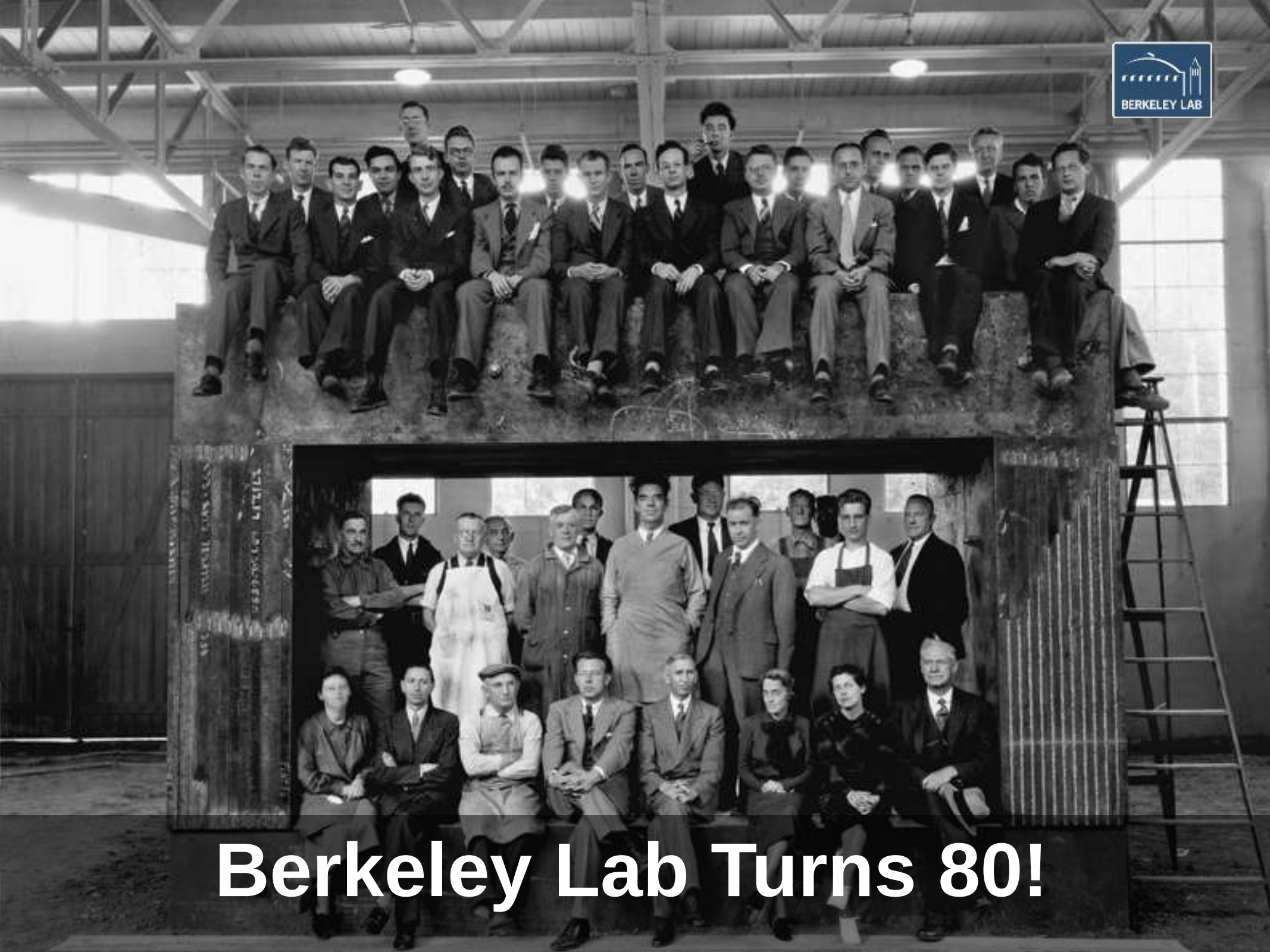
State of the Lab

Presentation to the Community Advisory Group

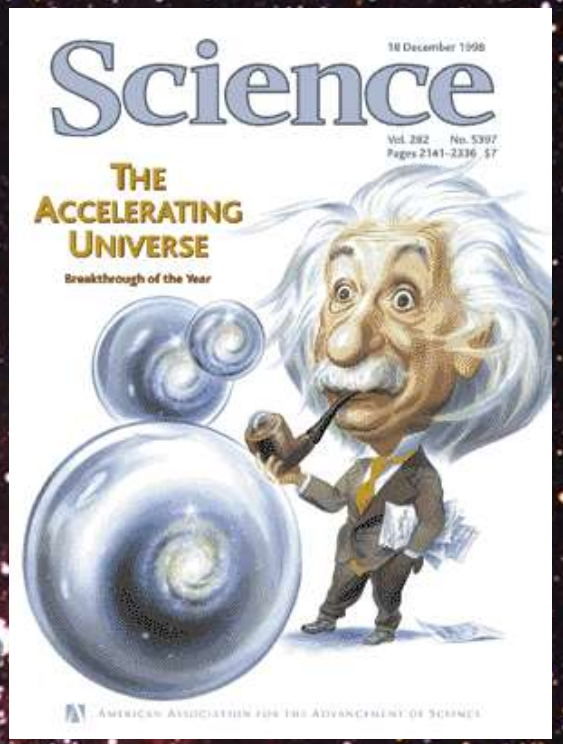
Dr. Paul Alivisatos
Director, Lawrence Berkeley National Laboratory

January 9, 2012



Berkeley Lab Turns 80!

