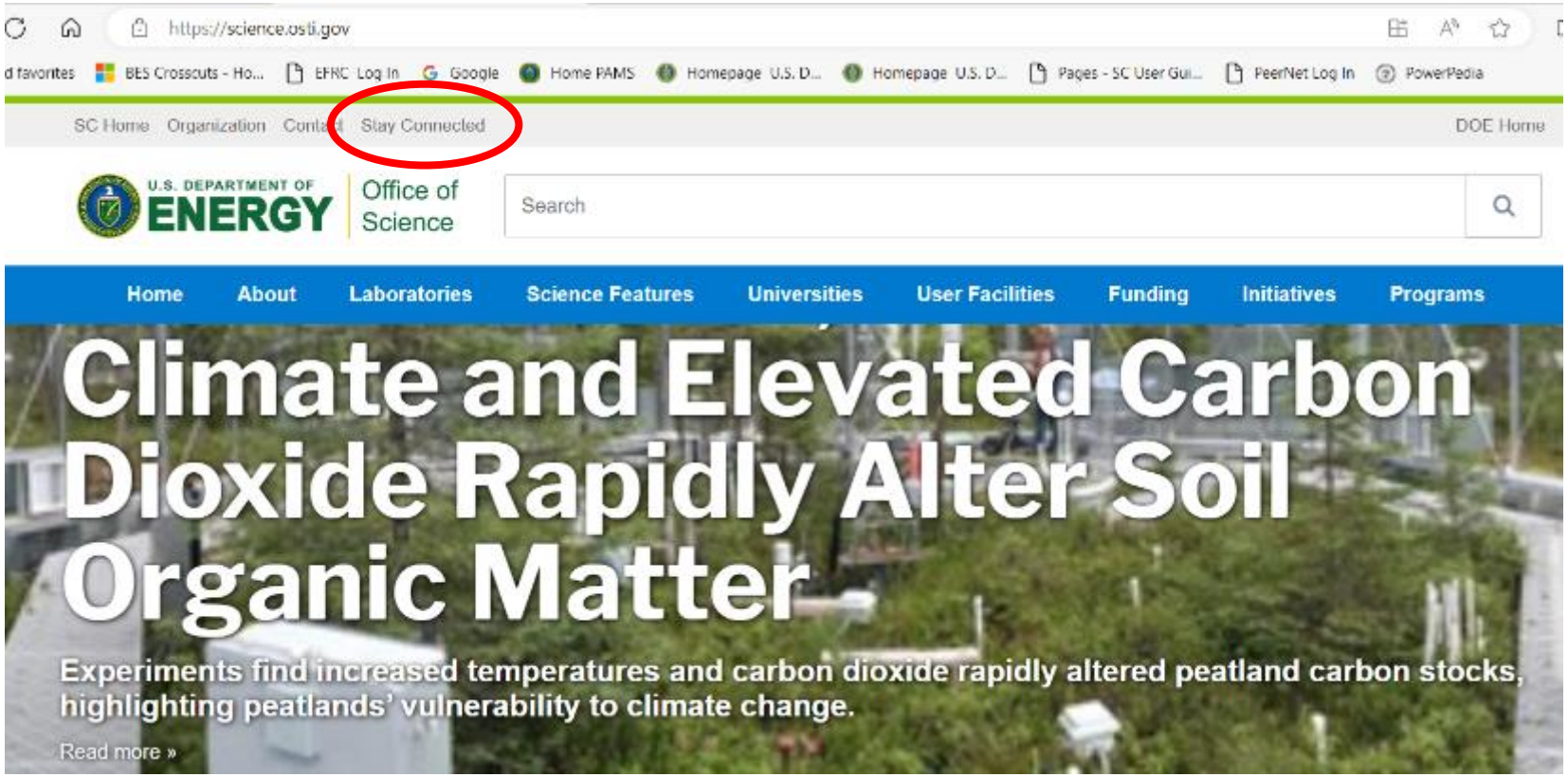


THANK YOU!