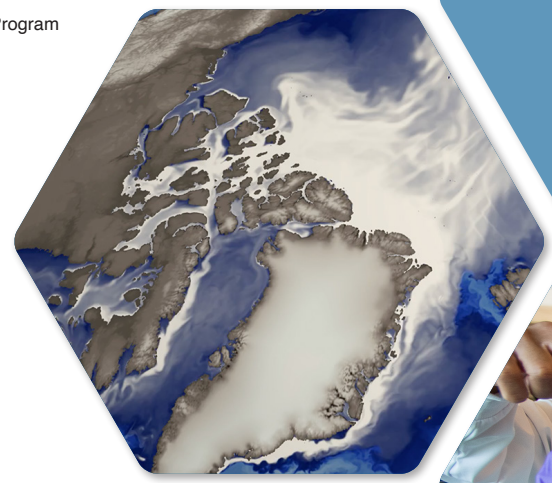
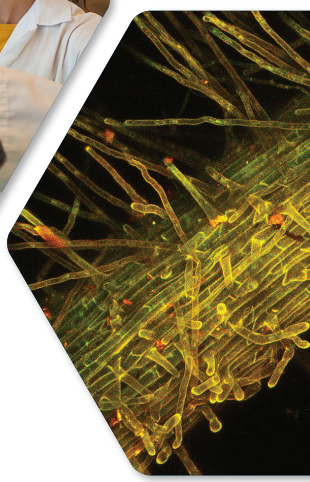
U.S. DEPARTMENT OF ENERGY | Office of Science

Biological and Environmental Research Program

science.osti.gov/ber





U.S. Department of Energy Office of Science

Biological and Environmental Research

The Biological and Environmental Research (BER) program supports transformative science and scientific user facilities examining complex biological, Earth, and environmental systems for clean energy and climate innovation.

BER research seeks to understand the fundamental biological, biogeochemical, and physical principles needed to predict a continuum of processes occurring across scales, from molecules and genomes at the smallest scales to environmental and Earth system change at the largest scales. This research—conducted at universities, U.S. Department of Energy (DOE) national laboratories, and research institutions across the country—is contributing to a future of reliable, resilient energy sources and evidence-based climate solutions.

Essential to these missions are research practices and a scientific workforce that embrace belonging, accessibility, justice, equity, diversity, and inclusion. As part of DOE-wide initiatives to advance these values, BER is pursuing new avenues to engage historically underrepresented individuals and institutions and piloting new models of support for research and training.

BER BY THE NUMBERS

FISCAL YEAR 2022

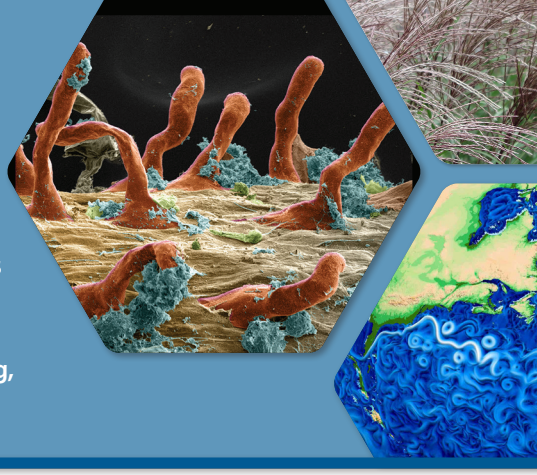
$815 MILLION
Total Budget

MORE THAN 185
Universities, Nonprofits, and Research Institutions and 13 DOE National Laboratories Conduct BER Basic Research

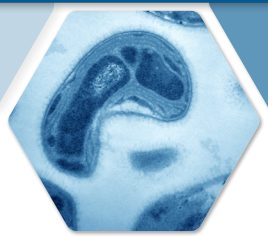
1,337 PUBLICATIONS
in 424 Journals

MORE THAN 4,100
Users at 3 User Facilities

Biological Systems Science



BER's Biological Systems Science Division (BSSD) seeks to understand, predict, manipulate, and design plant and microbial systems for advances in renewable energy, insights into environmental processes, and biotechnological breakthroughs supporting the U.S. bioeconomy. To expand knowledge of biological systems, BSSD supports basic research and capabilities in foundational genomic science, systems biology, genome engineering, computational analysis, molecular imaging, and structural characterization.



Bioenergy

Provides genomics-based insights needed to produce and deconstruct renewable plant biomass and convert it to sustainable fuels, chemicals, and other bioproducts.

Biosystems Design

Accelerates the ability to securely design, build, and control plants and microbes for beneficial purposes such as clean energy, biomaterials, and carbon sequestration.

Environmental Microbiome

Develops a process-level understanding of the impacts of plant and soil microbial communities on the cycling and fate of carbon, nutrients, and contaminants in the environment.

Computational Biology

Integrates capabilities, including artificial intelligence and machine learning, tailored to large-scale data science investigations of plant and microbial systems.

