

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report

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U.S. DEPARTMENT OF  
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Office  
of Science

Office of Biological  
and Environmental Research

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report

May 30-31, 2012 Washington DC

## **Co-chairs:**

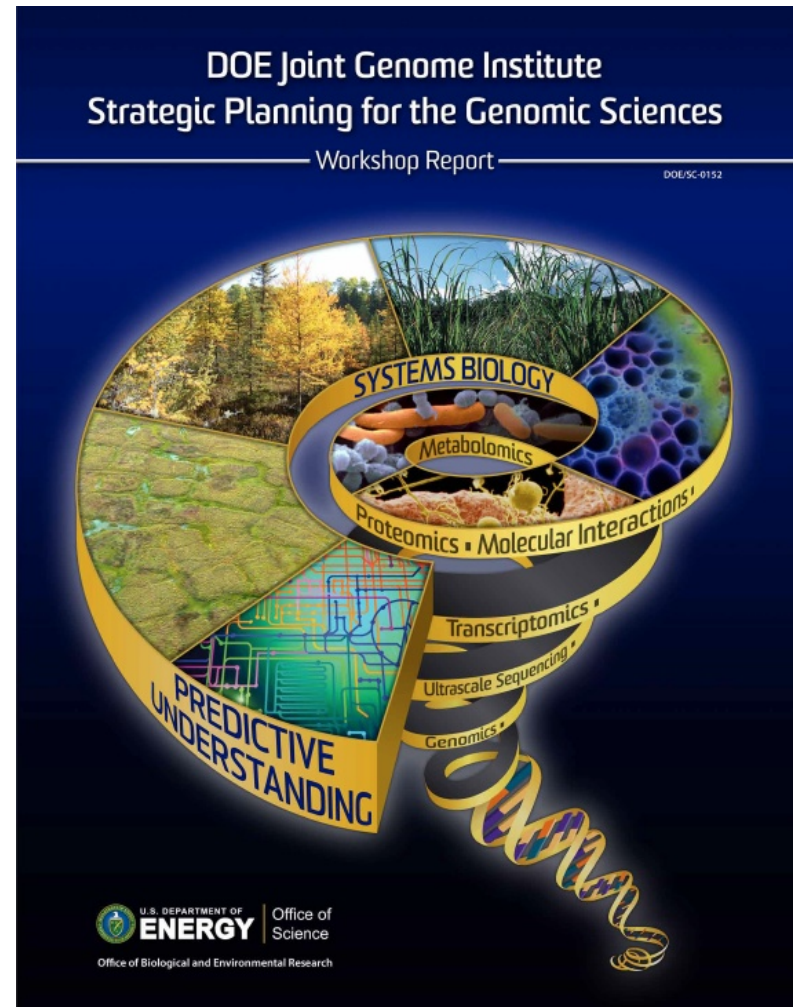
Jim Fredrickson (PNNL)  
Jan Leach (Colorado State)  
Michael Laub (MIT)