October 4, 2011 – Nobel Prize in Physics



Saul Perlmutter
Berkeley Lab's 13th Nobel Laureate

Looking to the Future of Berkeley Lab

Carbon Cycle 2.0 Initiative

New dynamic window coatings

Efficiency

Low-swirl burner

Combustion

Arsenic removal from drinking water

Developing World

New industry consortium

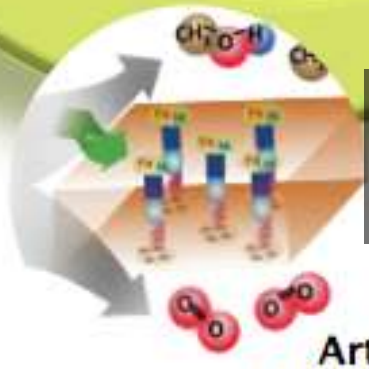
Solar PV

Materials for CO_2 Capture at 3x lower cost

Carbon Capture & Storage

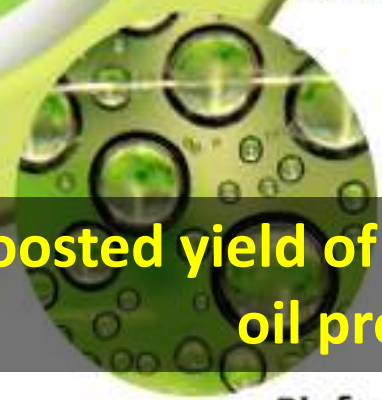
New flow cell battery design for grid scale storage

Energy Storage



Artificial Photosynthesis

Boosted yield of microbe oil production



Biofuels

Team science to address most difficult challenges – *Biofuels*

Chemical pre-treatment to break down cell walls

Sequencing plant genomes

Enzyme discovery via microbial communities

Metabolic synthesis and conversion

Plant

Biomass

Pre-treatment

Cellulose

Enzymes

Sugar

Microbes

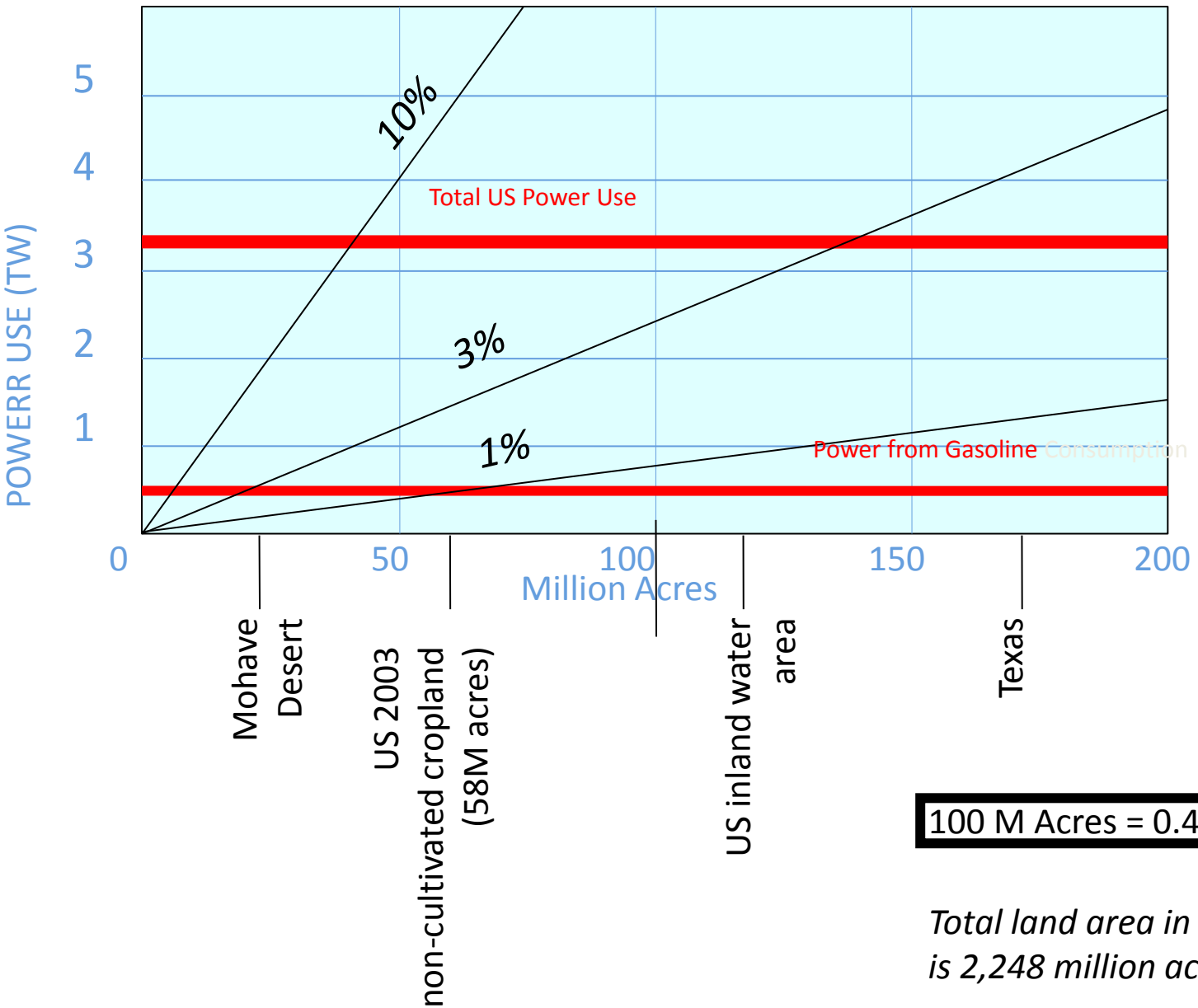
Genomics (JGI)

Physical Biosciences

Life Sciences

Earth Sciences

Solar Efficiency & Land Usage



- **Create fuels from sunlight with > 1% energy conversion efficiency using abundant low-cost materials, and scalable processes, with 10 year target for demonstration**

