Biological and Environmental Research (BER) User Facilities

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U.S. DEPARTMENT OF ENERGY | Office of Science

Energy.gov/science

Office of Science Statement of Commitment & Other Guidance

- **SC Statement of Commitment** – SC is fully and unconditionally committed to fostering safe, diverse, equitable, inclusive, and accessible work, research, and funding environments that value mutual respect and personal integrity.
  https://science.osti.gov/SW-DEI/SC-Statement-of-Commitment
- **Expectations for Professional Behaviors** – SC's expectations of all participants to positively contribute to a professional, inclusive meeting that fosters a safe and welcoming environment for conducting scientific business, as well as outlines behaviors that are unacceptable and potential ramifications for unprofessional behavior.
  https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/Harassment
- **How to Address or Report Behaviors of Concern** – Process on how and who to report issues, including the distinction between reporting on unprofessional, disrespectful, or disruptive behaviors, and behaviors that constitute a violation of Federal civil rights statutes.
  https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/How-to-Report-a-Complaint
- **Implicit Bias** – Be aware of implicit bias, understand its nature – everyone has them – and implicit bias if not mitigated can negatively impact the quality and inclusiveness of scientific discussions that contribute to a successful meeting.
  https://kirwaninstitute.osu.edu/article/understanding-implicit-bias

Housekeeping

During the presentation, submit questions using the Zoom Q&A feature. This is accessible at the bottom of your Zoom window. We will answer these live at the end of the presentation as time permits.

After the presentation if there is time, you can ask your question live by raising your hand in Zoom. We will ask you to unmute to ask your question.

If your question is not answered today, or if you have additional questions about a specific topic, please contact any BSSD program manager.

Recordings and slides from office hours will be posted after completion of each office hour. https://science.osti.gov/ber/officehours

Agenda

- Introduction to BER
- Role of User Facilities in the BER strategy
- Strategy and tips for using BER's user facilities
  - Joint Genome Institute (JGI)
  - Environmental Molecular Science Laboratory (EMSL)
  - Atmospheric Radiation Measurement (ARM)
- Q&A

U.S. DEPARTMENT OF ENERGY | Office of Science

Our Mission:

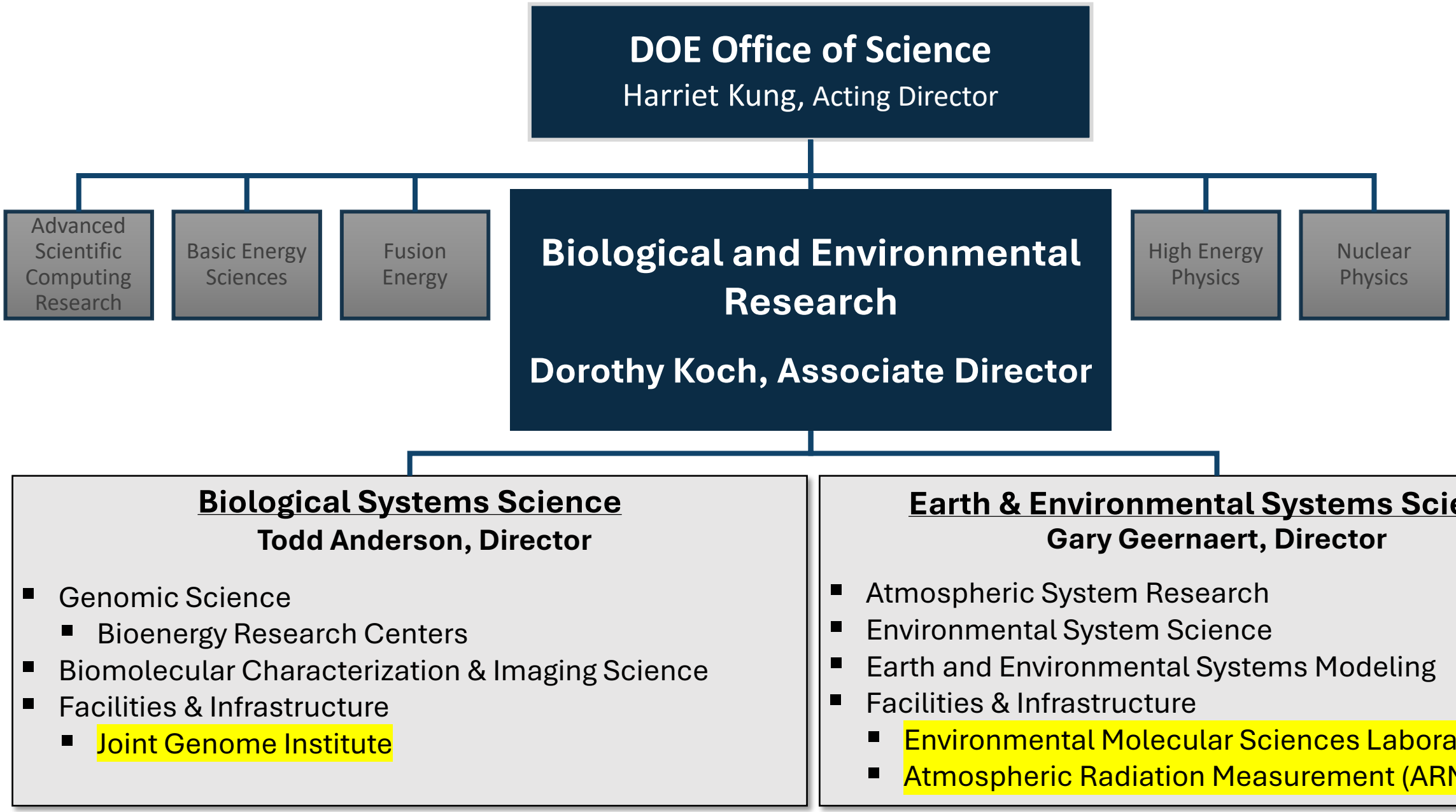
Deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States.

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

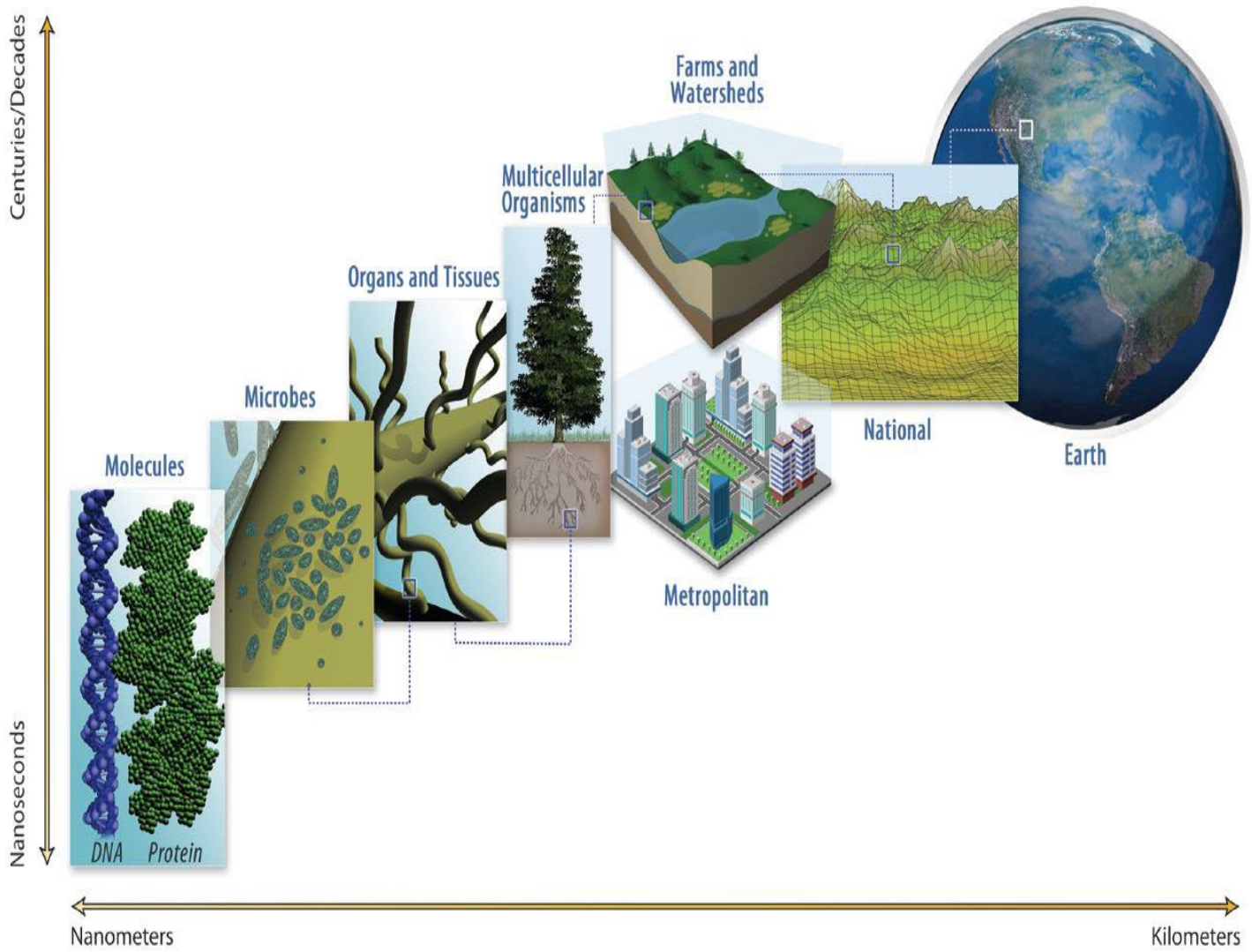
More than **37,000** users of **28** Office of Science scientific user facilities

