2019 Genomic Science Program Annual PI Meeting

Todd Anderson, Ph.D.
Director, Biological Systems Science Division, Department of Energy, Office of Biological & Environmental Research
February 25, 2019
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.
New funding Opportunity Announcements for FY 2019

**Systems Biology Enabled Research on the Roles of Microbiomes in Nutrient Cycling Processes (DE-FOA-0002059)**
Pre-App due: 3/13/19
Pre-App Response: 3/21/19
Proposals due: 5/17/19 – (Dr. Dawn Adin, Dr. Boris Wawrik)

**Genomics-Enabled Plant Biology for Determination of Gene Function (DE-FOA-0002060)**
Pre-App due: 3/13/19
Pre-App Response: 3/21/19
Proposals due: 5/17/19 – (Dr. Cathy Ronning)

**New Bioimaging Approaches for Bioenergy**
Pre-App due: 4/4/19
Pre-App Response: 4/19/19
Proposals due: 5/20/19 – (Dr. Prem Srivastava)

**Early Career Research Program (in progress)**
Pre-App due: 2/6/19
Pre-App Response: 3/8/19
Proposals due: 4/29/19 – (Dr. Pablo Rabinowicz for BSSD)
New Investments at the Labs for Cryo-EM and Neutron science

Cryo-EM capabilities

**Brookhaven National Laboratory** (PI: Sean McSweeney)
Operational support for a new cryo-EM facility (in association with New York State) to stand up a functional cryoEM capability at BNL as soon as FY 2020.

**Stanford Linear Accelerator Center** (SLAC) (PI: Wah Chiu)
Operational and instrumental support to complement recent NIH-funded cryo-EM center at SLAC.

**Lawrence Berkeley National Laboratory** (PI: Karen Davies)
Instrumental support for a screening microscope for cryo-EM prior to accessing the high-end cryo-EM instruments.

Neutron Science Capabilities

**Oak Ridge National Laboratory** (PI: Hugh O’Neill)
Pilot funding to build to demonstrate biological applications in neutron science.

*Program Manager: Dr. Amy Swain*
**Integrative Computational Capabilities**

**Continuing co-development/collaboration between KBase, the Joint Genome Institute (JGI) and NERSC**

- Towards a common open-source, open-access IT infrastructure structure for bioinformatics and computational biology.

- Connections with the Environmental Molecular Science Laboratory (EMSL)
- KBase and JGI move into a new building on the LBNL campus in July 2019

**National Microbiome Data Collaborative (NMDC)**

- Opportunity at the DOE National Laboratories
- Integrative with ongoing BSSD bioinformatics projects
Informative Workshops for BSSD Planning

**BER Workshops**

**Genome Engineering for Material Synthesis (GEMS) Workshop**
- Exploring possibilities for designed materials using genome engineering techniques
- October 9-11, 2018 (Brief out Weds AM – by **Dr. Brian Fox** – Univ. Wisconsin)

**Breaking the bottleneck of genomes: Understanding gene function across taxa**
- Addressing the annotation problem in genomics
- November 1-2, 2018 (Brief out Weds AM – by **Dr. Adam Deutschbauer-LBNL**)

**National Academy Studies**

- “Developing a Research Agenda for Utilizing Gaseous Carbon Waste Streams.” Board on Chemical Sciences and Technology and the Board on Energy and Environmental Systems (BER, BES, ARPA-E, FE, EERE)

- “Breakthroughs 2030: A Process for a 10-year Agenda for Food and Agricultural Research.” Board on Agricultural and Natural Resources
BSSD Staff Changes

Dan Drell
Program Manager
Joint Genome Institute
Retired from Federal Service September 2018

Boris Wawrik
Program Manager
Environmental Genomics
Started January 2019

Sujata Emani
AAAS Science & Technology Policy Fellow—working with BSSD
Started September 2018
The Biological Systems Science Division Portfolio

Genomic Science Program

- Bioenergy Research Centers (BRCs)
- Systems Biology for Bioenergy
- Plant Biology Research*
- Sustainability Research for Bioenergy
- Biosystems Design
- Environmental Microbiome Science*
- Computational Biosciences

Biomolecular Characterization and Imaging Science*

Facilities & Infrastructure

- Joint Genome Institute (JGI)
Bioenergy Research Centers

Multidisciplinary fundamental science guided by milestones & deliverables, targeted to key areas needed to improve production of biofuels from renewable biomass.

