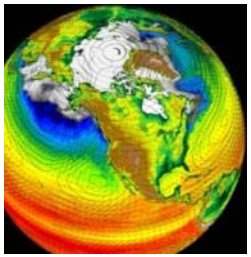
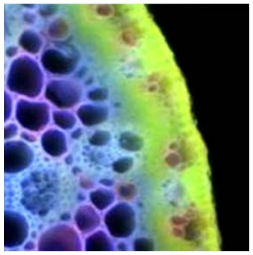
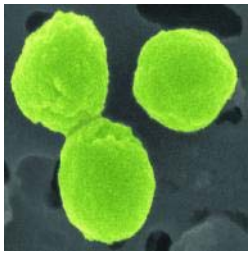


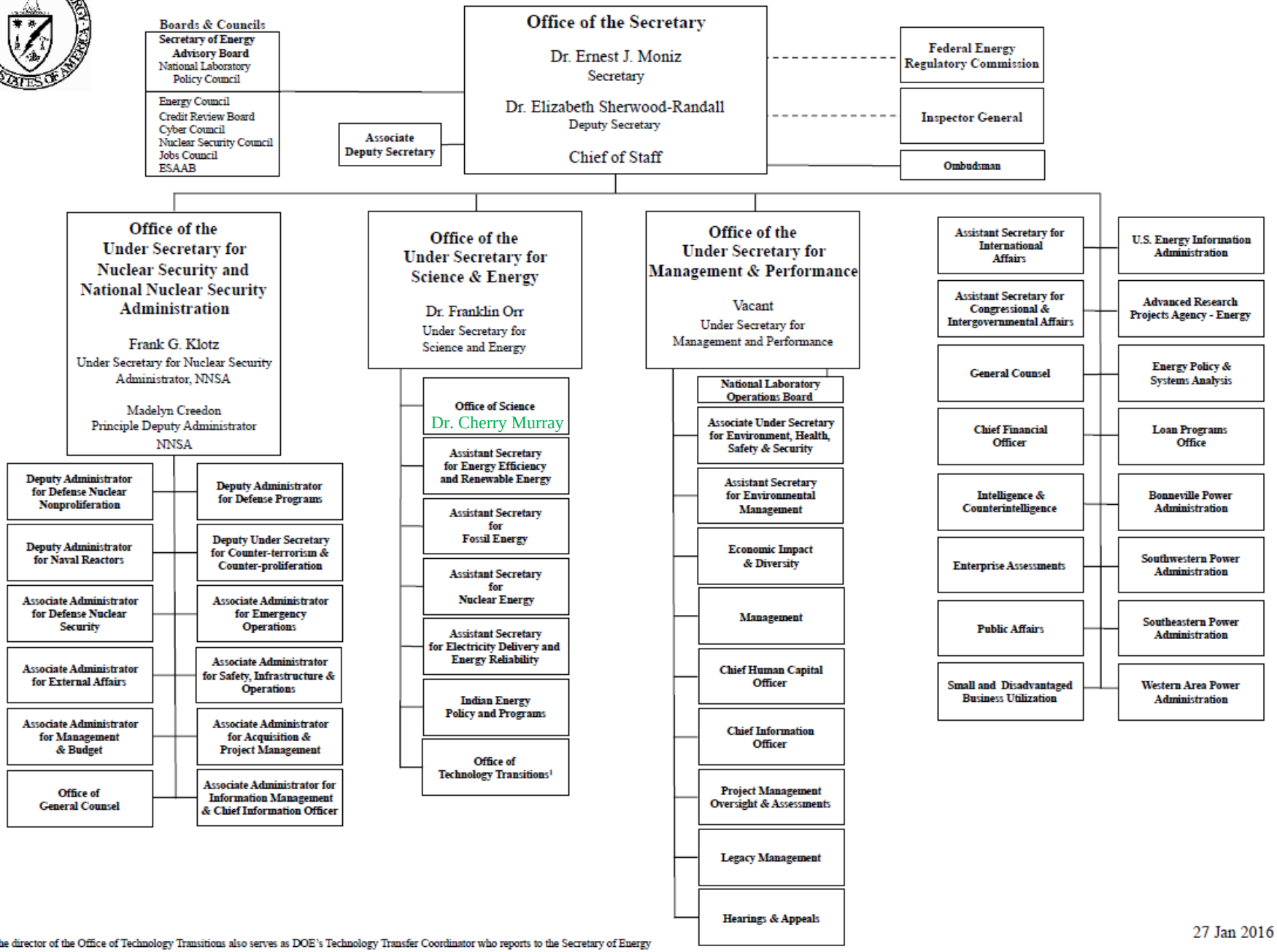




BER Advisory Committee Meeting

Sharlene Weatherwax
Associate Director of Science
Biological and Environmental Research