$8.1B (FY 23 enacted)


DOE Office of Science
Harriet Kung, Acting Director
Advanced Scientific Computing Research
Basic Energy Sciences
Fusion Energy
Biological and Environmental Research
Dorothy Koch, Associate Director
High Energy Physics
Nuclear Physics
Biological Systems Science
Todd Anderson, Director
Genomic Science
Bioenergy Research Centers
Biomolecular Characterization & Imaging Science
Facilities & Infrastructure
Joint Genome Institute
Earth & Environmental Systems Science
Gary Geernaert, Director
Atmospheric System Research
Environmental System Science
Earth and Environmental Systems Modeling
Facilities & Infrastructure
Environmental Molecular Sciences Laboratory (EMSL)
Atmospheric Radiation Measurement (ARM)

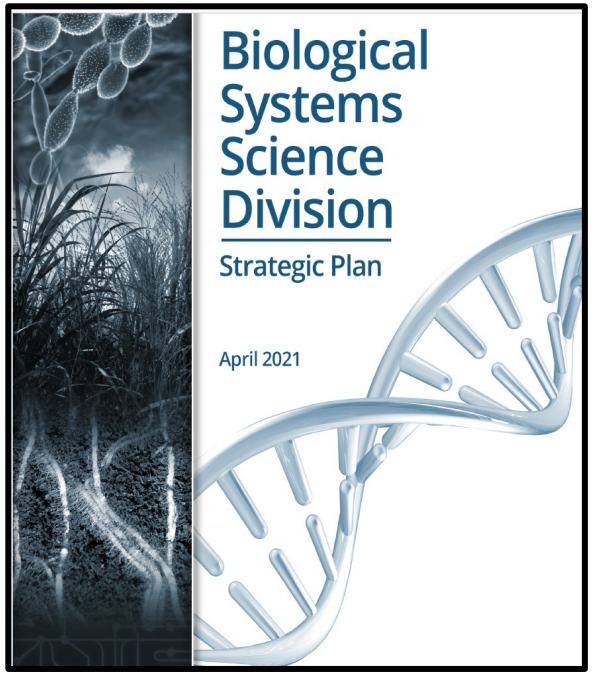
Scope of the BER Portfolio

MISSION: to achieve a predictive understanding of complex biological, earth, and environmental systems with the aim of advancing the nation's energy and infrastructure security.



Strategic Questions: Biological Systems Science

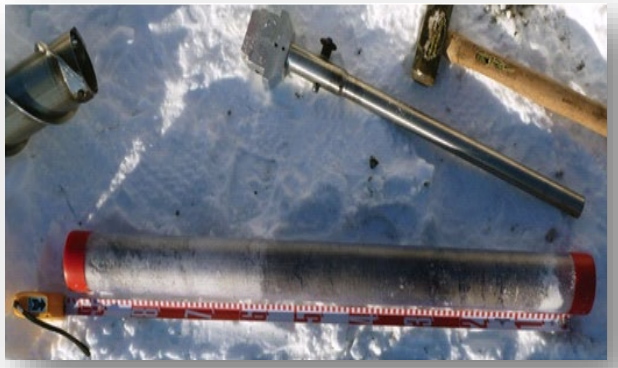
- What information is encoded in the genome sequence and how does this information explain the functional characteristics of cells, organisms, and whole biological systems?
- How do interactions among cells regulate the functional behavior of living systems and how can those interactions be understood 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

Strategic Questions: Earth and Environmental Systems Sciences

- How can we understand and predict cloud-aerosol-precipitation interactions, and their influence on the Earth's energy balance?
- Can we design Earth system models that accurately reflect advanced scale-aware process representations of Earth system observations, incorporating physical, chemical, biological, and human components?
- What do we need to know about terrestrial ecosystems, watersheds, urban, and coastal systems to improve how they are represented in Earth system models?
- How can we improve understanding of heterogeneous, climate-sensitive systems, such as urban communities, and their resilience to climate-relevant changes and disturbance?

DOE BER Permanent Staff

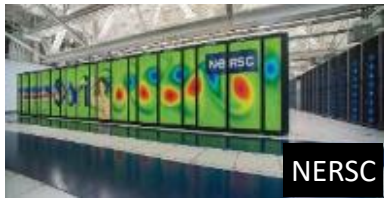
Office of Science User Facilities

https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance

FY 2023

28 scientific User Facilities

>37,000 users



U.S. DEPARTMENT OF ENERGY
Office of Science

BER-Supported User Facilities

https://arm.gov/

https://www.emsl.pnnl.gov/

https://jgi.doe.gov

DOE Scientific User Facilities Provide researchers with the most advanced tools of modern science, including accelerators, colliders, supercomputers, light and neutron sources, as well as facilities for studying the nano world, the environment, and the atmosphere.

BER supports three world class scientific user facilities:

- **Joint Genome Institute (JGI)**
- **Environmental Molecular Sciences Laboratory (EMSL)**
- **Atmospheric Radiation Measurement (ARM)**

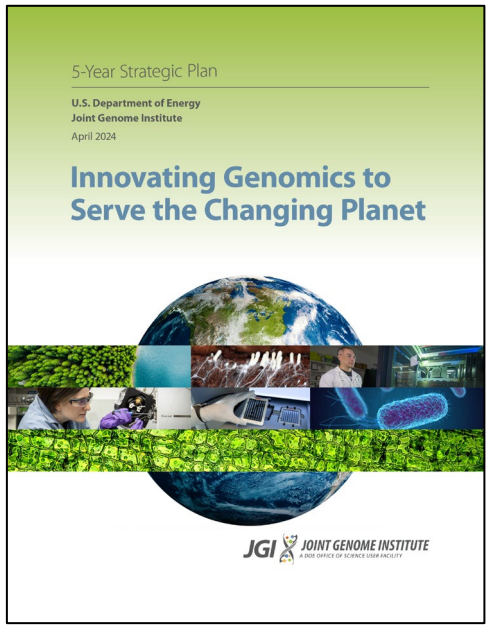
Free access to instruments and analysis via annual/regular user proposals.