## **Breakout Chairs:**

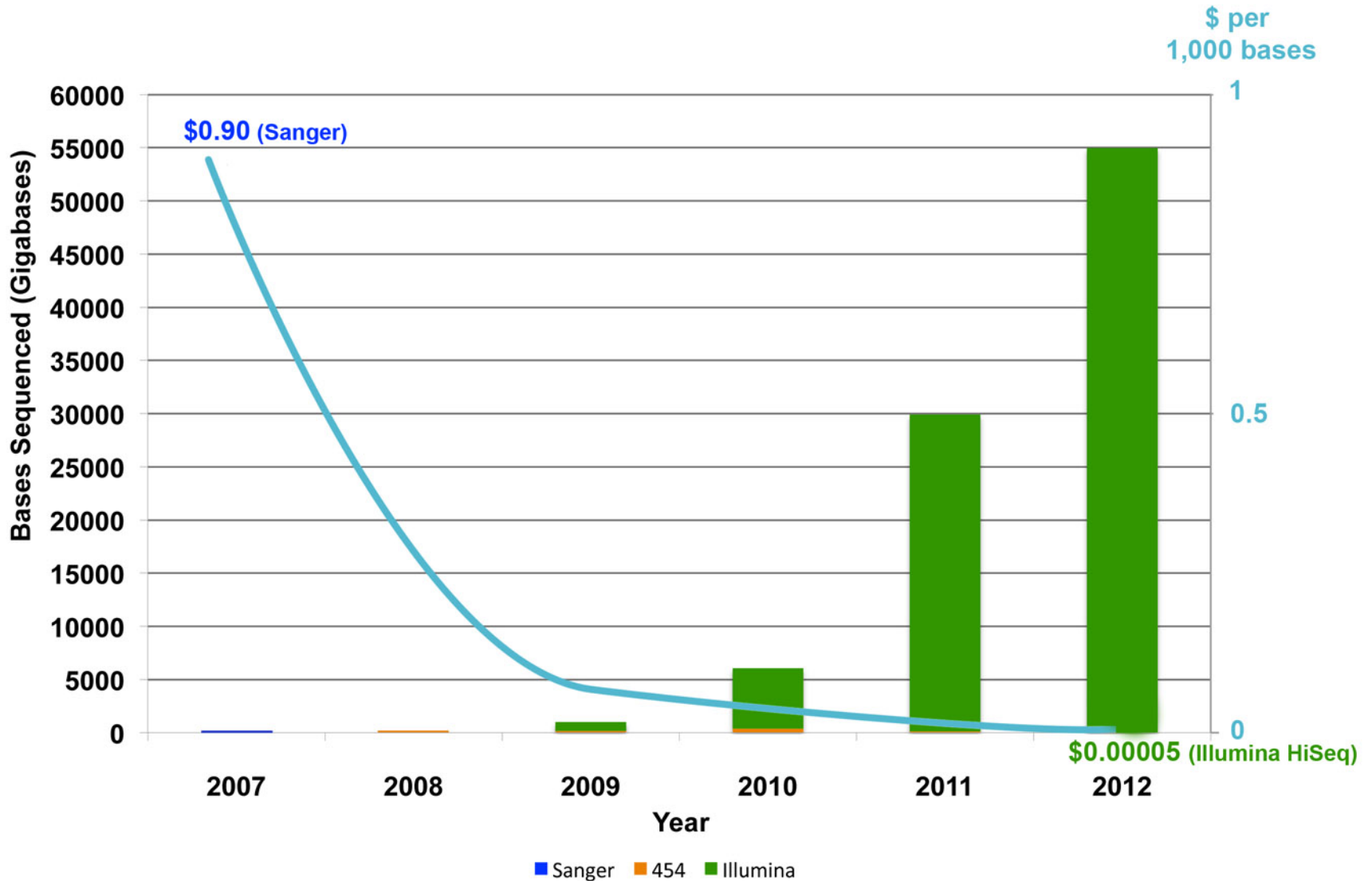
Kimmen Sjolander (UC Berkeley),  
Tom Schmidt (Michigan State)  
Richard Michelmore (UC Davis)