March 22, 2016

DEPARTMENT OF ENERGY



[1] The director of the Office of Technology Transitions also serves as DOE's Technology Transfer Coordinator who reports to the Secretary of Energy

27 Jan 2016

BER Personnel Updates

Dr. Tris West
Senior Technical Advisor

Dr. Amy Swain
Program Manager
Biological Systems Science Division

New BERAC members – WELCOME!

Dr. Jerry Melillo
Marine Biological Laboratory

Dr. Karen Schlauch
University of Nevada, Reno

Dr. Gloria Muday
Wake Forest University

Dr. Cheryl Kuske
Los Alamos National Lab

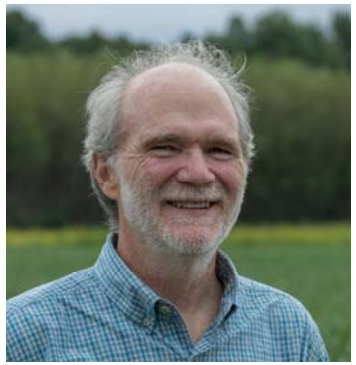
Dr. Bruce Hungate
Northern Arizona University

Dr. Daniel Segrè
Boston University

Significant Awards to BER Scientists

Dr. Ben Preston (ORNL) – 2015 Charles S. Falkenberg Award from the American Geophysical Union

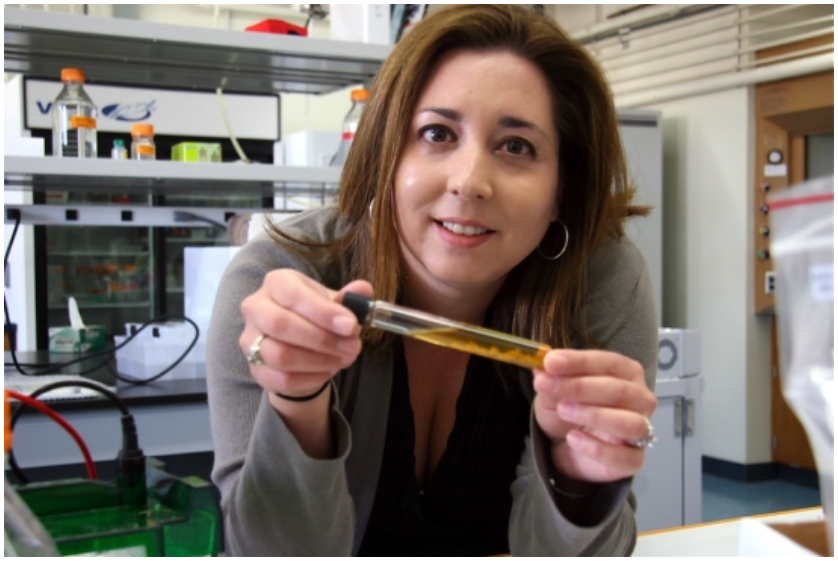
Dr. Allison Campbell (PNNL) – 2016 President-elect of the American Chemical Society



Dr. Phil Robertson (Michigan State U) – 2015 American Association for the Advancement of Science Fellow