JGI

Joint Genome Institute (JGI)

https://jgi.doe.gov/

A new Vision and Mission for JGI



New JGI Strategic Plan

April 2024

Download PDF at:
jointgeno.me/2024StrategicPlan

JGI Vision (2024)

Lead genomic innovation for a sustainable bioeconomy

JGI Mission (2024)

As a U.S. Department of Energy Office of Science user facility, we provide advanced genomic capabilities, large-scale data, and professional expertise to support the global research community in studies of complex biological and environmental systems. We optimize our service to the community through responsibly managing our people and resources.

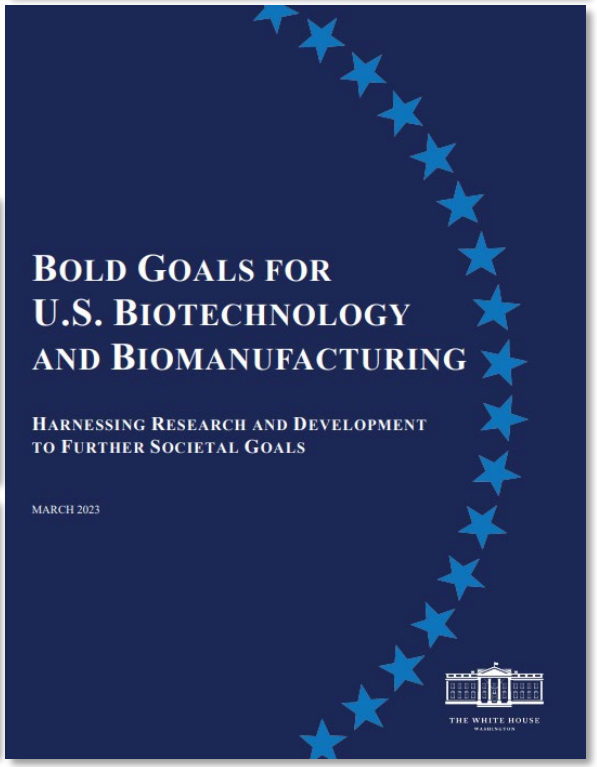

THE WHITE HOUSE

SEPTEMBER 12, 2022

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

BRIEFING ROOM › PRESIDENTIAL ACTIONS

"use biotechnology, biomanufacturing, bioenergy, and biobased products to address the causes and adapt to and mitigate the impacts of climate change"



JGI Future Strategic Themes and Initiatives

Four Strategic Themes

Nutrient Cycling
Understanding and Utilizing Biomolecular Mechanisms of Nutrient Cycling

Functional Diversity
Characterizing Functional Diversity across the Domains of Life

Data and Connectivity
Standardize and Streamline JGI Data, Systems, Tools, and Resources to Enable Scale

Stewarding Resources
Enhance JGI's Impact Through Nurturing its People, Systems, Processes, and Communications

Two Strategic Initiatives

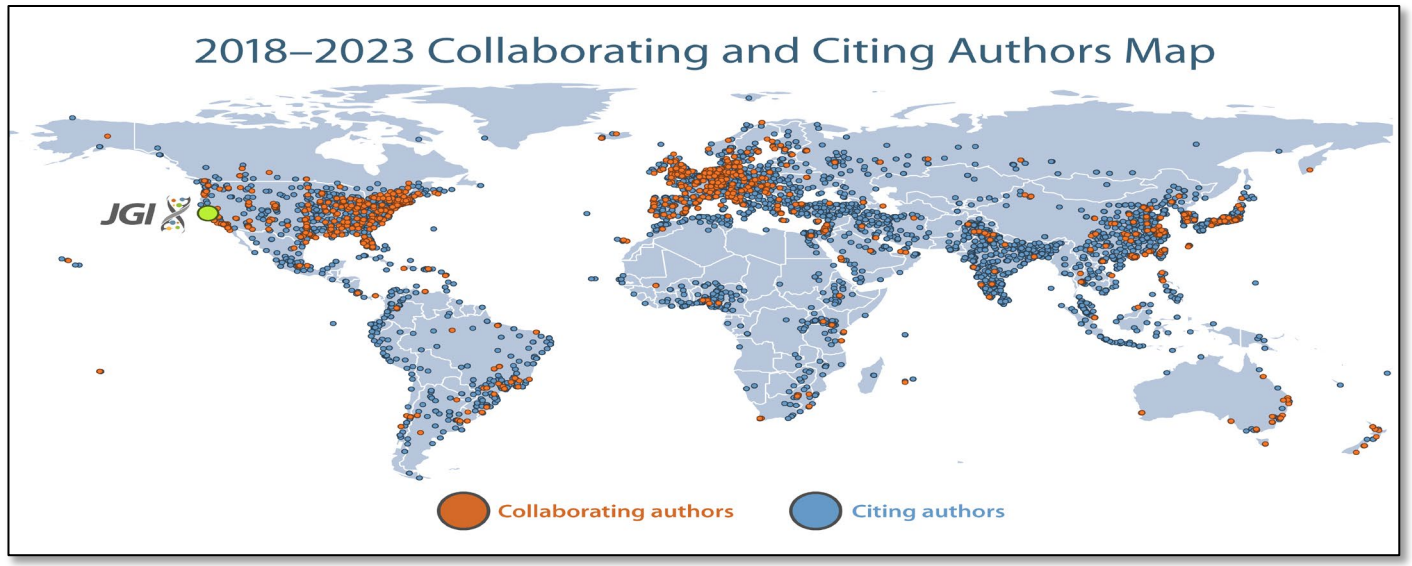
Strategic Initiative A:
Biomolecular Materials

Strategic Initiative B:
Biosurveillance and Biopreparedness

The JGI: A Unique DOE User Facility

Among the DOE user facilities, the JGI isunique in providing access to

- state-of-the-art sequencing
- advanced functional genomics
- DNA synthesis and metabolomics
- related analysis tools and data portals



Affiliations of ~300,000 authors who have collaborated with JGI personnel or primary users, or who have cited JGI publications, data, or data systems in the past 5 years.

- 716.9 Terabases sequence generated
- 11 Megabases DNA synthesized
- 11.56K metabolomics analyses runs
- 161 proposals submitted
- 64 proposals approved

- Total files requested: 7.9M
- JGI Archive size grew to:
  15.2 million file records
- 15.95 Petabytes (PB) of data

8.2K total podcast downloads

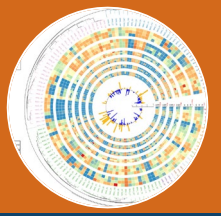
2,373 Primary Users
22,262 Secondary Users

JGI Designs & Builds Advanced Genomic Capabilities for BER Users

JGI provides advanced genomic capabilities, large-scale data, and professional expertise to support the global research community in addressing energy and environmental research grand challenges.