## **Speakers:**

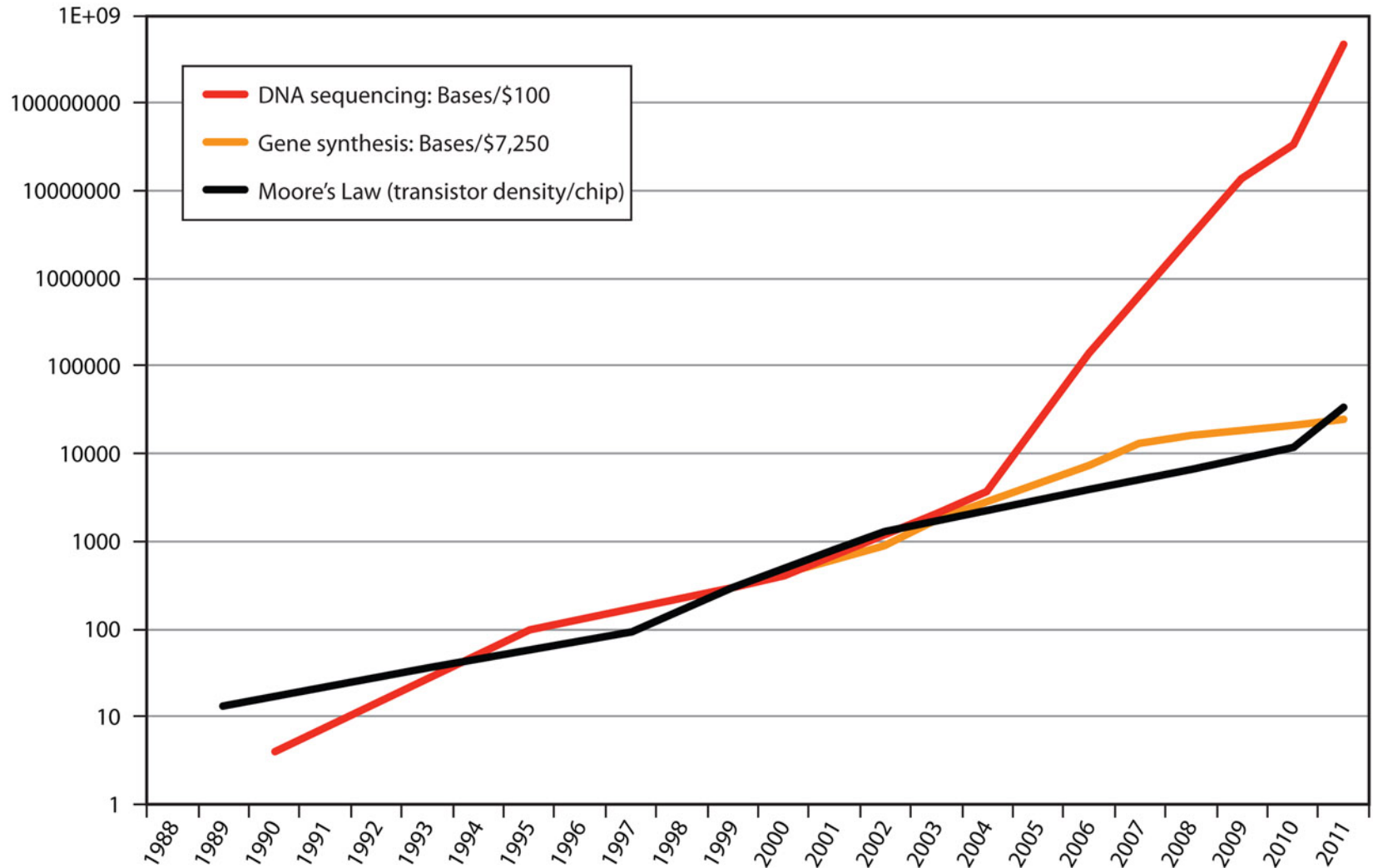
Greg Petsko (Brandeis)  
Maureen McCann (Purdue)  
Claire Fraser (U Md)  
John Gerlt (UIUC)



# DOE JGI Sequencing Economies of Scale



# Rate of Sequencing Outpaces Moore's Law



# Motivation for the Workshop

- A need to solicit broad community ideas, input, and support for what a next-generation genome center (the DOE-JGI) should evolve into, and the challenges it should be able to address, to remain current and necessary.
- Given that sequencing technologies have advanced so rapidly, how might this affect the scientific scope at the DOE-JGI and its ability to stay at the forefront of exploiting these changes.
- Connection to BER mission needs be articulated carefully and clearly.