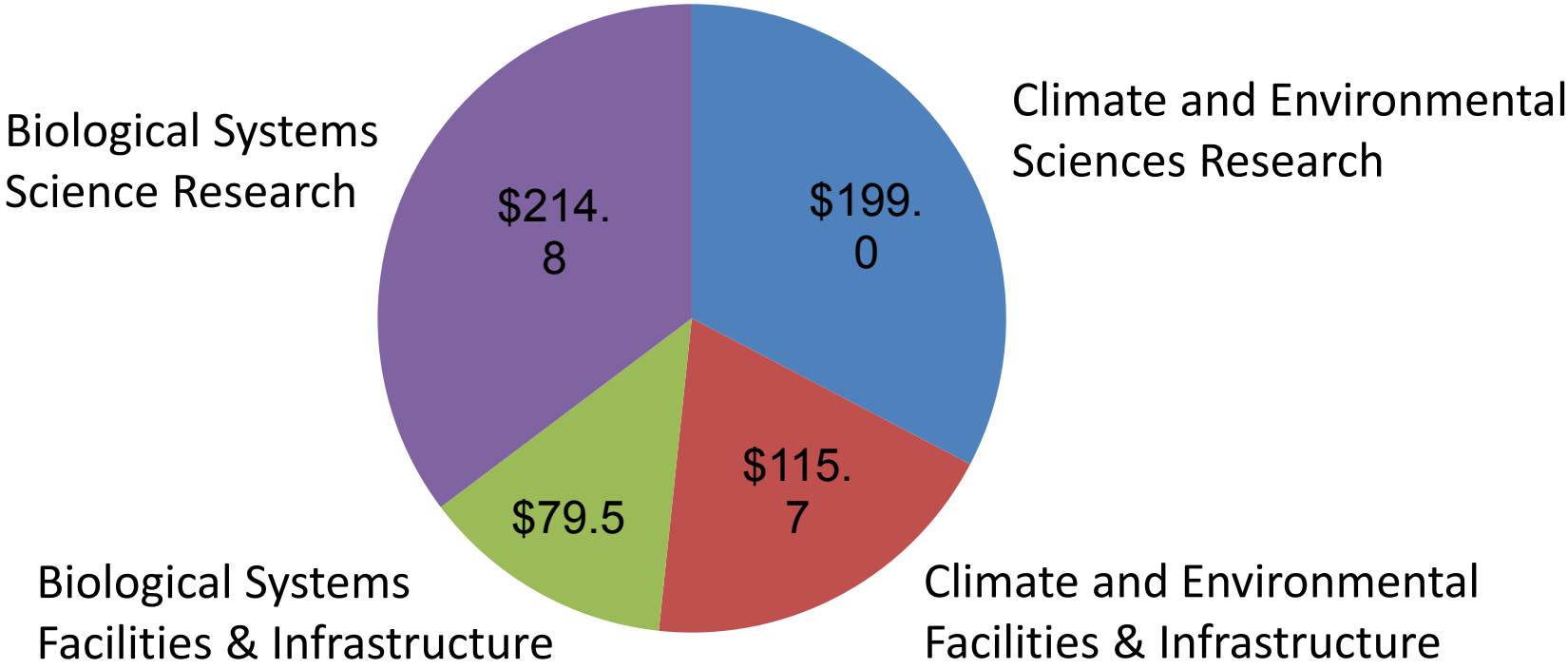
Significant Awards to BER Researchers

2013 Presidential Early Career Awards for Scientists and Engineers



Dr. Michelle A. O'Malley
Department of Chemical Engineering
University of California, Santa Barbara

BER FY 2016 Enacted Budget
($ in millions)



FY 2017 President's Budget Request — Office of Science ($ in thousands)

	FY 2015 Enacted Approp.	FY 2016 Enacted Approp.	FY 2017 President's Request	FY 2017 President's Req. vs. FY 2016 Enacted Approp.	
Science					
Advanced Scientific Computing Research	541,000	621,000	663,180	+42,180	+6.8%
Basic Energy Sciences	1,733,200	1,849,000	1,936,730	+87,730	+4.7%
Biological and Environmental Research	592,000	609,000	661,920	+52,920	+8.7%
Fusion Energy Sciences	467,500	438,000	398,178	-39,822	-9.1%
High Energy Physics	766,000	795,000	817,997	+22,997	+2.9%
Nuclear Physics	595,500	617,100	635,658	+18,558	+3.0%
Workforce Development for Teachers and Scientists	19,500	19,500	20,925	+1,425	+7.3%
Science Laboratories Infrastructure	79,600	113,600	130,000	+16,400	+14.4%
Safeguards and Security	93,000	103,000	103,000	.....	.....
Program Direction	183,700	185,000	204,481	+19,481	+10.5%
University Grants (Mandatory)	.....	.....	100,000	+100,000	.....
Small Business Innovation/Technology Transfer Research (SC)	.....	.....	.....	.....	.....
Subtotal, Science	5,071,000	5,350,200	5,672,069	+321,869	+6.0%
Small Business Innovation/Technology Transfer Research (DOE)	.....	.....	.....	.....	.....
Rescission of Prior Year Balance	-3,262	-3,200	.....	+3,200	-100.0%
Total, Science	**5,067,738**	**5,347,000**	**5,672,069**	**+325,069**	**+6.1%**