Nutrient Cycling

Functional Diversity



Data and Connectivity

Stewarding Resources

Genome Targets

Plant

Fungal & Algal

Metagenome

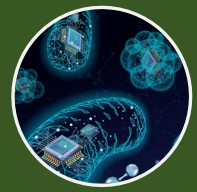
Microbial

Infrastructure & Capabilities

DNA Sequencing Platforms
- Illumina NovaSeqX
- PacBio Revio
- Oxford Nanopore PromethION

Advanced Genomic Technologies
- Single-cell Sequencing
- Stable Isotope Labeling
- Methylation/Epigenomics
- Transcriptomics

Metabolomics
- Polar-/non-polar LC/MS metabolite profiling
- Targeted and untargeted metabolite analysis

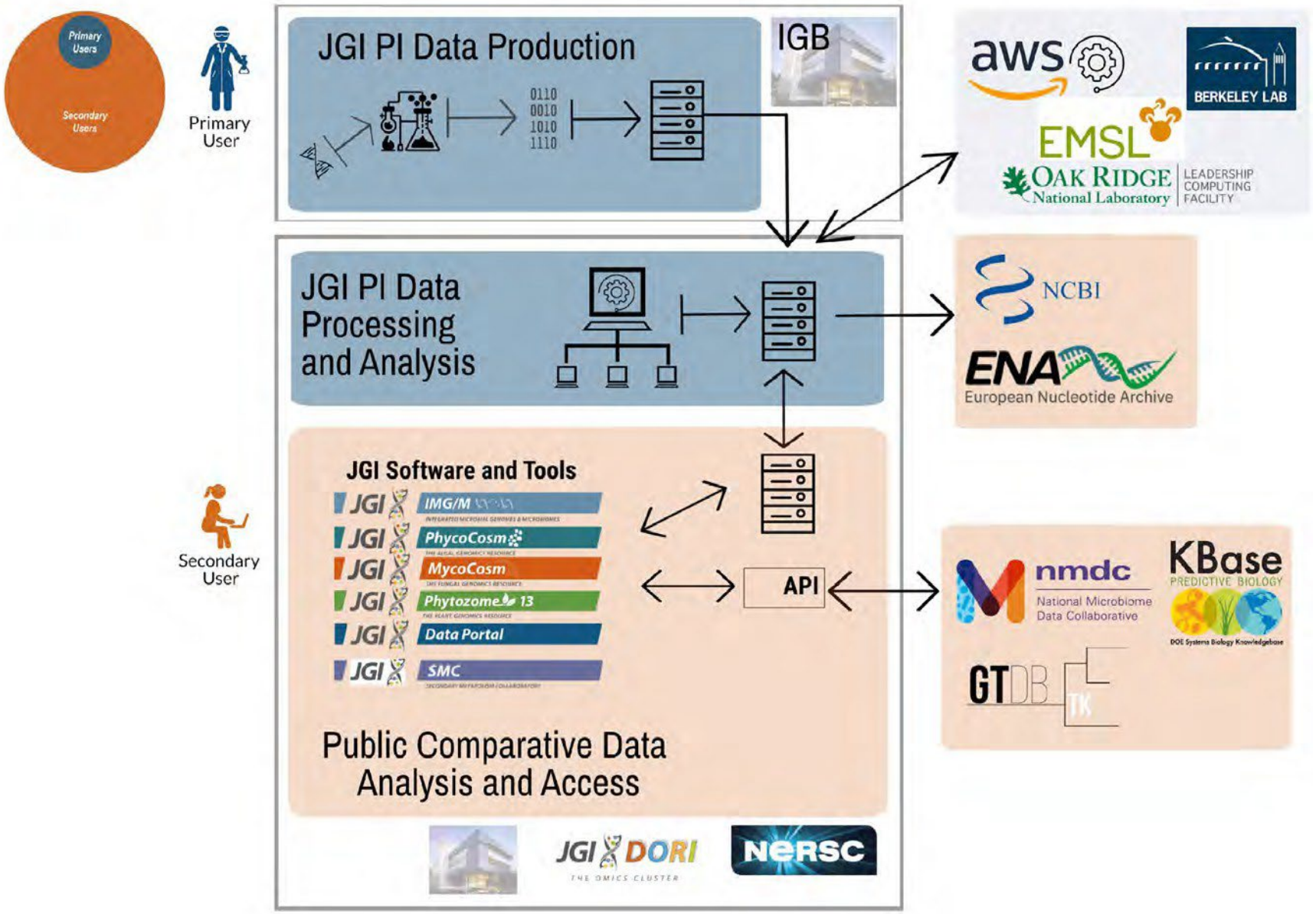


DNA Synthesis
- Design & Pathway Assembly
- Host Engineering

Secondary Metabolites
- Large-scale bioinformatic mining
- Integrated workflows
- BGC exploration

Data Science & Informatics

JGI Data Science Group Provides Infrastructure Support for Primary and Secondary JGI Users



Additional Computing Resources

National and international Data Repositories

External Partners

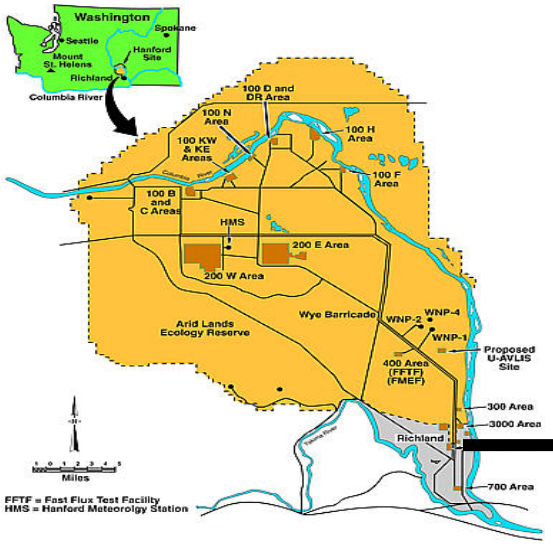
User Program calls: frequencies, scales and scopes

	Annual CSP	New Investigator CSP (New PI!)	Functional Genomics CSP	JGI-EMSL FICUS
FREQUENCY	Once per year	Once per year	Once per year	Once per year
SCALE				
Sequencing	10 Tb Illumina, 1 Tb PacBio	3 Tb	54 RNAs	3 Tb
Synthesis	500 kb (-1,500 kb) synthesized DNA	500 kb synthesized DNA	500 kb (-1,500 kb) synthesized DNA	500 kb synthesized DNA
Metabolomics	200 samples (polar), 500 samples (nonpolar)	50 samples (polar), 150 samples (nonpolar)	50 samples (polar), 150 samples (nonpolar)	200 samples (polar), 500 samples (nonpolar)
SCOPE	**All JGI capabilities offered**	Reference genomes, Resequencing, RNA-seq, Metagenomes & transcriptomes, DNA synthesis, Metabolomics	DNA synthesis, Reference genomes, RNA-seq, Metabolomics, Sequence data mining, Strain engineering, CRAGE and DAP-seq	**All JGI capabilities offered**

https://jgi.doe.gov/news-publications/webinars/

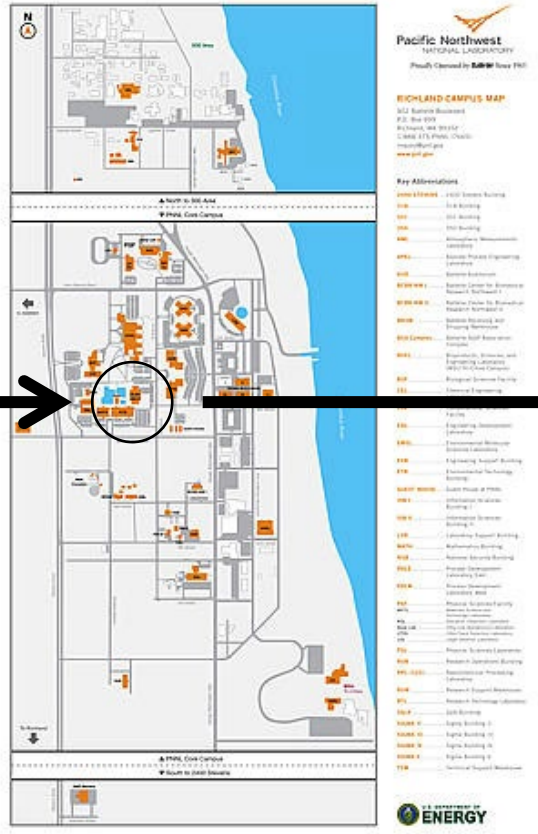
EMSL

Environmental Molecular Sciences Laboratory (EMSL) Location



DOE Hanford Site
586 mi^2

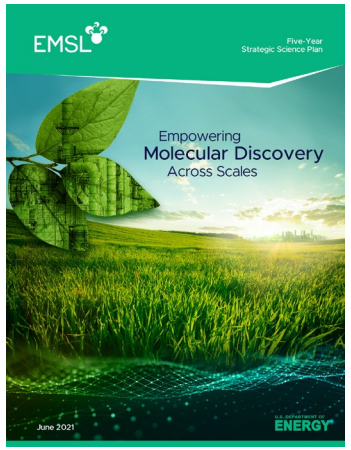
At the Pacific Northwest National Laboratory (PNNL) in Richland, WA.