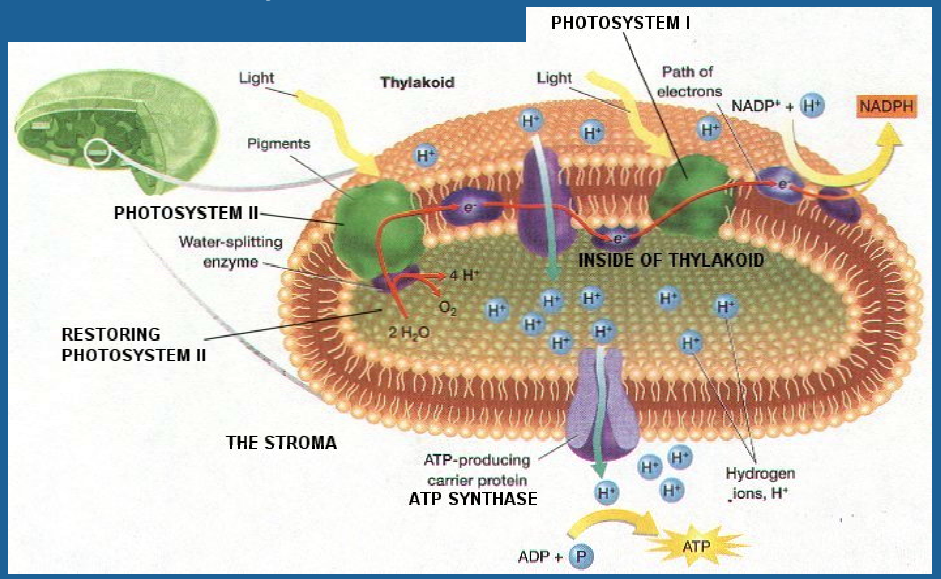
100 M Acres = 0.4 M Sq Km

Total land area in contiguous US is 2,248 million acres

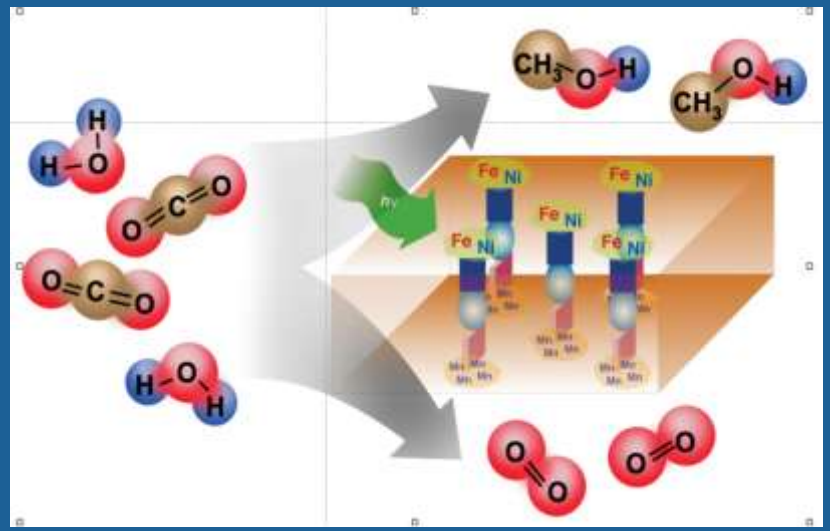
Joint Center for Artificial Photosynthesis

- **Melvin Calvin, 1982**: It is time to build an actual artificial photosynthetic system, to learn what works and what doesn't work, and thereby set the stage for making it work better
- **10-year JCAP Goal, 2010**: To demonstrate a manufacturably scalable solar fuel generator, using earth-abundant elements, that, with no wires, robustly produces fuel from the sun, 10 times more efficiently than (current) crops

