

Biomass R&D Programs at DOE-BER

**Biomass Research and Development
Technical Advisory Committee Meeting
15 December 2010**

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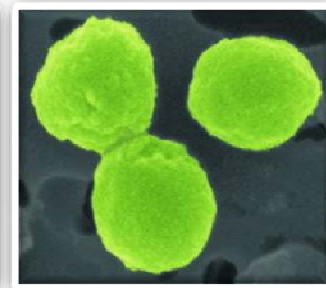
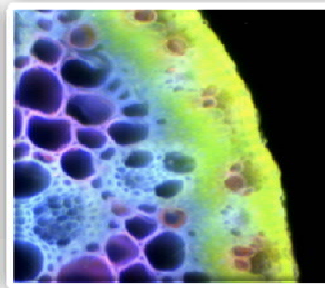
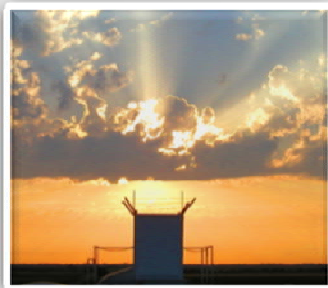
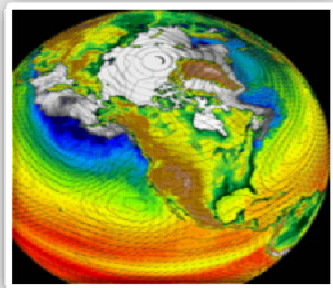


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Biological and Environmental Research Mission

- To understand complex biological, climatic, and environmental systems across spatial and temporal scales; provide the foundational science to:
 - **Support the development of biofuels as major, secure, and sustainable national energy resources**
 - Understand the potential effects of greenhouse gas emissions on Earth's climate and biosphere and the implications of these emissions for our energy future
 - Predict the fate and transport of contaminants in the subsurface environment at DOE sites
 - Develop new tools to explore the interface of biological and physical sciences



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Biological and Environmental Research

Biological Systems Science Division (BSSD)

(FY 2011 request: \$ 321,947 K)

- **Genomic Science Program (\$176,891 K)**
 - Bioenergy Research Centers (\$25,000 K each)
 - DOE Joint Genome Institute (\$69,267 K)
 - USDA-DOE Plant Feedstocks Genomics for Bioenergy (FY 10: \$6,000 K; includes \$2,000 from USDA)



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Bioenergy Research Centers (BRCs) Program Overview

- Funding: planned funding of **\$405 million over five years** for establishment and operation of **three BRCs**
- Goals: **transformational discoveries** in basic science to make production of **cellulosic ethanol** and other **plant fiber-based biofuels cost-effective** and **economically viable**
- Method: advanced **genomics-based systems biology** research on **plants** and **microbes**:
 - Developing and modifying dedicated bioenergy feedstock plants
 - Overcoming “recalcitrance” of lignocellulose – **key cost barrier** – deconstruction of plant fiber into fermentable sugars
 - Microbial synthesis of fuels – ethanol and beyond



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Bioenergy Research Centers (BRCs)

Joint BioEnergy Institute (JBEI)

- Model plants (Arabidopsis and rice) - lignin modification;
- Synthetic biology approaches to fuels;
- Advanced biomass pretreatment;
- New stable, active cellulase enzyme in ionic liquids.

Great Lakes Bioenergy Research Center (GLBRC)

- Model and potential bioenergy crops
- Microbial biorefinery
- Sustainable production
- Improved screening of hydrolytic enzymes.

Bioenergy Science Center (BESC)

- Research to overcome recalcitrance
- Consolidated bioprocessing (CBP)
- New high throughput screening of chemical, structural, and genetic features of biomass; imaging



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Some BRC Highlights:



Gene responsible for synthesis of low viscosity seed oil identified in *Euonymus alatus* (Burning Bush)



Identifying new biofuel synthesis pathways in microbes (*Micrococcus luteus*)



High spatial-resolution, chemical imaging of lignin supplies potential explanation for improvements in saccharification



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The DOE Joint Genome Institute (JGI)

Mission: to serve the scientific community as a user facility enabling application of large-scale genomics and analysis of plants and microbes in support of the DOE mission needs in bioenergy and the environment.