PNNL

EMSL - 234,000 ft^2 of Laboratory space (blue), including the “Quiet Wing,” plus Office (green) space.

EMSL Vision, Mission, and Proposal Opportunities



2021 EMSL Strategic Plan

EMSL's Vision: A research community empowered to study the role of molecular processes in controlling the function of biological and ecological systems across spatial and temporal scales, and to enable a predictive understanding of the living Earth system.

EMSL's Mission: To provide access to premier multi-modal molecular science instruments, data analytics, production computing, and multi-scale modeling to enable researchers to study biotic and abiotic processes, and to understand their function in a systems context for energy and environmental security and infrastructure resilience.

Annual Call for Proposal Opportunities at EMSL

FICUS PROGRAM
One proposal to access EMSL, JGI and other user facilities. Call opens in January.

LARGE SCALE RESEARCH
Project duration up to 24 months.
Call opens in December.

EXPLORATORY PROPOSALS
Project duration of up to 9 months.
Call opens in June.

SCIENTIFIC PARTNER
Strategically aligned projects to develop EMSL capabilities, including instrumentation. Partners must provide significant in-kind contribution. Proposals accepted year round.

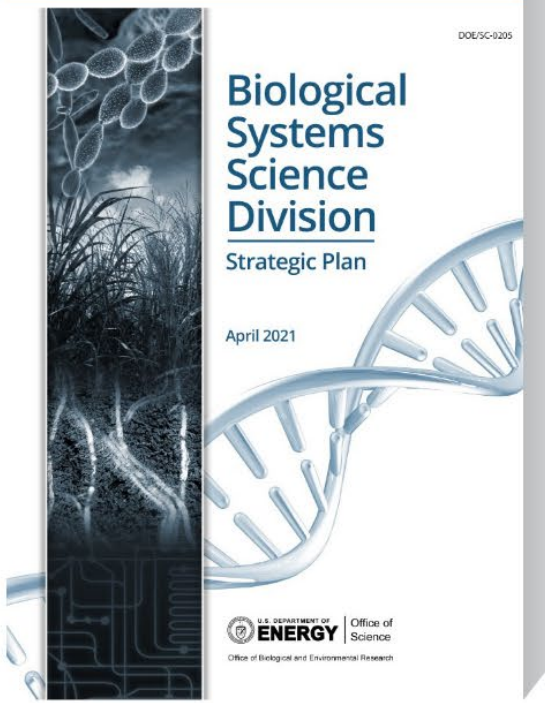
LIMITED SCOPE
Highly focused research projects of limited duration. Proposals accepted year round.

https://www.emsl.pnnl.gov/user-program/how-to-work-with-us

EMSL

EMSL's User Program Supports the Range of BER Science

Biological Systems Sciences Division

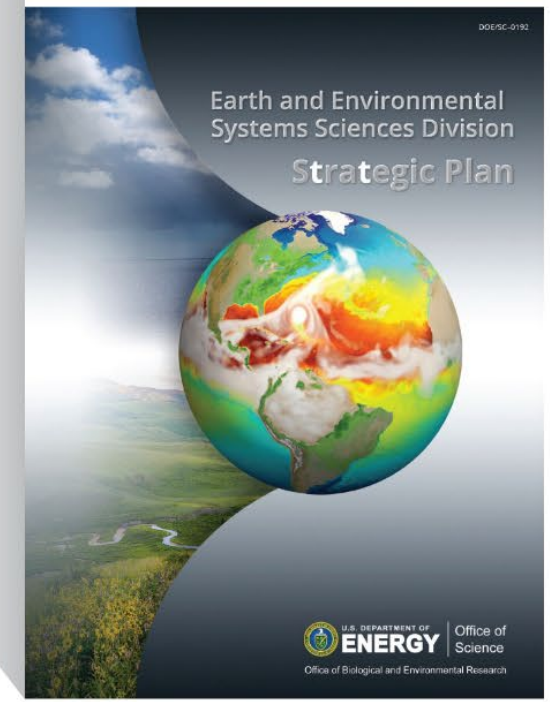


EMSL's Research Community: BER supported and aligned with BER's areas of research.

Functional and Systems Biology	Computing Analytics and Modeling	Environmental Transformations and Interactions
INTEGRATED RESEARCH PLATFORMS		
Structural Biology	Systems Modeling	Biogeochemical Transformations
Biomolecular Pathways	Data Transformations	Terrestrial-Atmospheric Processes
Cell Signaling & Communication	Computing Platforms (coming soon)	Rhizosphere Function

EMSL's more than 150 instruments are organized for scientific research and impact.

Earth and Environmental Systems Sciences Division



https://www.emsl.pnnl.gov EMSL

EMSL Future – Strategic Science Objectives

Environmental Transformations and Interactions

Biogeochemical Transformations

Terrestrial-Atmospheric Processes

Rhizosphere Function

MONet

Modeling from elements to ecosystems

https://www.emsl.pnnl.gov/monet

Functional and Systems Biology

Structural Biology

Biomolecular Pathways

Cell Signaling & Communication

DigiPhen

Engineering biology from biomolecules to organisms

https://www.emsl.pnnl.gov/digiphen

Computing Analytics and Modeling

Systems Modeling

Data Transformations

Computing Platforms (coming soon)