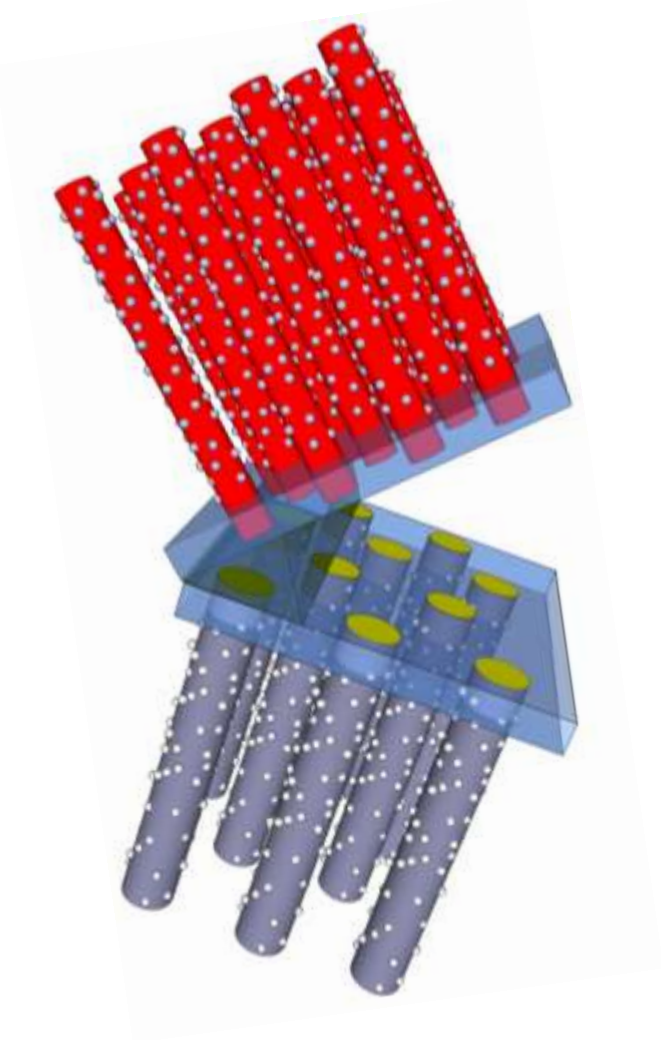
Photosynthesis

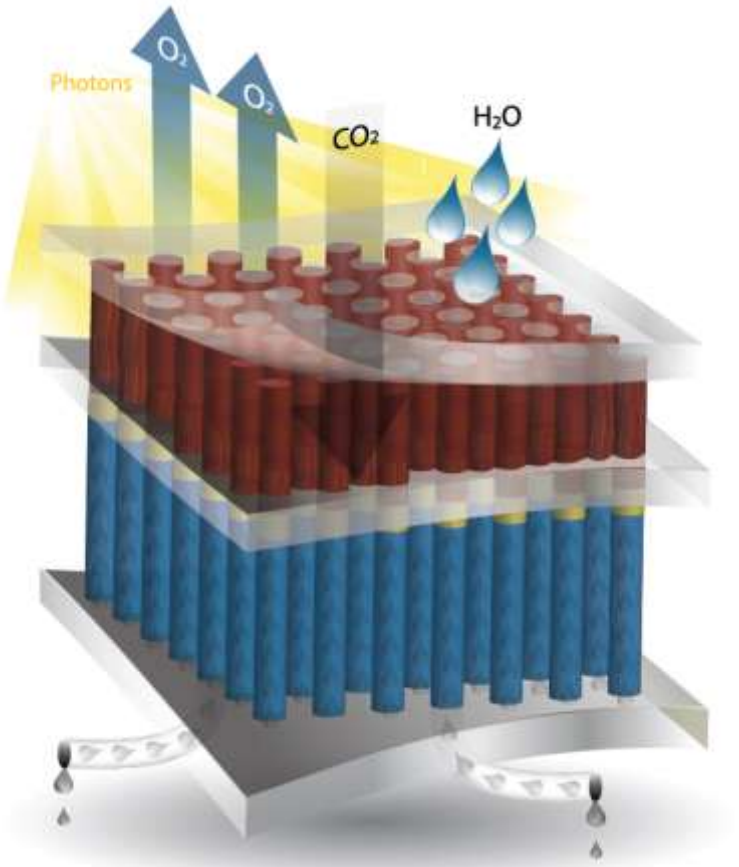


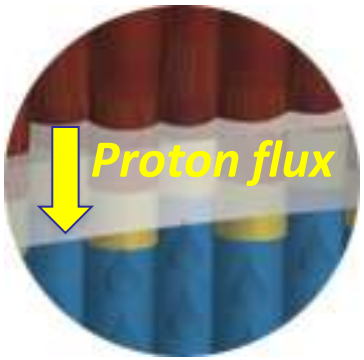
Artificial Photosynthesis

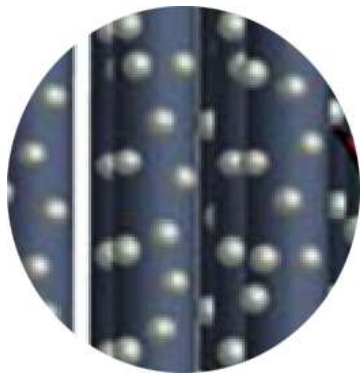


JCAP Activity









Nanostructured Light Absorbers
Earth-abundant materials
Novel Catalysts
New proton transport membranes

First prototypes Spring 2012

Societal needs for technical solutions to energy and environment problems will intensify

Measurement tools will open new realms of inquiry

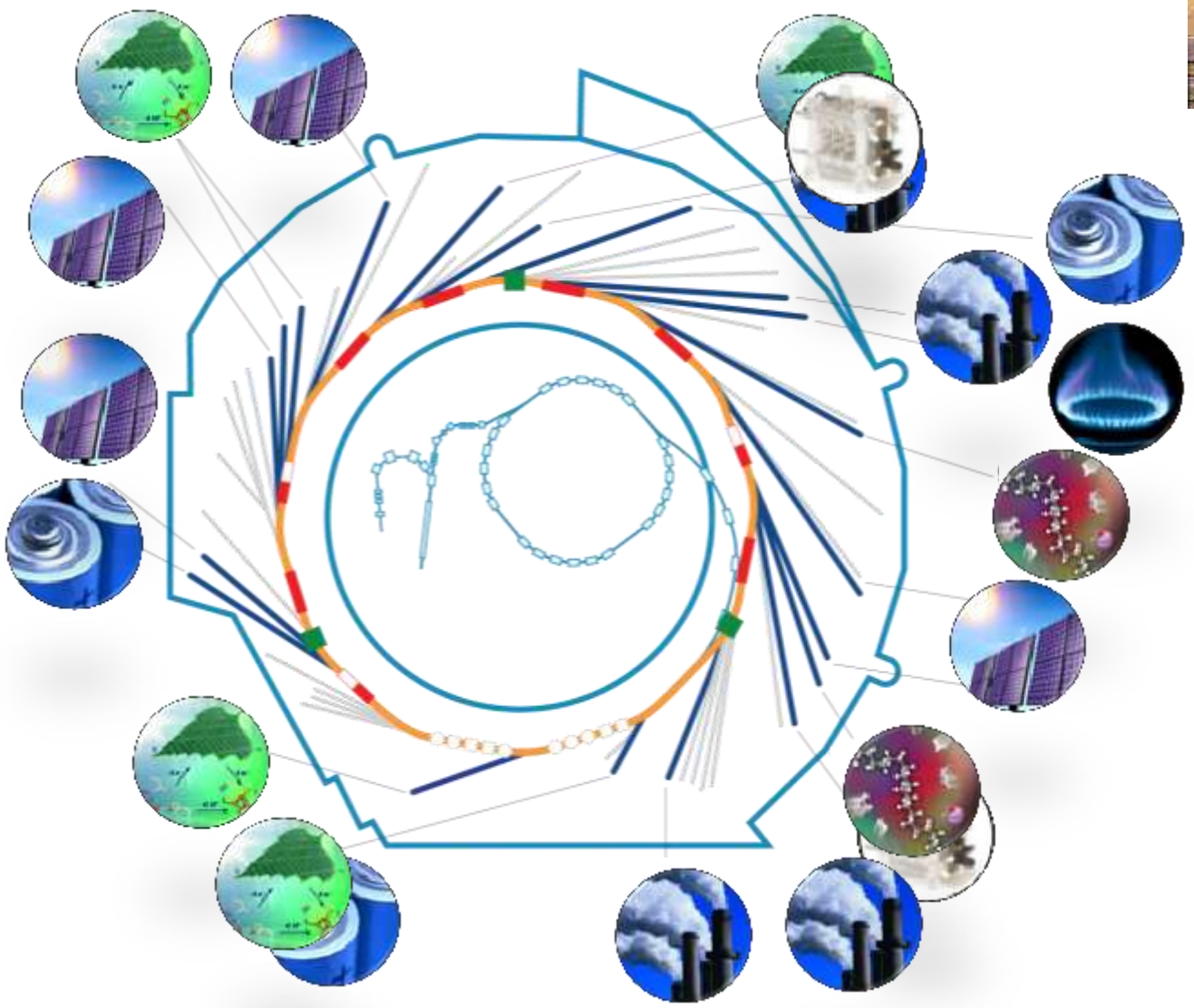
The biology revolution will deepen and impact other disciplines