- Center for Bioenergy Innovation (CBI)
  Oak Ridge National Laboratory ([https://cbi.ornl.gov/](https://cbi.ornl.gov/))

- Great Lakes Bioenergy Research Center (GLBRC)
  University of Wisconsin, Michigan State University ([https://www.glbrc.org/](https://www.glbrc.org/))

- Joint BioEnergy Institute (JBEI)
  Lawrence Berkeley National Laboratory ([https://www.jbei.org/](https://www.jbei.org/))

- Center for Advanced Bioenergy and Bioproducts Innovation (CABBI)
  University of Illinois (UIUC) ([https://cabbi.bio/](https://cabbi.bio/))

Program Manager:
Dr. Kent Peters

Monday: Plenary
8:30-10:30AM Fairfax Ballroom
**Systems Biology for Bioenergy**

*Fundamental, systems-level understanding of microbes and microbial communities relevant to advanced biofuels production.*

- Research to advance the development of promising new model organisms relevant to biofuels production.
- Development of novel microbial functional capabilities and biosynthetic pathways relevant to the production of advanced biofuels and the development of strategies to overcome associated metabolic challenges resulting from pathway modification.
- Development of novel analytical technologies or high throughput screening approaches.

*Broadens the portfolio in microbial research on advanced biofuels production*

**Monday: Breakout Session C**
2:00-5:00 PM Fairfax Ballroom B

**BER Program Manager:** Dr. Dawn Adin
Plant Feedstocks Genomics for Bioenergy

Research to overcome the biological barriers to the low-cost, high-quality, scalable and sustainable production of bioenergy feedstocks using the tools of genetics and genomics

- Developing the scientific basis for new bioenergy crops
- Complementary with ongoing bioenergy research in BRCs and Biosystems Design

BER Program Manager: Dr. Cathy Ronning and Dr. Bill Goldner (USDA)

Monday: Breakout Session B
2:00-5:00 PM Ash Grove Ballroom

New FOA in Plant Biology

Research to address the challenges and opportunities in associating gene(s) to function (i.e., genotype to phenotype) in DOE-relevant plant systems.

Goal: Elucidate and validate functional roles of genes, gene families, and associated pathways.

Latest Awards: https://genomicscience.energy.gov/research/DOEUSDA/usda_doe_handout.pdf

USDA
NATIONAL INSTITUTE OF FOOD AND AGRICULTURE
U.S. DEPARTMENT OF AGRICULTURE
Sustainability Research for Bioenergy

Research to Advance Bioenergy Agriculture

Understanding plant/soil/microbial interactions in field settings

- Enhance biomass productivity under changing conditions by:
  - Investigating molecular and physiological mechanisms that control bioenergy crop vigor, resource use efficiency, resilience/adaptability to abiotic stress;
  - Defining and characterizing interactions of bioenergy crop plants with the surrounding environment.

- Investigate the role(s) of microbial communities in the complex plant-soil environment:
  - Contributing to plant performance, adaptation, and resilience under changing environmental conditions and abiotic stressors;
  - Impacts of introducing bioenergy cropping systems on the local ecosystem.

Poster Session Presentations
Mon-Tues 5:00-7:00PM Tysons Ballroom

Program Manager:
Dr. Cathy Ronning
Biosystems Design

Plant biodesign awards:
- Transitioning from model plants such as *Arabidopsis* and *Setaria* to *Camelina* and sorghum
- Adding energy cane and aquatic monocot (duckweed)
- Targeting nitrogen fixation by engineering symbiosis
- Increase water use and photosynthetic efficiency
- Engineer oil production in stems and leaves

Microbial biodesign awards:
- New non-model yeast that produce oils and organic acids
- Expanding algae genome-scale design and engineering to diatoms and green algae
- Developing *in vivo* and cell-free microbial bioprocessing systems
- Computer-aided design and high throughput recombineering in model and non-model microorganisms

Tuesday Breakout Session E
2:00-5:00 PM Fairfax Ballroom A

Systems biology and genome engineering to enable design of new biological systems for bioenergy and bioproduct production

BER Program Manager:
Dr. Pablo Rabinowicz
**Environmental Microbiome Science**

*Genome enabled research linking structure and function of microbial communities with key environmental or ecosystem processes*

- Systems biology of model microbes and consortia important in carbon cycle and environmental processes of relevance to DOE
- Extending systems biology approaches and understanding to integrated microbial communities and plant-microbe interactions
- Development of environmental “meta–omics” approaches to understand how shifts in environmental variables impact microbial community structure and functional processes
- High resolution, high throughput techniques for analysis of biological processes across multiple scales of spatial and temporal resolution
- Development of new techniques for in situ bioprocess analysis in terrestrial ecosystems

**Poster Session Presentations**

*Mon-Tues 5:00-7:00PM Tysons Ballroom*

**BER Program Manager:**

*Dr. Dawn Adin and Dr. Boris Wawrik*
Computational Biosciences

- Knowledge engine Apps built
- Relation engine prototype deployed
- JGI Collaboration products released