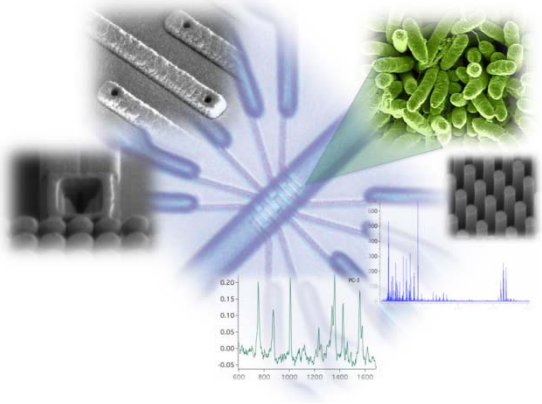
BER FY 2017 Budget Request

	FY 2015	FY2016	FY2017	Δ (FY17-FY16)
	Enacted	Enacted	Request	
Biological Systems Science	$299.9	$294.3	$339.1	+ $44.8
Research	$215.5	$214.8	$258.6	+ $43.8
Facilities	$84.4	$79.5	$80.5	+ $1.0
Climate and Environmental Science	$292.1	$314.7	$322.9	+ $8.1
Research	$174.2	$199.0	$204.8	+ $5.8
Facilities	$117.9	$115.7	$118.0	+ $2.4

Biological Systems Science and FY2017 Budget Request

Biological Systems Science supports basic research and technology development to achieve a predictive, systems-level understanding of complex biological systems.

Foundational knowledge in genome science with advanced computational and experimental approaches serves as the basis for the confident redesign of microbes and plants for sustainable biofuel and bioproducts production from renewable biomass and improved understanding of carbon/nutrient cycling and contaminant transport in the environment.