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report

## Initial Assumptions:

- 1) DOE-JGI will remain an Office of Science User Facility
- 2) DOE-JGI will continue to generate BER-mission relevant sequence in large amounts and high quality
- 3) DOE-JGI can't do everything, it must be strategic in what capabilities it develops and how it transitions to a next-generation genome science center
- 4) Rather than “reinventing the wheel”, DOE-JGI should avail itself of other DOE assets where appropriate (e.g. Kbase, EMSL, etc.)

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report: Participants

- Elizabeth Edwards, U Toronto
- Mary Ann Moran, U Georgia
- Richard Michelmore, UC Davis
- Toby Kellogg, U Missouri
- Kathleen Treseder, UC Irvine
- Zach Serber, Amyris Corp
- Kimmen Sjolander , UC Berkeley
- Paramvir Dehal, LBNL
- James Minor, Dupont (ret.)
- Udaya Kalluri, BESC
- Gary Stacey, U Missouri
- Jill Banfield, UC Berkeley
- Roy Kishony, Harvard
- Doreen Ware, CSHL
- Maureen McCann, Purdue
- Felice Lightstone, LLNL
- Andrew Bradbury, LANL
- Rick Stevens, ANL
- Claire Fraser, U Md
- Blake Simmons, JBEI/SNL
- Deb Mohnen, BESC/U Ga
- Tom Schmidt (MSU)
- Paula Imbro, SNL
- Don Bryant, Penn State
- Jeffery Chen, UT Austin
- Arthur Grossman, CIS
- Ryan Gill, U Colo
- John Gerlt, UIUC
- Reinhold Mann, BNL
- Greg Petsko, Brandeis
- Shawn Kaeppler, GLBRC/U Wisc
- Audrey Gasch, GLBRC/U Wisc

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report

## Workshop Charge:

- What new scientific insights could be enabled by next-generation sequencing? What vision for DOE mission-driven biology, rooted in and building on high-throughput genomic sequencing and analysis, can be identified for the next 5 to 10 years?
- What large-scale questions/grand challenges in systems biology, grounded in very high-throughput genomics and post-genomic analyses, will require a user facility to achieve necessary efficiencies and effectiveness and would have the highest impact and value for DOE biology?
- What capabilities and technologies that do not presently exist, presently lack high-throughput capability, or are not generally available to the biological research community, will be required to address the most important questions in biology and to meet the needs of DOE biological science?