- Three User working groups established (microbiome, metabolism, functional genomics)

Program Manager:
Dr. Ramana Madupu

- Monday: User Science Breakout Session A 2:00-5:00 PM Fairfax Ballroom A
- Tuesday: Plenary 8:30-10:00 AM Fairfax Ballroom
- Tuesday: Hand’s On Session 1:00-5:00 PM Potomac room
- Tuesday: Data Challenges Break out Session D 2:00-5:00 PM Fairfax Ballroom B

http://www.kbase.us
Some of the techniques available:
X-ray Crystallography; X-ray Cell Tomography, X-ray and Neutron and Scattering; Infrared spectromicroscopy, X-ray Spectroscopy and Imaging.

See posters and visit with staff during the poster session

BER Program Manager: Dr. Amy Swain

Biomolecular Characterization and Imaging Science

Structural Biology Beamline Resources
Supported by BER and Other Sponsors at DOE Basic Energy Sciences Light Source and Neutron User Facilities

BER Structural Biology and Imaging Resources at Synchrotron and Neutron Facilities

Scientists have made remarkable progress over the past few decades in biological imaging, from the atomic scale (subnanometer) to the cellular (micron) scale. There are extraordinary opportunities for scientists working to understand and harness biological systems for addressing mission-relevant challenges of the U.S. Department of Energy’s (DOE) Office of Biological and Environmental Research. Many of these advances are made possible by the unique capabilities of X-ray, scattering, spectromicroscopy, and imaging capabilities available at DOE’s neutron and synchrotron light sources, which are national user facilities.

See posters and visit with staff during the poster session

BER Program Manager: Dr. Amy Swain

BERStructuralBioPortal.org

https://science.energy.gov/bes/suf/user-facilities/
Community Science Program (CSP) FY2020 Topics
(LOIs due April 11, 2019)
- Genes to function
- Plant functional genomics and microbiomes
- Inter-organismal interactions
- Microbes and communities involved in elemental cycling in terrestrial and coastal environments
- Algal genomics

CSP New Investigator Call
Proposal due Mar 1 & Nov 4, 2019

DNA Synthesis Call
Proposals due July 31, 2019

IFICUS (JGI-EMSL) Call:
LOIs due Mar 20, 2019
- Combines JGI genomics and molecular characterization at the Environmental Molecular Sciences Laboratory (EMSL)

JGI User Meeting and NELLI workshop
April 2-5, San Francisco, CA

Tuesday: Plenary
8:30-10:00 AM Fairfax Ballroom

Program Manager:
Dr. Ramana Madupu
## Mapping Research Efforts onto BSSD Objectives

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<th>Core Objectives in:</th>
<th>FOA-led efforts</th>
<th>DOE Lab-led efforts</th>
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| **Plant & Microbial Bioenergy Research** | • Bioenergy Research Centers  
• Plant Biology Research  
• Systems Biology for Bioenergy  
• Sustainability Research for Bioenergy  
• DOE-UCLA Institute | • Bioenergy Research Centers  
• ORNL – Lignocellulosic degradation  
• LLNL – Resource allocation in microbial communities  
• (Pilot) BNL- Quantitative Plant Science |
| **Biosystems Design & Synthetic Biology** | • Biosystems Design  
• Harvard Project | • (Pilot) LBNL m-CAFÉs  
• elements of the BRCs |
| **Carbon/Nutrient Cycling & Environmental Microbiology** | • Environmental Microbiome Science  
• Sustainability Research for Bioenergy | • LBNL- ENIGMA project  
• LANL – Soil Metagenomics  
• ORNL- Plant-Microbe Interactions  
• LANL  
• LLNL  
• PNNL  
• (Pilot) LBNL m-CAFÉs |
| **Enabling Capabilities** | • Computational Biosciences  
• Bioimaging Research | • KBase  
• Computational Biosciences  
• Bioimaging Research  
• National Microbiome Data Collaborative |
| **User Facility Integration** | | • Joint Genome Institute  
• Structural Biology Infrastructure  
• NERSC  
• EMSL |
Thank you!

**BSSD Program Staff**
Dr. Dawn Adin  
Dr. Sujata Emani (AAAS S&T Policy Fellow)  
Dr. Kent Peters  
Dr. Ramana Madupu  
Dr. Pablo Rabinowicz  
Dr. Cathy Ronning  
Dr. Seema Singh (SNL Detailee)  
Dr. Prem Srivastava  
Dr. Amy Swain  
Dr. Boris Wawrik  
Dr. Elizabeth White  
Ms. Meredith Rutledge

[http://genomicscience.energy.gov](http://genomicscience.energy.gov)