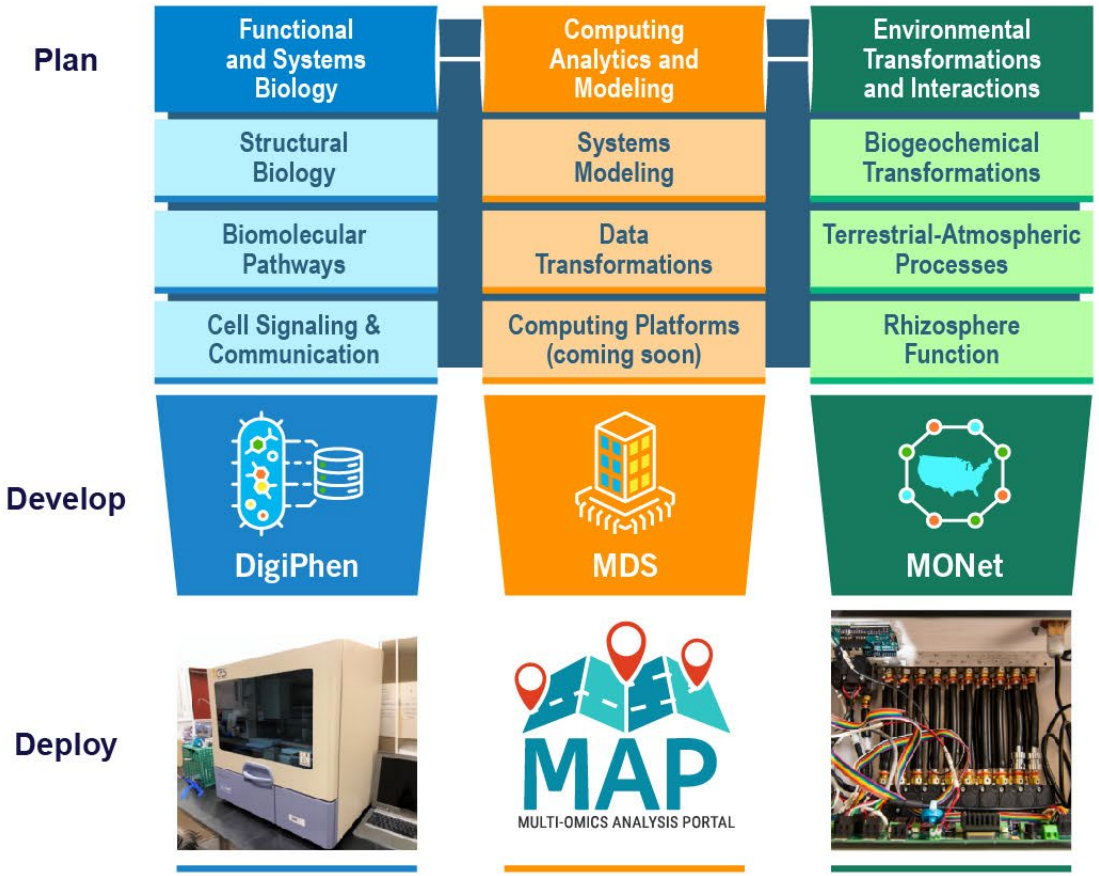
MDS

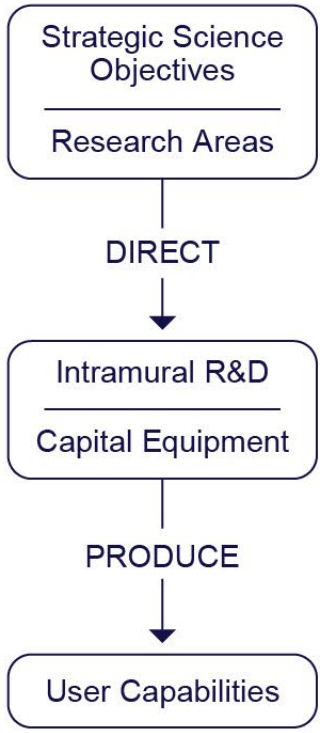
Modeling from elements to ecosystems

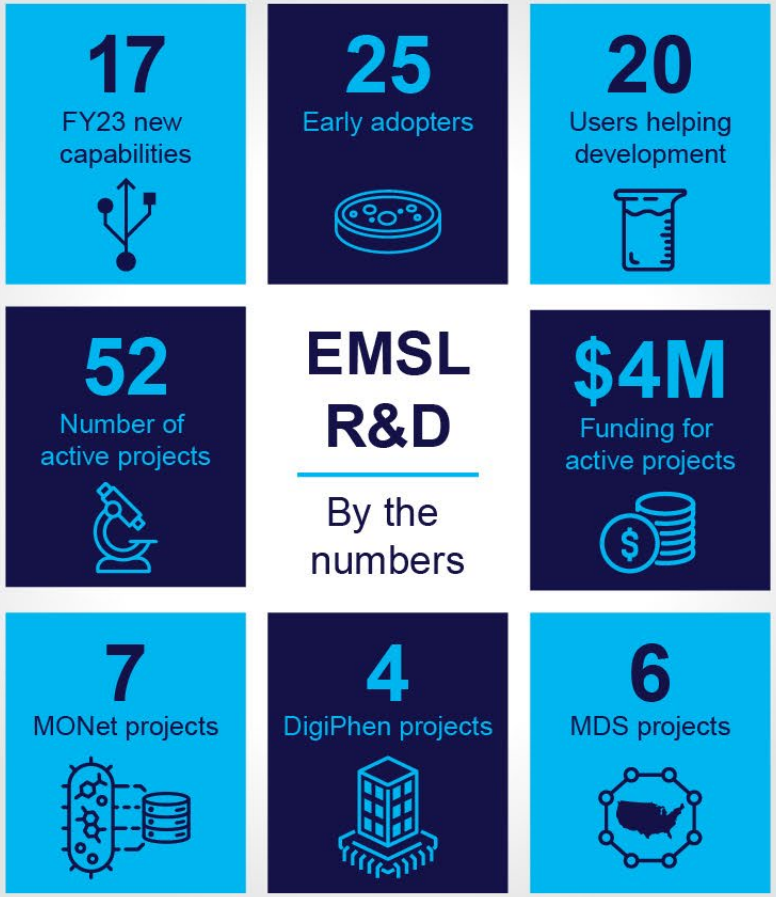
https://www.emsl.pnnl.gov/MDS

EMSL

EMSL Designs & Builds Tomorrow's Capabilities for BER Users







EMSL

Future EMSL Capabilities

Project Title

Microbial Molecular Phenotyping Capability (M2PC)

Objective

A high-throughput and highly automated microbial phenotyping capability.

Purpose

Facilitate "Big" BER-relevant Science

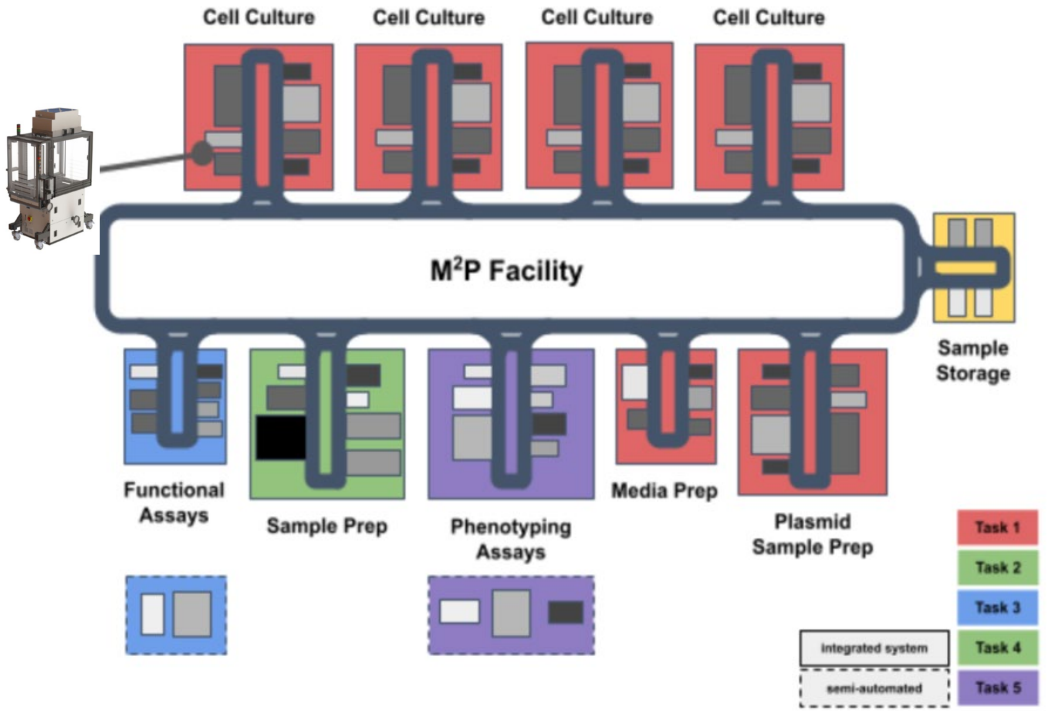
Project Details

Cost ~$122M

Building Size ~ 24,500 sq. ft.[2]

