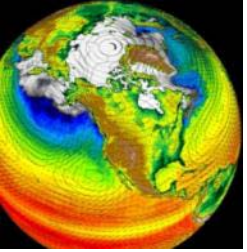
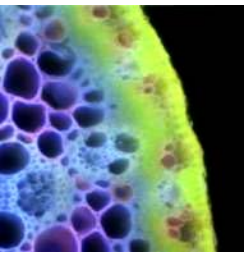
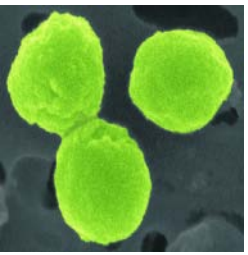


Moving Toward the Horizon: Leveraging Fundamental Science for a Future Bioenergy Economy

Sharlene Weatherwax, Ph.D.
Associate Director of Science
Biological and Environmental Research

July 27, 2011

Office of Science

Science to Meet the Nation's Challenges Today and into the 21st Century

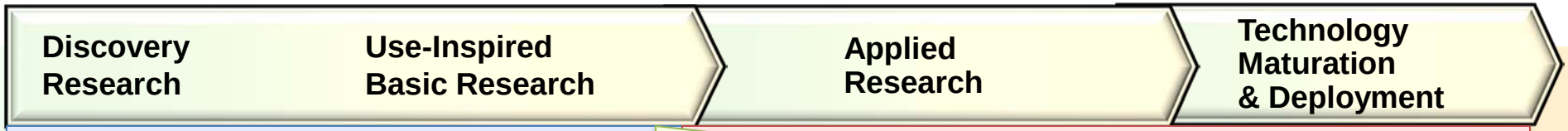
The Frontiers of Science

- Supporting research that led to over 100 Nobel Prizes during the past 6 decades—22 in the past decade alone
- Providing 45% of Federal support of basic research in the physical sciences and key components of the Nation's basic research in biology and computing
- Supporting over 27,000 Ph.D.s, graduate students, undergraduates, engineers, and support staff at more than 300 institutions

21st Century Tools of Science

- Providing the world's largest collection of scientific user facilities to over 26,000 users each year

R&D Continuum for Biofuels



Office of Science | **ARPA-E** | **Applied Programs**

BER:

- Systems biology towards understanding the principles underlying the structural and functional design of living systems
- Predictive capability to model and engineer optimized plants, microorganisms and enzymes

BES:

- Rational catalyst design and chemical transformation control
- Structure-activity relationships of inorganic, organic, and hybrid catalytic materials in solution or solids

BER:

- Genetic properties, molecular and regulatory mechanisms and resulting functional potential of microbes & plants for novel approaches to new biofuels
- Mining for natural environments for new biological catalysts.
- Characterization of microbial soil communities

BES:

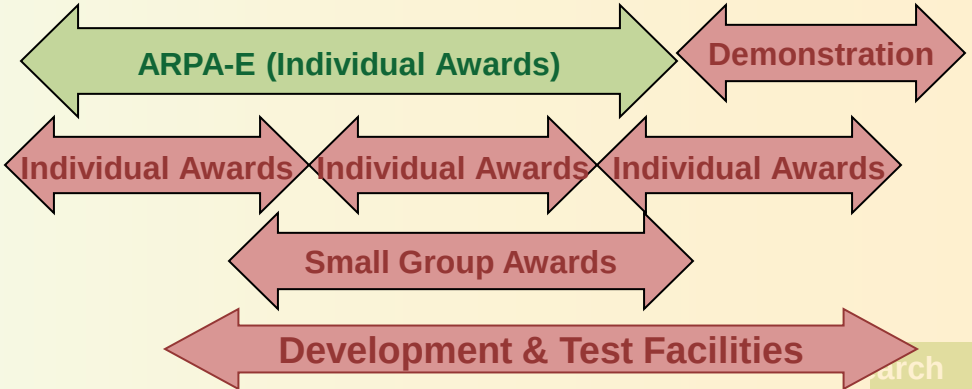
- Biochemical and biophysical principles determining assembly and architecture of biopolymers and protein complexes
- Mechanisms of biological energy transduction, bioinspired solar energy conversion
- Synthesis of robust, functional catalysts that mimic biological processes
- Solar conversion into oils and biofuels in plant and algal systems

ARPA-E

- Non-photosynthetic electrofuels – using microbial use of electric currents (from solar PV) to convert CO_2 & H_2O to fuels; engineering of H_2-using microbes to convert CO_2 liquid fuels and other hydrocarbons
- Production of isobutanol from seaweed

EERE:

- Validate and demonstrate biorefinery technologies at pilot through commercial scale; integrated biorefineries employing combinations of feedstocks and conversion technologies, main focus is biofuels, but side products (chemicals, heat, power) allowed
- Sustainable feedstock production; cellulosic bioenergy crop selection and inventory – updating the "Billion Ton Study," replicated field trials
- New technologies for sustainable commercialization of algal biofuel
- Process improvement of industrial enzymes and microbial biofuel fermentation; performers take strains to a commercial scale and have a business strategy to market the organism/process.
- Development and testing of biofuels and fuel mixes for performance, emissions, engine longevity, also combined with different vehicle technologies



Advancing Energy Technologies through Bioenergy Research Centers

Single focus, multi-disciplinary, team-based science

BioEnergy Science Center (Oak Ridge National Lab)

- Strategic focus on overcoming biomass "recalcitrance" as route to cost-effective cellulosic biofuels
- Goal of "Consolidated Bioprocessing" – one-microbe or microbial community approach going from plants to fuel

Great Lakes Bioenergy Research Center (University of Wisconsin, Michigan State University)

- Goal of re-engineering plants to produce more starches and oils
- Using HTP technologies to optimize chem/bio process for biomass deconstruction
- Major research thrust on sustainability of biofuels

Joint BioEnergy Institute (Lawrence Berkeley National Lab)

- Experimenting with new pretreatment process using room temperature ionic liquids
- Beyond cellulosic ethanol: re-engineering *E.coli* and yeast to produce hydrocarbons – goal of "green" gasoline, diesel, jet fuel

Genomic Science--DOE Systems Biology Knowledgebase
Establishing a systems biology modeling framework

Data generators

Seamless Submission and Incorporation of Diverse Data

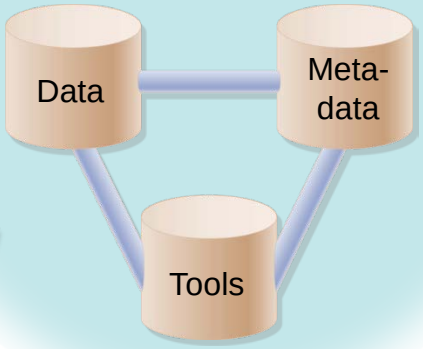
- Standards for data, metadata
- Quality control and assurance
- Automated data handling

Open-Access Data and Information Exchange

- Flexible user interfaces
- Easy data retrieval
- Environment for *in silico* experimentation

Data users

DOE Systems Biology Knowledgebase



Community-Wide Stewardship

- User, Standards, and Advisory committees
- Value-added analysis
- Training, tutorials, and support

Software and tool developers

Open Development of Open-Source Software and Tools

- Analysis and visualization
- *In silico* experimentation
- Tracking and evaluation of tool use

Near-Term priorities—from fundamental research to commercial deployment

- Diversity—performers, modalities, geographical
- Strategic planning to lay a sustainable foundation for future technology innovation
- Communication and outreach
- Partnerships, collaboration, coordination
- Resources--A work force trained in the most modern science and technologies and with access to the best tools.