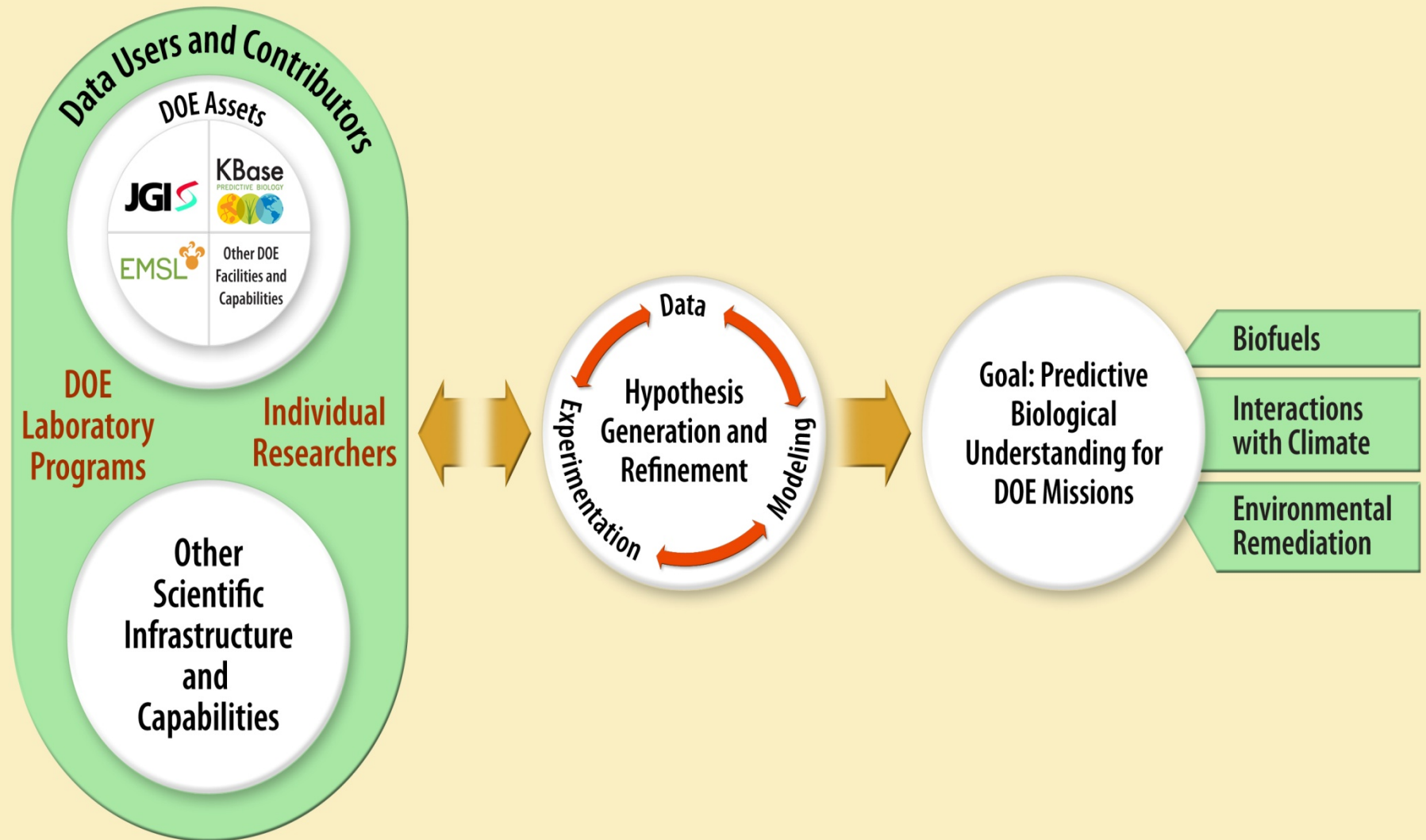
# **DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report: Areas of Focus (1)**

- 1. Continued and increasing large-scale sequencing of biologically important organisms and communities.**
- 2. Large-scale functional genomics technologies for high-throughput functional annotation, informed by global measurements of actual cellular activities rooted in genome sequencing.**
- 3. Extended and improved bioinformatics methods to enable integration and analysis of unprecedented quantities of data and to generate testable hypotheses critical to advancing DOE science**