Automation Capabilities – Culturing, Phenotypic Characterization, Data Analytics

Available - 2031



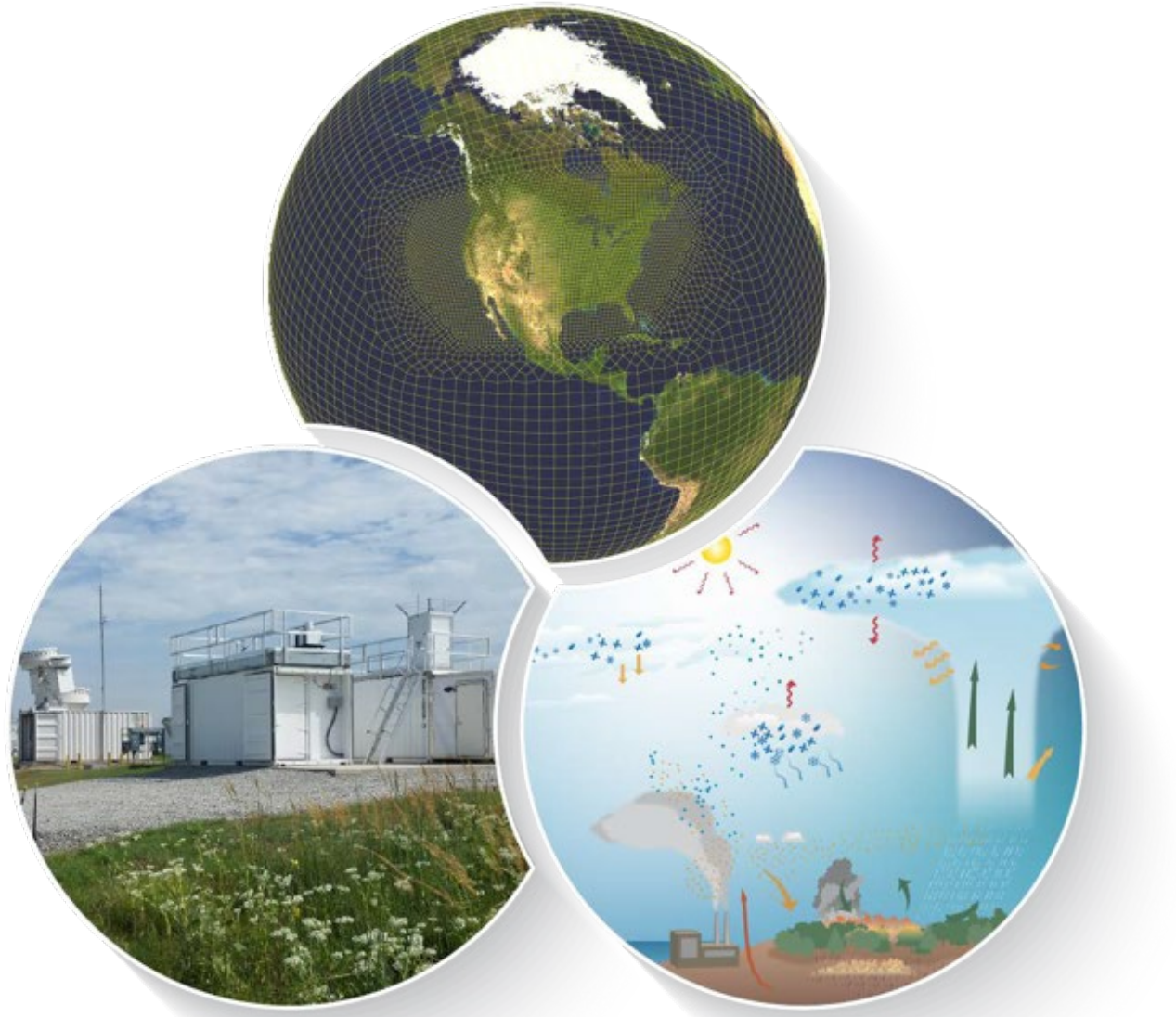
EMSL

ARM

Atmospheric Radiation Measurement (ARM) User Facility

MISSION:

- Provide the climate research community with strategically located atmospheric observatories to improve the understanding and representation in earth system models of clouds and aerosols and their interactions with the Earth's surface.



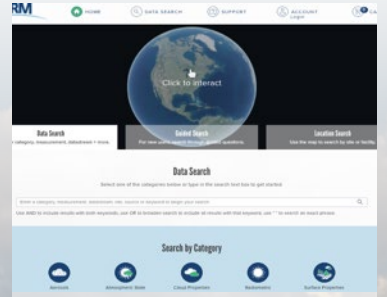
The Atmospheric Radiation Measurement (ARM) User Facility

Measurements of clouds, aerosols, precipitation, radiation, surface properties & the atmospheric state since 1992

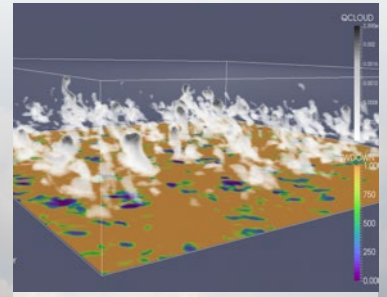
Support for process studies & model & satellite development

Network of 3 fixed-location & 3 mobile observatories

Piloted & uncrewed aerial measurement platforms



Extensive data management infrastructure. Data freely available

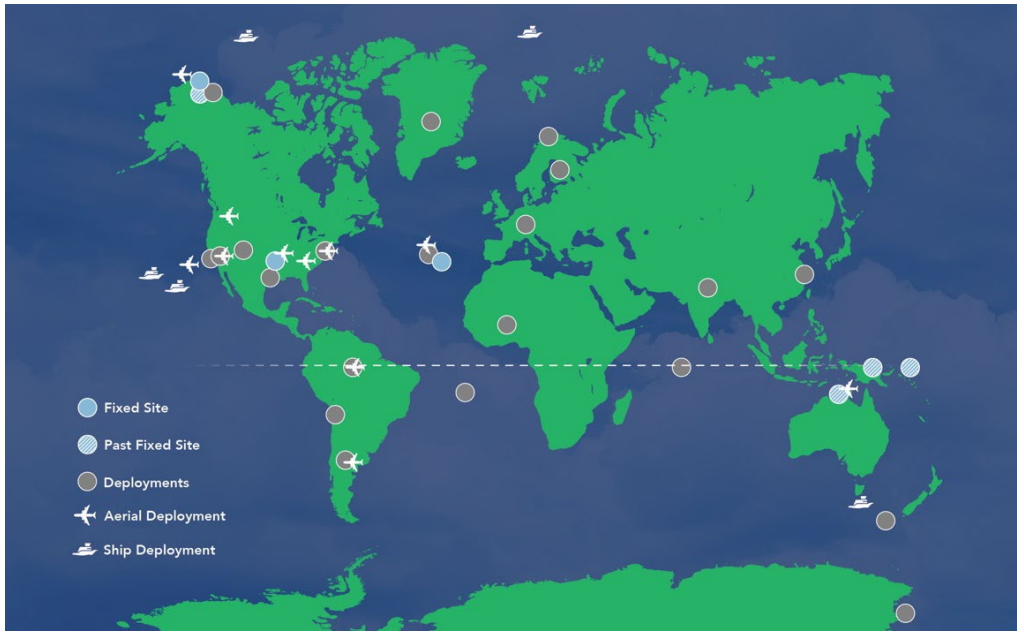


Large-eddy simulation (LES) model simulations & analysis tools

Support for field campaigns ranging from guest instruments to facility deployments

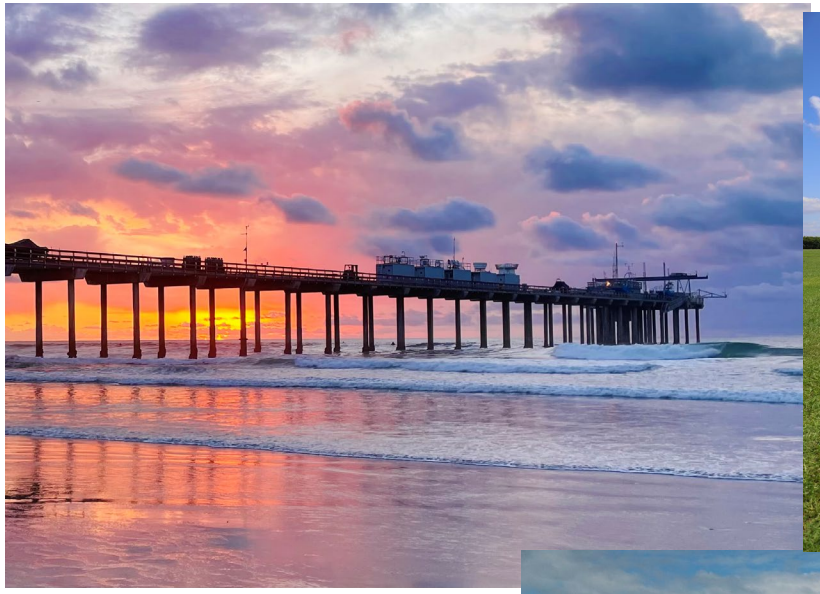
ARM Data and Facilities Support Research Applications, Capability Development and Education