Bioimaging Science

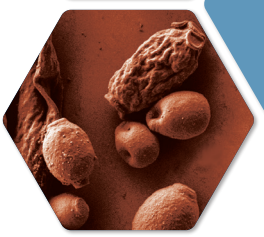
Advances multifunctional technologies, including quantum-enabled approaches, to image, measure, and model key metabolic processes in microbial cells and plant tissues.

Joint Genome Institute

The JGI user facility is the preeminent resource for sequencing plants, fungi, algae, microbes, and microbial communities foundational to energy and environmental research. With nearly 1,600 users worldwide, JGI sequences more than 450 trillion DNA bases per year. Beyond sequencing, JGI provides state-of-the-science capabilities for metabolomics, data synthesis, and analysis.

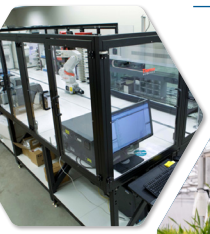
jgi.doe.gov

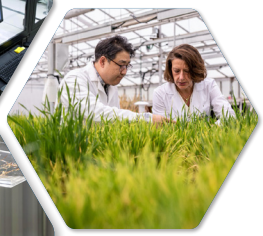
Structural Biology and Imaging Resources



BER supports unique crystallography, scattering, spectroscopy, imaging, and cryogenic electron microscopy and tomography capabilities at DOE synchrotron and neutron user facilities. The spatial and temporal resolutions provided by these resources enable unprecedented characterization and imaging of interactions among plants, microbes, and the environment.

www.berstructuralbioportal.org



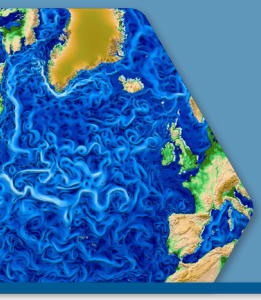


Bioenergy Research Centers

Bringing together top scientists from multiple disciplines, DOE's four Bioenergy Research Centers (below) are advancing the basic science underlying commercial production of biofuels and bioproducts. Research is focused on sustainable production and development of plant feedstocks and their deconstruction and conversion to fuels, chemicals, and other useful products.

- ***Center for Advanced Bioenergy and Bioproducts Innovation**, led by the University of Illinois at Urbana-Champaign*
- ***Center for Bioenergy Innovation**, led by Oak Ridge National Laboratory*
- ***Great Lakes Bioenergy Research Center,** led by the University of Wisconsin–Madison*
- ***Joint BioEnergy Institute**, led by Lawrence Berkeley National Laboratory*

genomicscience.energy.gov/bioenergy-research-centers/



Earth and Environmental Systems Sciences

The Earth and Environmental Systems Sciences Division supports research to characterize and understand feedbacks between Earth and energy systems, including studies on atmospheric physics and chemistry, ecosystem ecology, and biogeochemistry. Research also includes developing and validating Earth system models that integrate information on the biosphere, atmosphere, terrestrial land masses, oceans, sea ice, land ice, subsurface, and human components.

Atmospheric Research

Explores the interdependencies of clouds, atmospheric aerosols, and precipitation that influence Earth's radiation balance, advancing insights that improve climate and Earth system models.

Environmental System Science

Deepens understanding of terrestrial ecosystems, watersheds, and coastal regions by investigating their interdependent microbial, biogeochemical, ecological, hydrological, and physical processes across space and time scales.

Earth and Environmental Systems Modeling

Extends the frontiers of Earth system knowledge, with emphasis on the complex interactions of its natural and human components and climate system processes, centered around advanced computational modeling and methods that include the Energy Exascale Earth System Model, multimodel approaches, data-driven machine learning, and discovery-based visualization.

Data Management

Develops multiscale visualization and analysis methods for observational and model-generated data to benefit the scientific community.

Atmospheric Radiation Measurement User Facility

ARM supports highly instrumented ground stations, mobile measurement resources, and aerial vehicles to continuously measure cloud and aerosol properties and their impacts on Earth's energy balance. ARM's long-term observations provide an unparalleled resource for examining atmospheric processes and evaluating Earth system model performance.

www.arm.gov

Environmental Molecular Sciences Laboratory

EMSL provides users with integrated experimental and computational resources for discovery and technological innovation in the environmental molecular sciences. Researchers use EMSL to extend understanding of the physical, biogeochemical, chemical, and biological processes that underpin energy and environmental challenges.

www.emsl.pnl.gov

Urban Integrated Field Laboratories

Urban IFLs are dedicated to developing the science framework, observational tools, and prediction capabilities needed to understand how urban areas interact with the climate system. The four Urban IFLs (below) will provide the knowledge necessary to inform equitable climate and energy solutions that can strengthen community-scale resilience across urban landscapes.

- ***Baltimore Social-Environmental Collaborative**, led by Johns Hopkins University*
- ***Community Research on Climate and Urban Science**, led by Argonne National Laboratory*
- ***Southeast Texas**, led by University of Texas–Austin*
- ***Southwest Urban Corridor**, led by Arizona State University*

ess.science.energy.gov/urban-ifls/

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