Reliance on computation will expand while massive data sets will challenge

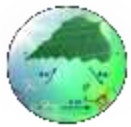
Physics Chemical Sciences Materials Science Mathematics

A Foundation of Basic Science

Today: The Advanced Light Source Microscopes enable our science



Sunlight to electricity



Sunlight to fuel

Batteries

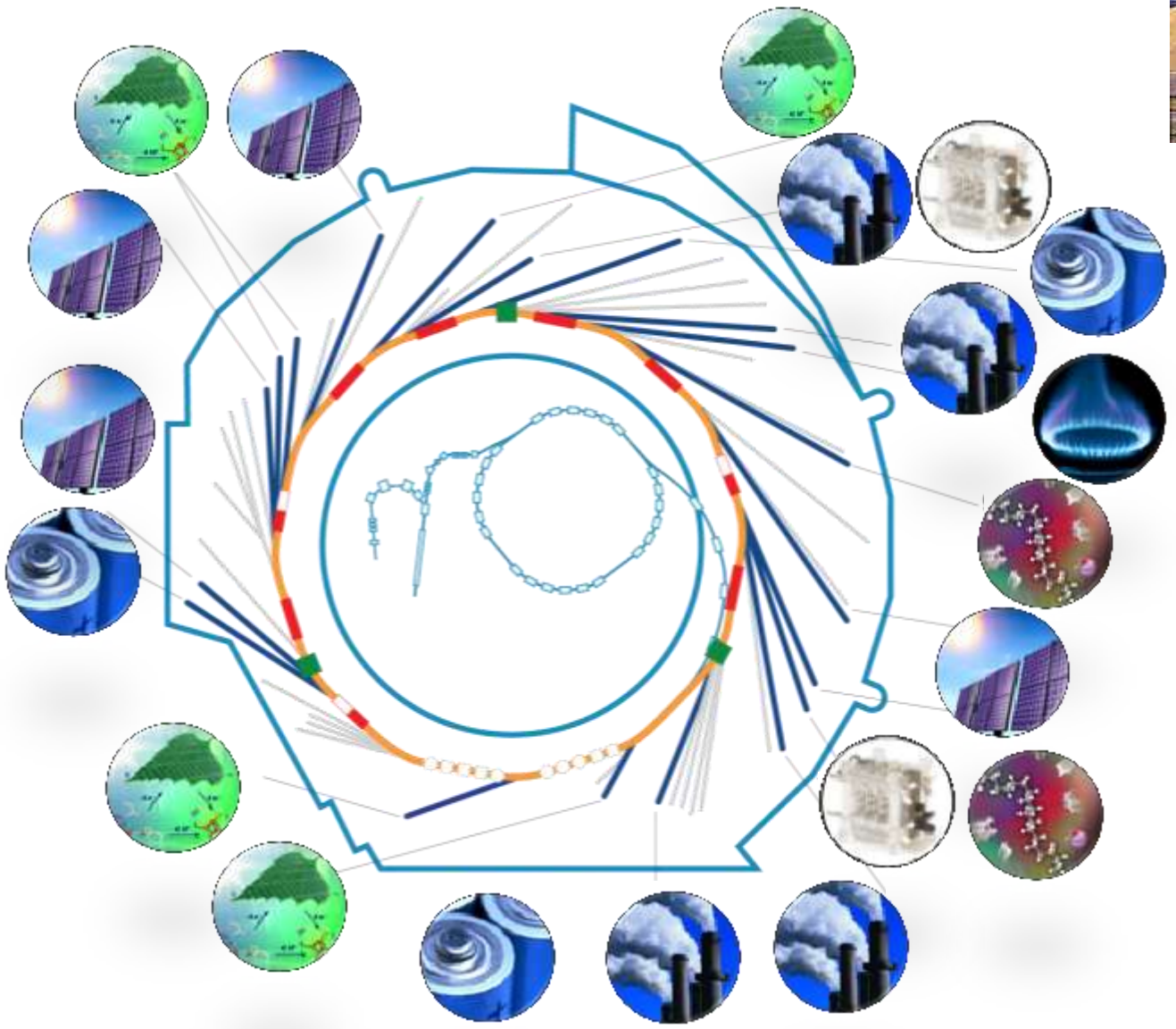
Fuel Cells

CO_2 Capture and Seq.

Combustion

Catalysis

ALS Energy Research Areas



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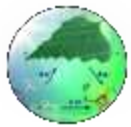