JGI JOINT GENOME INSTITUTE DEPARTMENT OF ENERGY

KBase PREDICTIVE BIOLOGY
DOE Systems Biology Knowledgebase

BESC BioEnergy Science Center

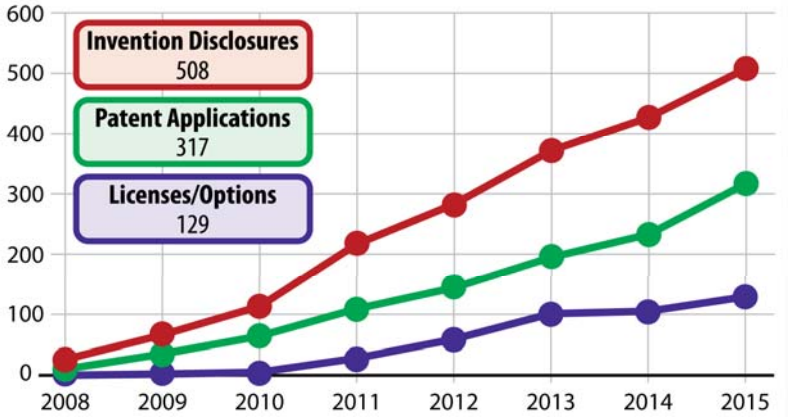
jbei Joint BioEnergy Institute

GREAT LAKES BIOENERGY RESEARCH CENTER

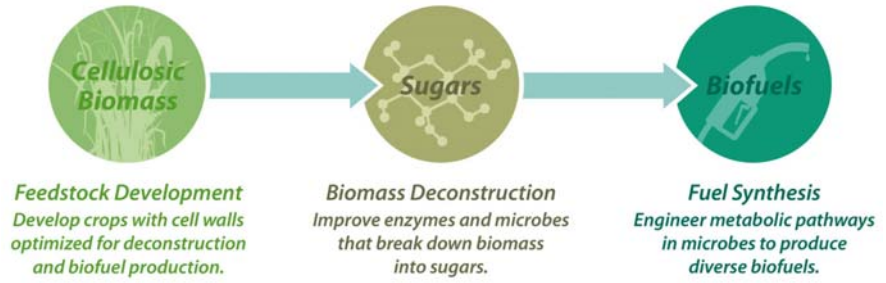
- Funding increases in Genomic Science support efforts in clean energy research including (Δ +$42.6M):
  - Increased efforts to speed bioenergy research results to commercial development (Δ +$15M).
  - Increased Biosystems Design efforts to underpin biotechnology advances for a bio-based economy (Δ +$20M).
  - New effort in Microbiome research for bioenergy (Δ +$10M).
- Increases in Mesoscale to Molecules will broaden the development of new bioimaging technology (Δ +$1M).
- The Joint Genome Institute will increase performance of complex genome sequencing, synthesis, and analysis (Δ +$1M).

Bioenergy Research Centers—Innovation for Clean Energy

- **BioEnergy Science Center** (Oak Ridge National Lab)
- **Great Lakes Bioenergy Research Center** (U. of Wisconsin, Michigan State U.)
- **Joint BioEnergy Institute** (Lawrence Berkeley National Lab)



DOE-funded Bioenergy Research Centers File 500th Invention Disclosure - March 3, 2016



- **FY 2017 requests increased funding in final year of current funded period to accelerate innovation and translation of research results to industry ($5M for each BRC).**
- **A competitive FOA will be issued in FY 2016 for merit review and selection in FY 2017.**

Microbiome

BER supports fundamental microbiome research on plant-microbe associations relevant sustainable biomass production, soil microbiomes that impact nutrient availability and carbon cycling processes, and subsurface microbiomes that effect environmental contaminant fate and transport.

NSTC Life Sciences Subcommittee chartered a fast track interagency working group to identify current Federal R&D investments and key priorities in microbiome research

Significant recommendations:

- Development of high resolution analytical technologies is needed to characterize and quantitatively measure microbiome processes
- Databases, bioinformatics, and computational modeling will be critical to advance predictive understanding of microbiomes

New collaborative, multidisciplinary microbiome research efforts incorporating:

- experimental systems biology
- genome enabled environmental research
- predictive computational modeling
- partnerships between DOE National Laboratories, academia, and field research facilities

Goal: Understand the role of microbiomes in key DOE mission relevant environments such as:

- Biomass focused agricultural systems
- Terrestrial ecosystems particularly vulnerable to climate change variables, including permafrost, taiga, wetlands, and arid ecosystems.

Climate and Environmental Science and 2017 Budget Request

Climate and Environmental Sciences supports an integrated portfolio of experimental research and modeling aimed at developing predictive, systems-level understanding of the fundamental science associated with climate change. Core research addresses the three most important uncertainties in understanding the earth's radiant energy balance — clouds, aerosols, and atmospheric greenhouse gases.

- **Climate and Earth System Modeling ($103.5M, Δ +$4.9M)** develops physical, chemical, and biological model components to simulate climate variability and change at regional and global scales.
  - Research continues to extend capabilities for the Accelerated Climate Model for Energy (ACME) to accelerate the assimilation of advanced software, numerical methods, and high resolution physics for the study of extreme phenomena.
  - New efforts (Δ +$10.3M) in regional-scale data, modeling and analysis testbeds will focus on understanding the interdependencies of water, energy, and climate change.
- **Environmental System Science** supports research to provide a robust, predictive understanding of terrestrial surface and subsurface ecosystems. Continues support for long term field research in the Arctic and Tropics.
- The **Atmospheric Radiation Measurement (ARM) Facility** continues long-term measurements at fixed sites and deploys mobile facilities to climate-sensitive regions (Antarctica, Arctic, and South Atlantic). New unmanned aerial vehicle capabilities are deployed in the Arctic.
- The **Environmental Molecular Science Laboratory ($45.6M, Δ +$2.4M)** expands research on the molecular composition of aerosols, microbial communities, and chemistry of radioactive materials.