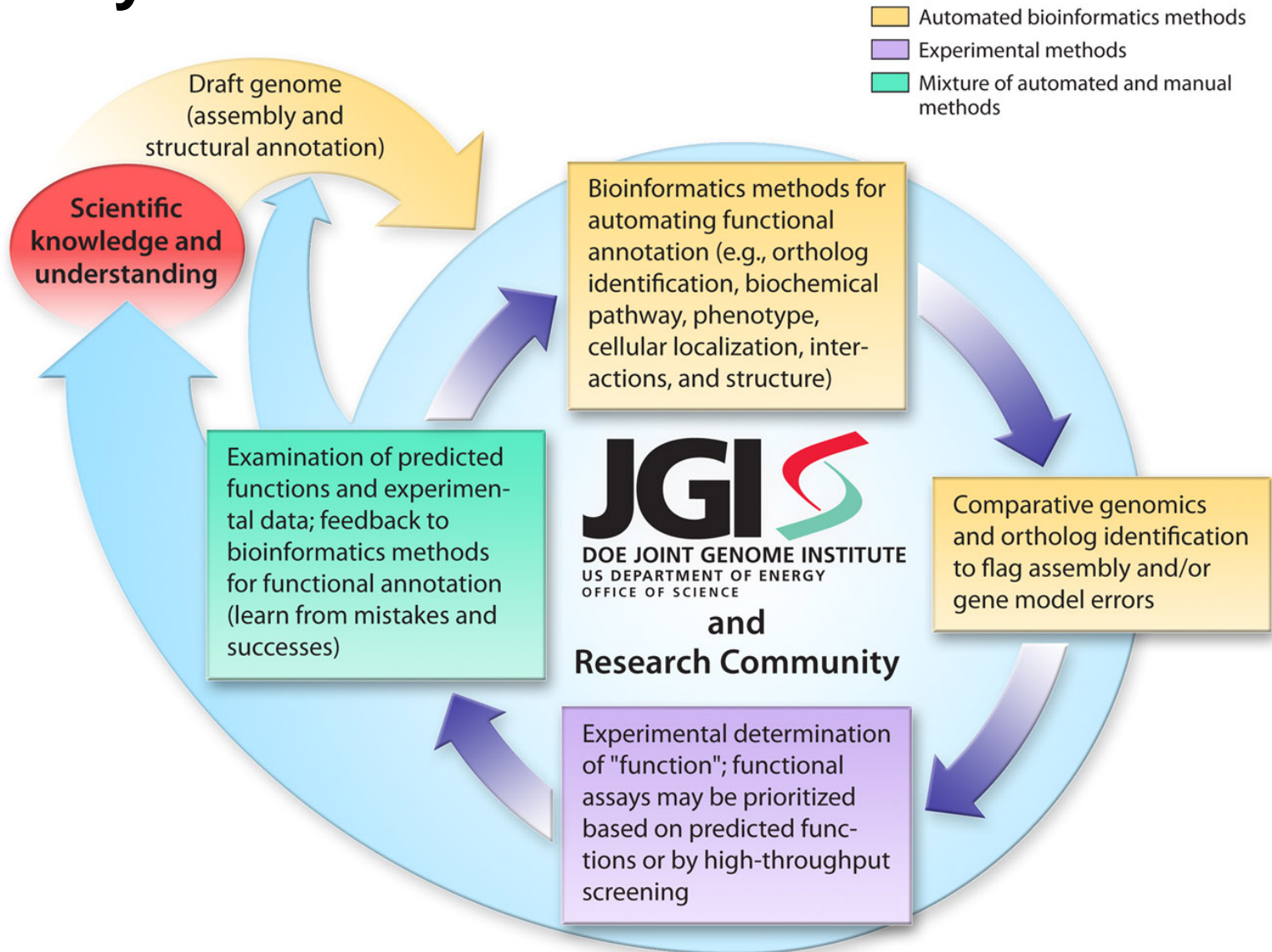
# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report: Areas of Focus (2)

4. Aggressively expanded capacity not only to sequence (“read”) DNA, but also to synthesize (“write”) DNA, enabling scientists to manipulate genomes.
5. Improved automation of biological experiments to match the throughput now prevalent in sequencing.
6. Communities of scientists led by the DOE-JGI and organized around key mission-relevant scientific questions.

# Vision for the DOE-JGI: Hypothesis-Generating and Validation Engine for Fundamental Systems Biology



# Toward a More Systematic Annotation Pathway



# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report: Exemplar Science Challenges

- 1) Designer Phototrophs: Engineering Cyanobacteria to Produce Biofuels
- 2) Understanding Interactions Between Microbes and Climate
- 3) Advanced Genomic Capabilities for Biofuel Sustainability
- 4) Mining Natural Variation to Improve Energy Capture (Photosynthesis) in Plants
- 5) Dynamics of Genomic Participation in CO<sub>2</sub> Cycling in Marine Environments
- 6) Characterizing Horizontal Gene Transfer (HGT)

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report:

## Next Steps (1)

- 1) Promote Emerging Technologies Opportunity Program (ETOP) at DOE-JGI **Posted 10-5-12**  
<http://www.jgi.doe.gov/programs/ETOP/index.html>
- 2) Tune the Community Sequencing Program at DOE-JGI towards challenges identified by the workshop
- 3) Continue to work closely with BRCs, Kbase, other sophisticated users to push the state of the art in next-generation genome analyses and annotation
- 4) Continue to develop new sequencing technology(ies) as a faster-better-cheaper “hypothesis-generation engine”

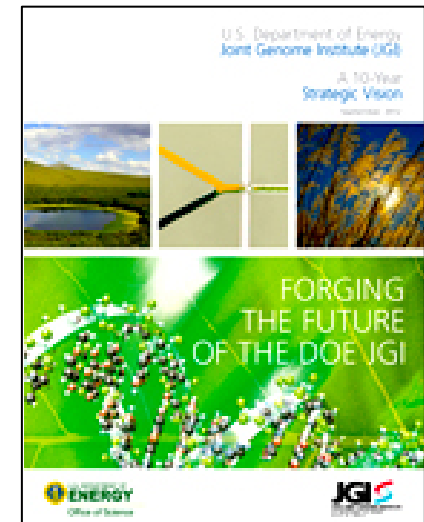
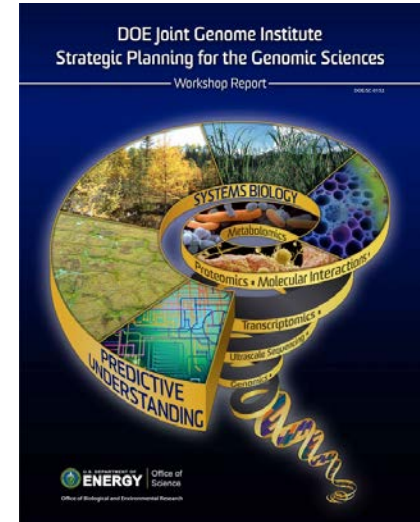
# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report:

## Next Steps (2)

- 5) Promote and encourage the development of complementary interactions with other DOE facilities and activities
- 6) Continue to explore opportunities for the application of high-performance computation to genome analyses
- 7) Build on emerging DNA synthesis capabilities to test annotations and enable biosystems design science
- 8) Continue to “seed” DOE-mission-focused communities of scientists to accelerate use of DOE-JGI generated sequence

# DOE JGI: Strategic Planning for the Genomic Sciences Workshop Report

- Report: Posted September 27, 2012
- URL:  
<http://genomicscience.energy.gov/userfacilities/jgi/futuredirections/DOE-JGI-StrategicPlanningWkshp.pdf>
- Report is in your packets, Executive Summary is on Joanne's table.
- DOE-JGI 10-Year Strategic Vision:  
<http://www.jgi.doe.gov/whoweare/10-Year-JGI-Strategic-Vision.pdf>
- Strategic Plan (posted September 27) is in your packets.





***Thank you***

# JGI Emerging Technologies Opportunity Program (ETOP)

- The overall objective of the ETOP is to support new and existing DOE JGI partners to develop promising projects focused on new technical capabilities that could be provided to users. Consistent with strategic vision plan, ETOP encourages projects to develop:
  - high-throughput functional genomic capabilities
  - microfluidic molecular biology approaches
  - New ways to isolate high quality DNA and RNA from fungi, microbes and plants
  - functional characterization of microbes and microbial communities, including non-destructive functional characterization of single cells
  - large scale microbial phenotyping
- Beginning in FY13, the DOE JGI anticipates making available up to \$1.5 million per year for the program through the funding of 3-5 projects for up to three years.
- Pre-proposals need to be received by December 15, 2012.
- Invitations to submit full proposals will be communicated to the applicants by January 25, 2013.
- Full proposals must be submitted by February 20, 2013.