Focus: plants, microbes, fungi, metagenomes

Provides state-of-the-science capabilities for sequencing and analysis.

Sequencing more than 18 *trillion* base pairs (**18 Terabases**) of DNA per year! (= **6000 1x human genomes!**)



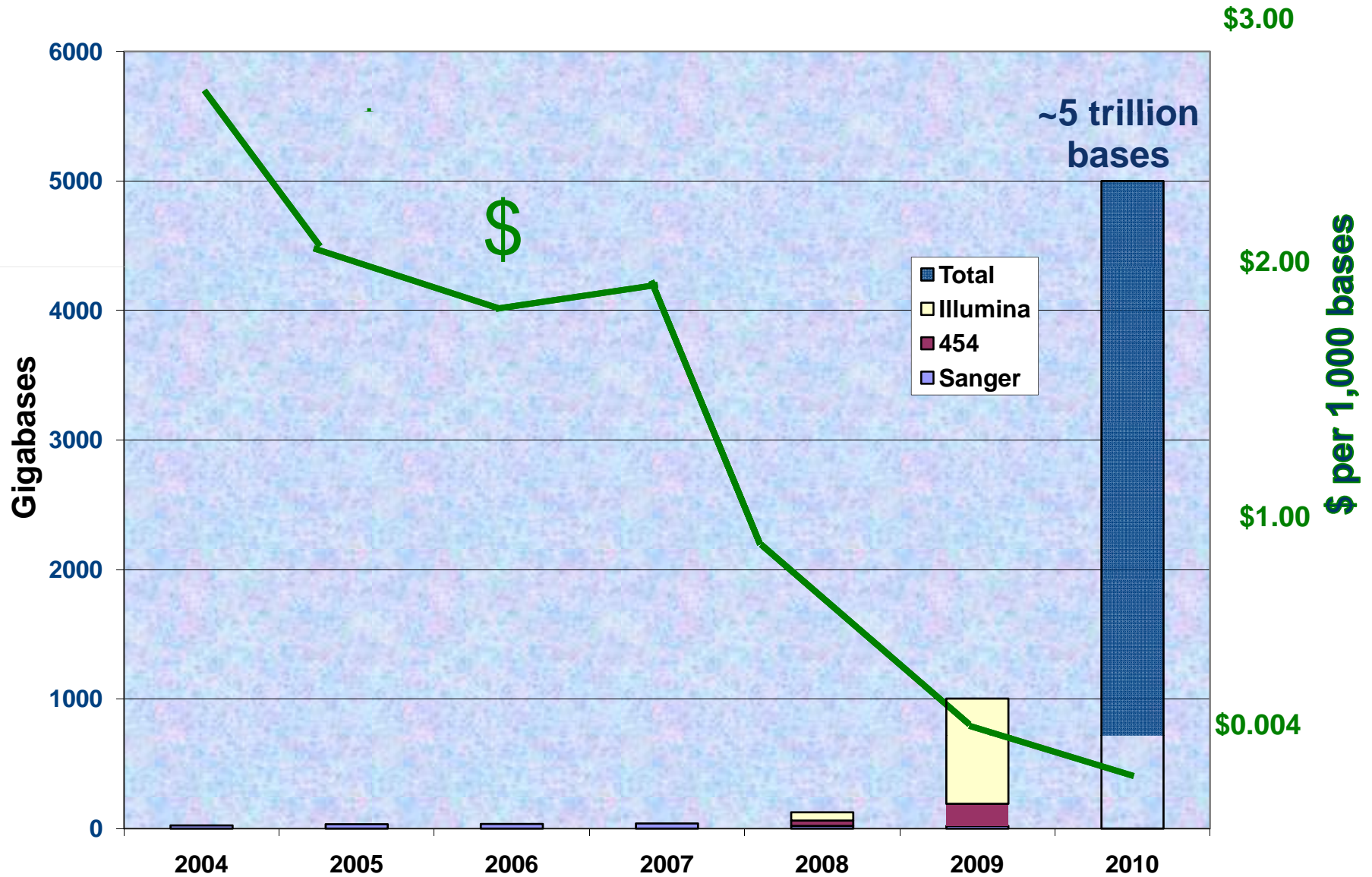
High throughput sequencing line at DOE-JGI in Walnut Creek, CA