Accelerated Climate Model for Energy (ACME)

ACME is a DOE multi-laboratory project to accelerate the assimilation of advanced software, numerical methods, and high resolution physics for the study of extreme phenomena

<u>World-leading capabilities</u>

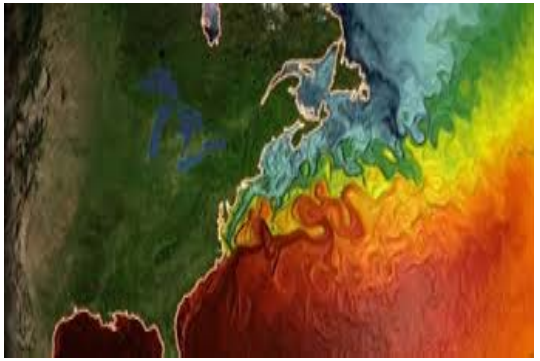
- Highest spatial resolution of all climate models in the world
  - Resolution at 15-25 km in fully coupled mode
  - Resolution below 10 km using advanced adaptive-mesh for specific regions
- Will be first climate model compatible with next generation computer architectures

<u>New science will be assimilated into ACME</u>

- Carbon cycle, with dynamic ecology, biogeochemistry, and land-atmosphere fluxes
- Detailed studies of the cryosphere: permafrost; ice sheets
- Detailed validation of ecosystem component models, using data from SC field projects in the Arctic and Tropics
- Uncertainty quantification for full system and its components

<u>Focus in FY 2017</u>

- Testing with Large-Eddy-Simulation, based on high resolution details obtained from the Atmospheric Radiation Measurement Facility to better predict extremes



Begun in 2014, involves 7 National laboratories and the National Center for Atmospheric Research (NCAR).

BER Participation in Department-wide– Crosscuts ($ in millions)

	Energy-Water Nexus (EWN)	Exascale Computing Initiative (ECI)	Total
BER	$24.3	$10.0	$34.3

- Energy-Water Nexus (EWN) is a set of cross-program collaborations to accelerate the Nation's transition to more resilient energy and coupled energy-water systems. BER will focus on advanced, integrated data, modeling, and analysis to improve understanding and inform decision-making.

- Exascale Computing Initiative (ECI) represents collaboration among SC's ASCR program the NNSA ASC program. BER will be responsible for determining the scope and management of climate modeling programs that require extreme scale computational capabilities.

Energy-Water Nexus (EWN) – Data, Modeling, and Analysis

Vision:

Understand and predict interdependencies at the nexus of energy and water

Goals for FY 2017:

- Design unified model and data analytics capabilities
- Deploy an Integrated Field Laboratory with test beds

Layered Energy Resiliency Data-Knowledge Framework

- Integrated data analytic system to examine the processes and forces (data layers) that shape the EWN.
- FY 2017 expansion to focus on federated data construct, priority data layers, and high performance scalable analytics.
- Scoping and conceptual design options only in FY2016

Regional-Scale Data, Modeling, and Analysis Test Beds

- 3 Test Beds with teleconnections
- 1 Test Bed more detailed evolving to Integrated Field Laboratory
- Regional locations and scales informed by community workshop(s)

Integrated Multi-System, Multi-Scale Modeling Framework & IAV Modeling

IAV Strategic Research and Analysis

Exascale Requirements Review for BER

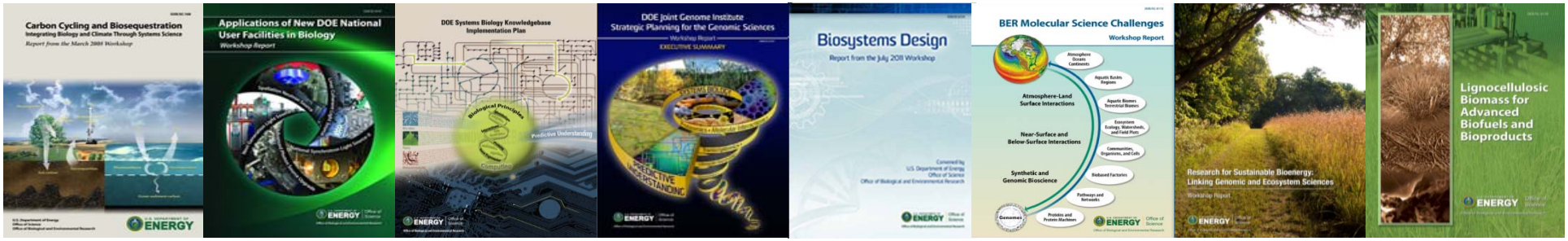
Why: ASCR is conducting requirements-gathering workshops with each office in the Office of Science to prepare for next computer procurements. The workshop will ascertain the full scope of BER computational science expected in the 2020-2025 timeframe and will cover "exascale-era science" requiring computing and data management, spanning "mid-range" to "exascale".