Sunlight to fuel

Batteries

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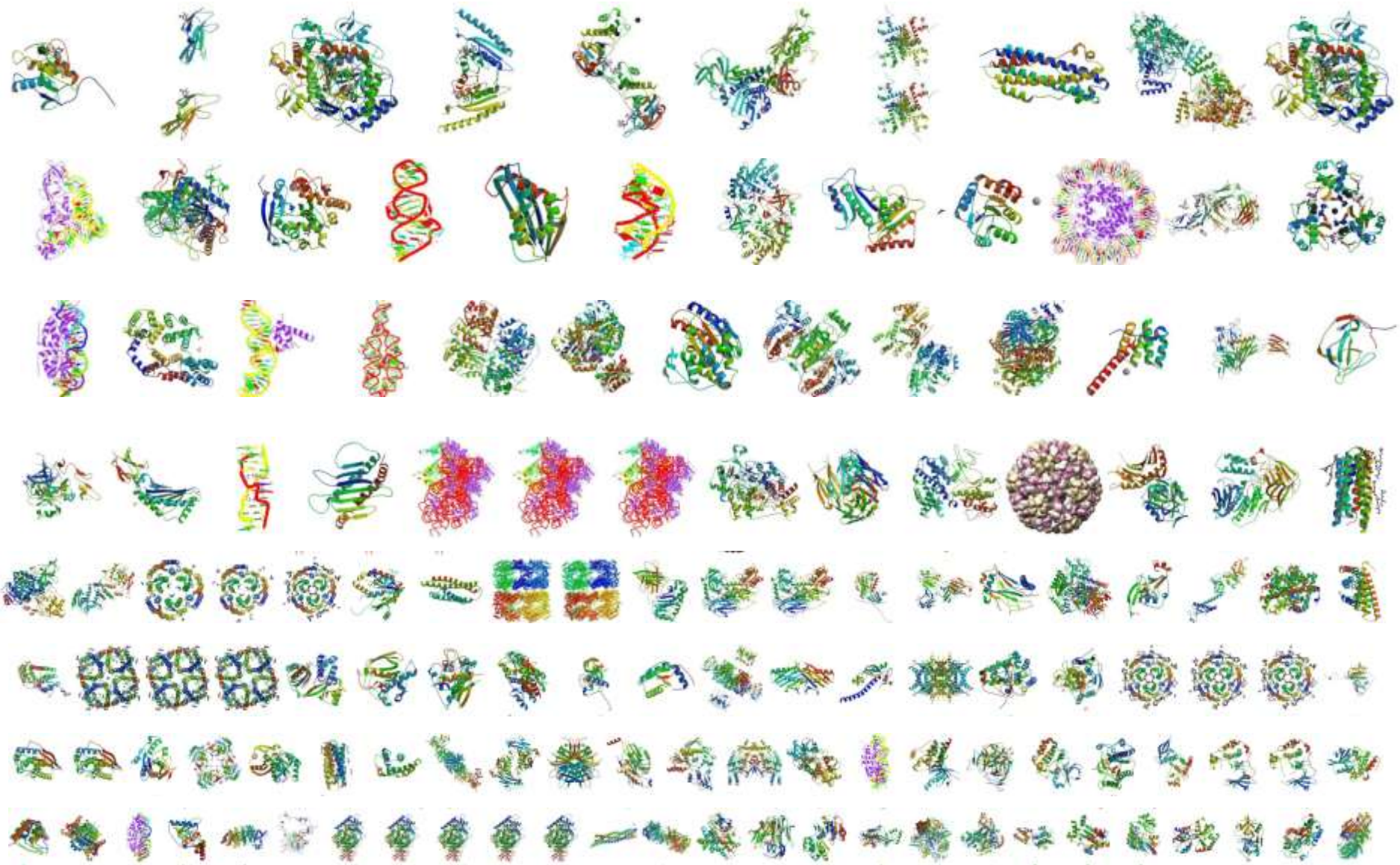
Catalysis

3366 published biological structures solved using data collected at the ALS



Berkeley Lab Advanced Light Source Used to Develop Melanoma Drug

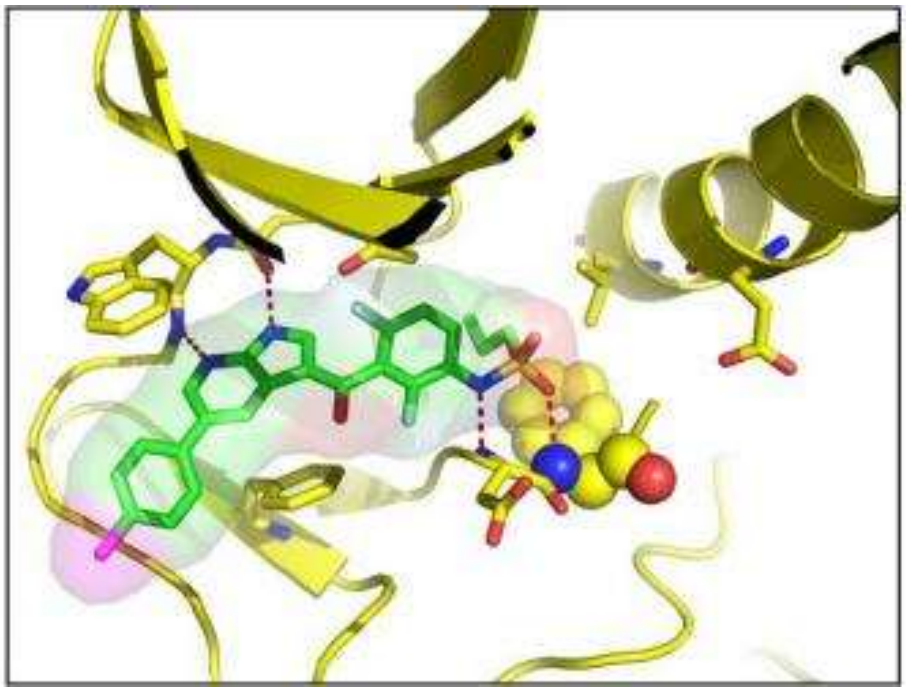


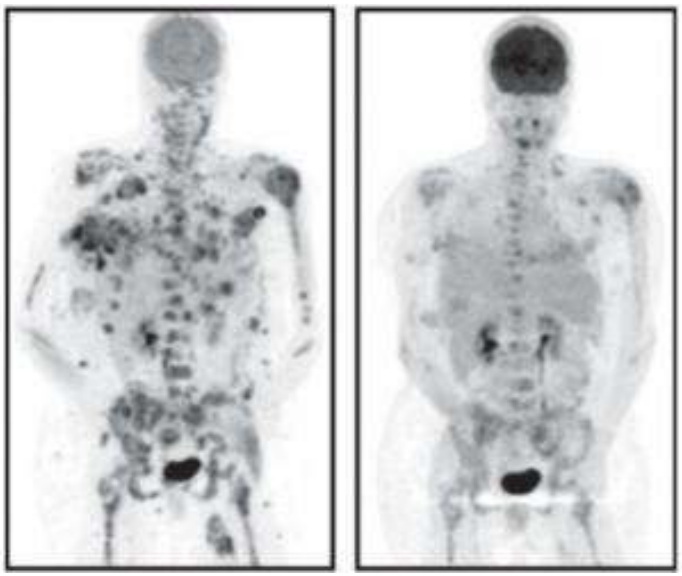
Illustration of a new anti-cancer drug at work - preventing a mutated enzyme from promoting the growth of melanoma.
Image courtesy Plexxikon Inc.

Creating custom-designed drugs to block disease at the molecular level.

Berkeley-based drug company, Plexxikon, used the Lab's Advanced Light Source to:

- Determine the structure of a protein involved in melanoma
- Guide the development of drug candidates that could stop its spread.