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Evolutionary to Revolutionary Changes in Sequencing Productivity and Cost Reductions



2011 JGI Community Sequencing Program (CSP) Portfolio

Focus on large projects: microbial & fungal collections, single cell genomes, metagenomes, plant resequencing

35 new projects:

- Two plant, two algal genomes
- Ten fungal projects
- Nine microbial projects, six of which involve single-cell genomics;
- Twelve metagenome (microbial communities) or metatranscriptome projects.



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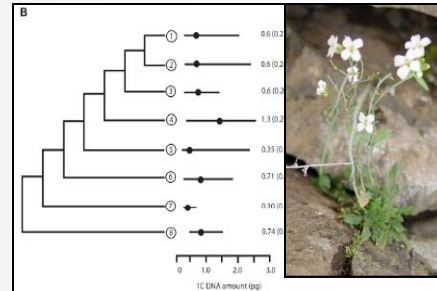
JGI Grand Challenge Pilot Projects



Prairie Soil
Metagenome



Rhizosphere



Brassicaceae
Project



Cow Rumen

Setting the ground work for Tera-Peta base projects

**Leadership in development of required sample handling,
project management and analysis**



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USDA-DOE

Plant Feedstock Genomics for Bioenergy

A joint competitive grants program initiated in 2006
(DOE-BER and USDA-NIFA)

Genomics-based research leading to improved use of biomass and plant feedstocks for the production of fuels such as ethanol or renewable chemical feedstocks:

- Improve biomass characteristics, biomass yield, or sustainability;
- Systems biology approaches enabling efficient manipulation and breeding;
- Prediction of phenotype from genotype that could lead to improved feedstock characterization and sustainability.



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USDA-DOE Joint Program:

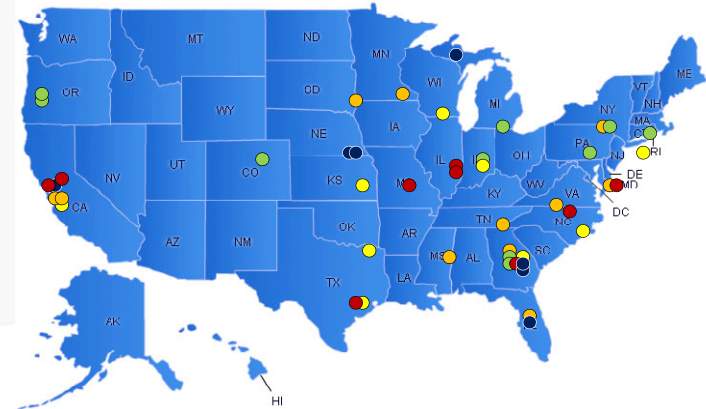
2006-2010 Portfolio

46 projects total to date:

Populus
Medicago
Foxtail millet
Sorghum
Switchgrass
Brachypodium

Rice
Miscanthus
Sunflower
Maize
Soybean

Resource development
Small RNAs
Plant-microbe interactions
Cell wall



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USDA-DOE Joint Program: Specific interests for 2011 (DE-FOA-0000417) :

- Phenotyping plant germplasm collections, advanced breeding lines of bioenergy crops (Brachypodium, energy cane, Miscanthus, sorghum, switchgrass)
- Translation of genomics information into cultivar improvement in bioenergy crops (Brachypodium, Miscanthus, Populus, sorghum, switchgrass)

November 1, 2010	Solicitation posted
December 17, 2010	Preapplications due
February 25, 2011	Proposals due



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For more on BRCs and BRC Science:

<http://genomicscience.energy.gov/centers/index.shtml>

the JGI:

<http://www.sc.doe.gov/ober/BSSD/jgi.html> /;

[http://www.jgi.doe.gov/](http://www.jgi.doe.gov)

the joint Plant Feedstocks Program:

<http://genomicscience.energy.gov/research/DOEUSDA/>



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