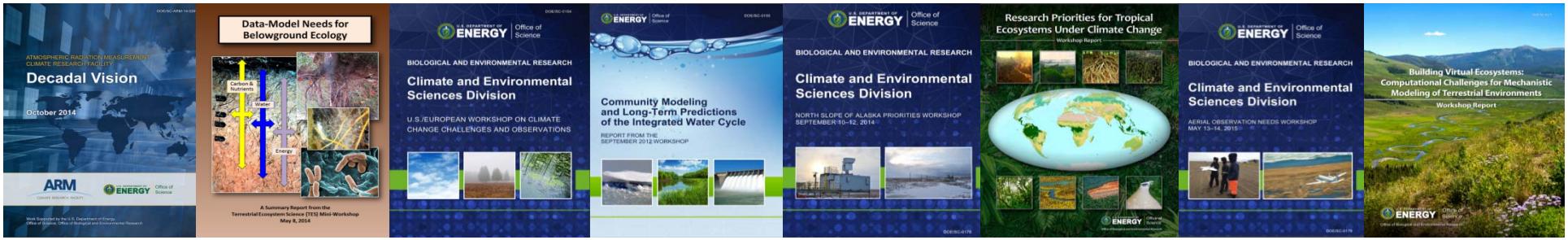
When: March 29-30, 2016
Who: ~80 scientists from across BER sciences
Outcome: Workshop report, available before the next BERAC meeting

Agenda topics:

- Climate and Environmental Science in the Exascale era
- Earth System Component-specific science and challenges
- Climate Coupled System Integration Challenges
- Computational Issues for Climate and Environment
- Big Data for Knowledge Discovery in Biology
- From Sequence to Models of Organisms and Communities
- Multiscale Simulation of Biological Processes from Molecules to Biological Interfaces

BER strategic science directions are guided by input from the research community, scientific workshops, the National Science and Technology Council, the National Academy of Sciences and BERAC.



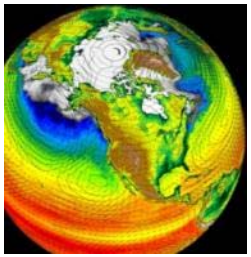


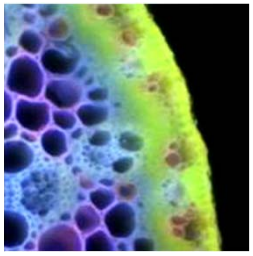
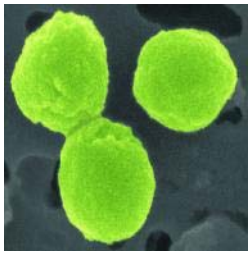
New BERAC Charge Questions

- To what extent has DOE BER successfully met, or positioned itself to meet, challenges outlined in the 2010 report that are within mission objectives of the Office of Science?
- To the extent that such predictions can be made, what are the greatest scientific challenges that DOE will be facing in the long term (20 year horizon) and for which of these should BER take primary responsibility?
- How should we position BER to address those challenges? For example, what continued or new disciplines of BER-relevant science are needed to achieve its future mission challenges?
- What new tools should be developed to integrate and analyze data from different disciplines, including the advancement of system science?
- What unique opportunities exist to partner with, or leverage assets from other programs within the Office of Science, or with other federal programs?
- What scientific and technical advances are needed to train the workforce of the future in integrative science, including complex system science?

Invitation for labs to provide strategic capabilities and future vision

1. Written narrative that includes the following topics:
    a. Laboratory Mission and Overview
    b. Summary of current RESEARCH core capabilities relevant to BER
    c. Summary of current FACILITY core capabilities relevant to BER
    d. Summary of future strategic science priorities—within the next 5-10 years
    e. Description of strategic partnerships for the future (other institutions, other federal partners, other DOE programs)
2. Oral presentation and Q&A at BERAC



Thank you!