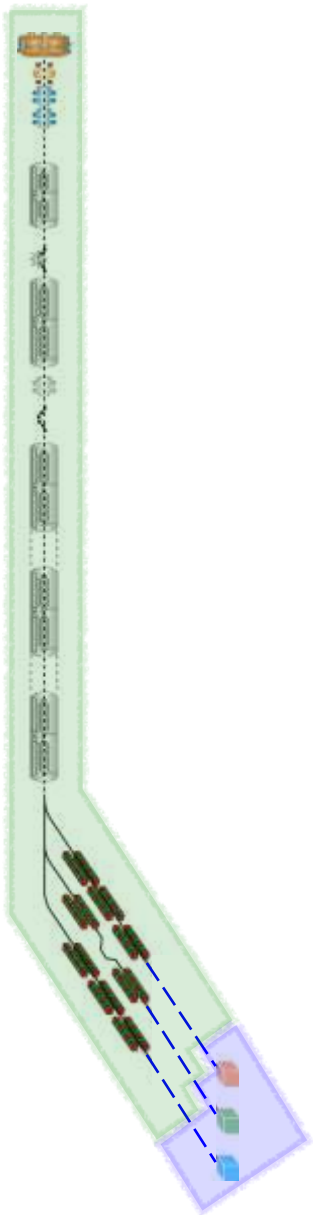
PET scan showing decrease in melanoma tumors using drug developed in part at the Berkeley Lab Advanced Light Source



Plexxikon
Scaffold-Based Drug Discovery

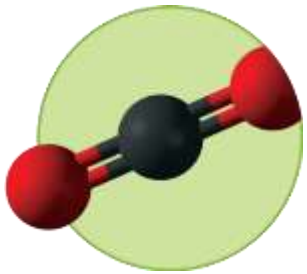
ALS
ADVANCED LIGHT SOURCE

Next Generation Science & Facilities



- **Renewable Energy**
  - — Enable us to observe photosynthesis at the molecular level; a key to creating a new clean, sustainable source of energy

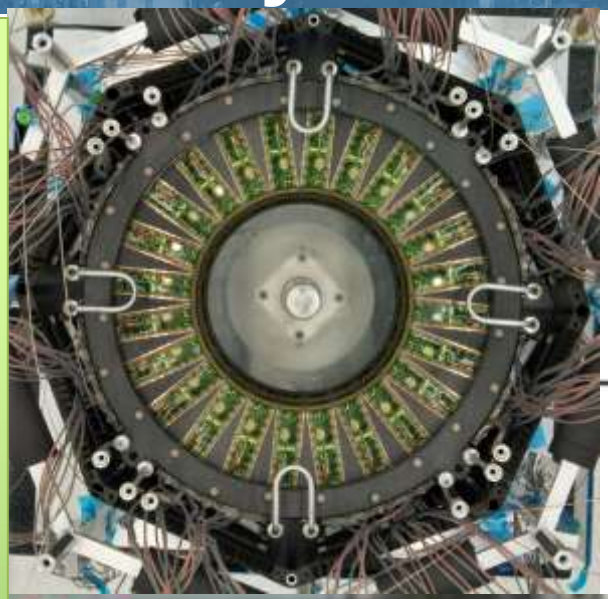
- **Human Health**
  - — Enable us to learn how enzymes work to repair DNA and to develop new antibiotics and anticancer agents with fewer side effects

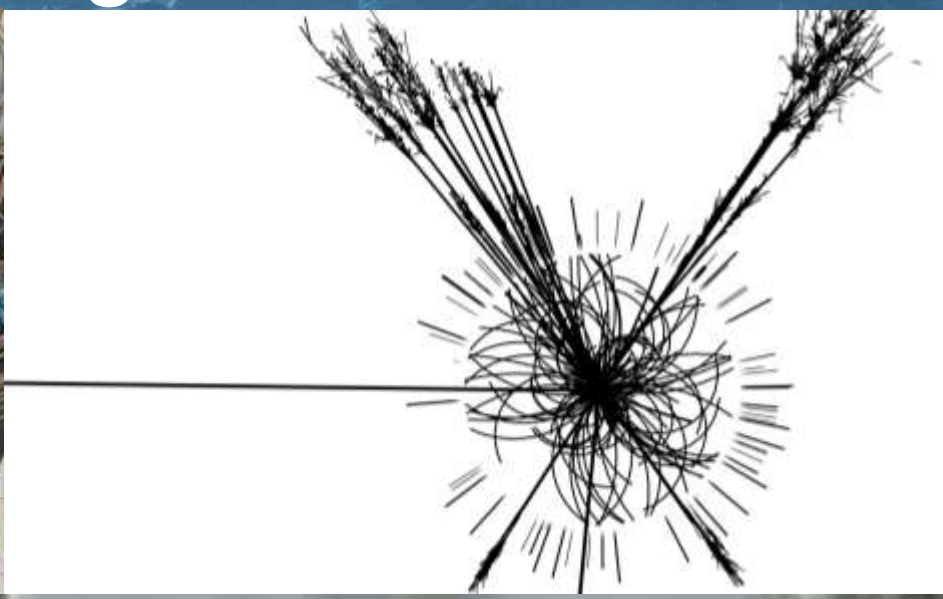


- **Environmental Quality**
  - — Enable us to understand how bacteria pull greenhouse gas, CO_2, out of the soil, water, and atmosphere to fight global warming