- Freely available data support diverse applications:
  - Research from climate science to renewable energy to bird migration
  - Testbed for evaluating instruments and models
  - Teaching measurement principles (~100 instrument types) and data analysis
- ARM observatories host visitors and ~50 field campaigns each year that enable:
  - Operation of guest instruments
  - Special operations of ARM instruments
  - Deployment of mobile ARM facilities
- Training events to inform the next generation of scientists



ARM Fixed Site/Mobile Facility Instruments

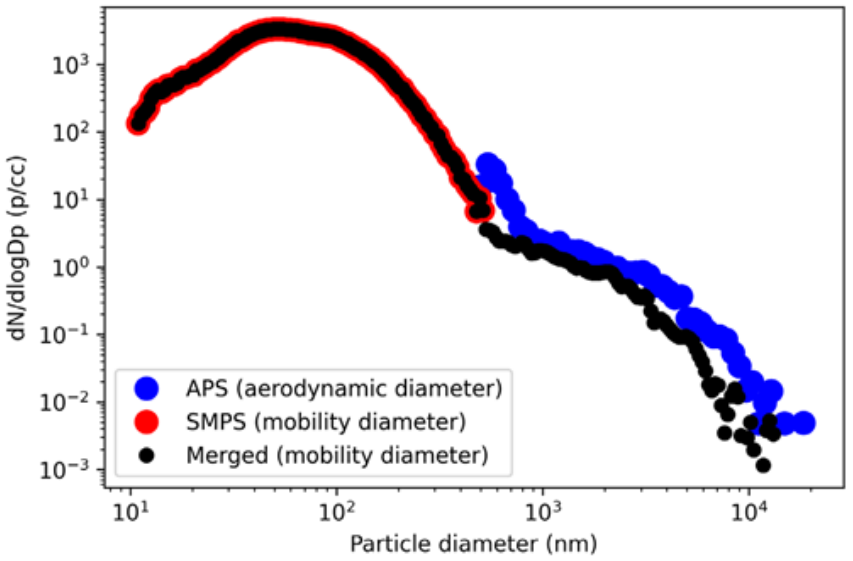
- ARM operates over 400 instruments; with ~50 instruments at each site
  - Surface meteorology
  - Surface radiation budget
  - In situ aerosol properties
  - Column water (microwave radiometer)
  - Column aerosol (solar spectral radiometer)
  - Atmospheric wind/ temperature/relative humidity profiles (radiosonde/Doppler lidar)
  - Cloud properties (radar and lidar)



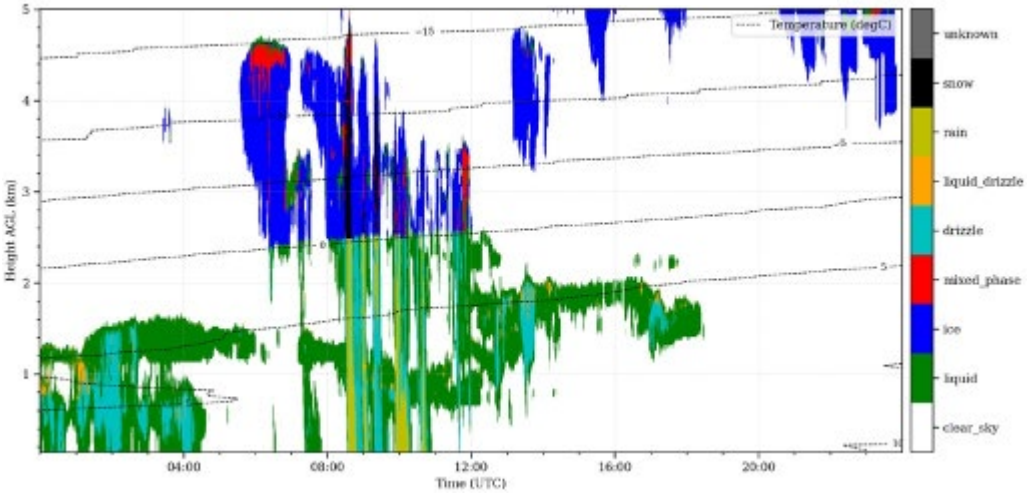
Using ARM Data

- Most ARM users are "data users" - download data for their research projects
- ARM data is freely available to research community at https://www.arm.gov/data/
  - Requires user registration
  - Demographic information, funding source, description of research project
- ARM "Value Added" Products
  - Merged datasets
  - Retrievals of geophysical variables from instruments
- ARM Data Workbench
  - JupyterHub notebooks for working with ARM data
  - High-performance computing for analysis of large ARM datasets (e.g., radar, LES output, etc.)

Merged Aerosol Size Distribution



Thermodynamic Cloud Phase



Using Other ARM Capabilities – Proposal Process

- Small campaigns
  - Propose to bring your own instrument to an ARM site
  - Request special operations of ARM instruments (scanning strategies, enhanced radiosondes, etc.)
  - Can be submitted any time
    - Reviewed internally by ARM Infrastructure Board
    - Submit at least 3 months before proposed start date
- Tethered balloon (TBS) / Unmanned aerial systems (UAS)
  - Annual proposal calls for TBS (including joint call with EMSL) and UAS missions
  - Scientific peer review & logistical review by ARM
- Mobile Facility
  - ~Annual proposal call for deployment of the ARM Mobile Facility
  - Scientific peer review & logistical review by ARM

Learn More About ARM

- ARM newsletter
  - https://www.arm.gov/news-events/newsletter-archive
- ARM website
  - https://www.arm.gov
- Resources for new ARM users:
  - https://www.arm.gov/about/resources-for-new-arm-users
- ARM webinars/tutorials
  - https://www.arm.gov/data/work-with-arm-data/webinars/
- Summer Schools
  - For early career scientists (graduate students/postdocs)

Expanding the Reach and Impact of BER-Funded Research

KBase

nmdc
National Microbiome
Data Collaborative

ESS-DIVE

Facilities Integrating Capabilities for User Science (FICUS)

Novel mechanism whereby researchers can gain access to multiple user facilities (whether supported by BER or BES, or even interagency) through a single proposal.

Participants include:

EMSL, JGI, ARM
APS & CSMB (ORNL)
NEON (NSF)

Call Solicitation (for 2-year projects) opens annually in December with awards commencing October 1st of the following year.

https://www.emsl.pnnl.gov/proposals/type/ficus-program

Future BER Office Hours

- Upcoming dates/topics:
  - Tuesday, July 23, 2024 at 2:00-3:00 pm ET
    FOA application and review process within BER programs
- Additional information and registration links here: https://science.osti.gov/ber/officehours

- **Zoom Poll**
  - How did you hear about BER office hours?
  - What additional office hours topics interest you?

Questions & Answers

Questions asked during the presentation through the Zoom Q&A will be answered live now.

If there is time available and you would like to ask your question live, raise your hand in Zoom and we will ask you to unmute to ask your question.

If your question is not answered today, or if you have additional questions about a specific topic, please contact any EESSD program manager.

Thank you!