Discovery Class Science Pushes Limits of Our Ability to Manage Data

Reliance on computation will expand while massive data sets will challenge us



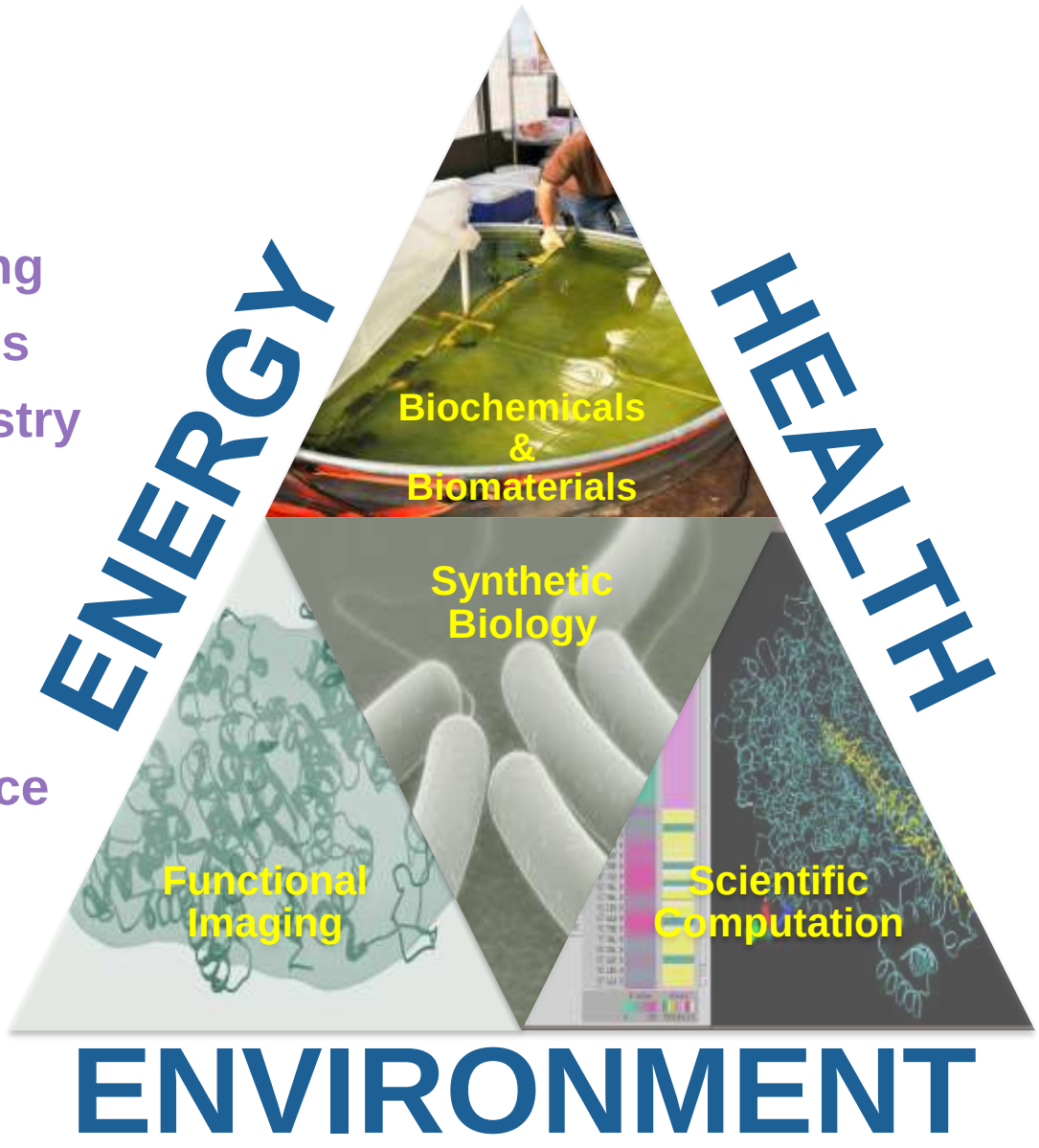


Integrated Biosciences Vision

The biology revolution will deepen and impact other disciplines

Key initiatives:

- biofuels
- biochemicals
- Bioengineering
- metagenomics
- biogeochemistry
- cancer
- imaging
- biomimmetic materials
- climate science

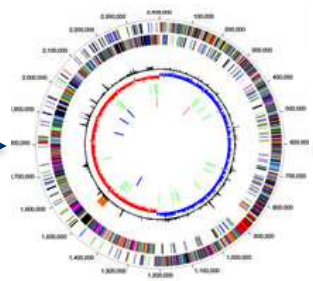


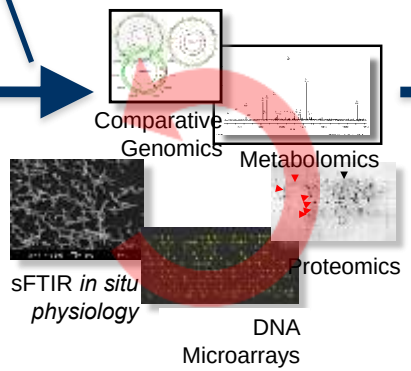
Team science to address most difficult challenges – *Soil carbon cycling and climate change*

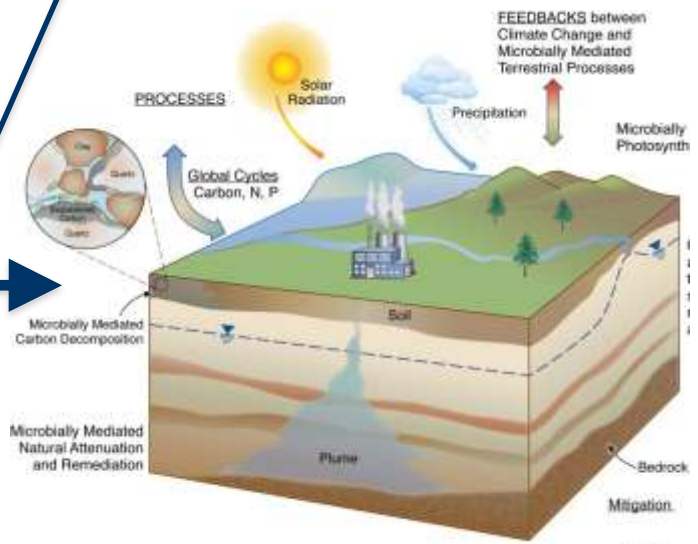
Functional genomics and structural biology of environmental microorganisms

Sequencing genomes of environmental microorganisms

Soil Carbon Biodegredation and feedbacks to climate







Genomics (JGI)

Physical Biosciences

Life Sciences

Earth Sciences

Team science to address most difficult challenges – *Low dose radiation and cancer*

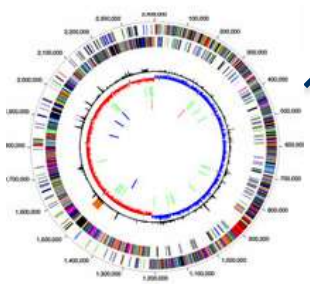
BERKELEY LAB

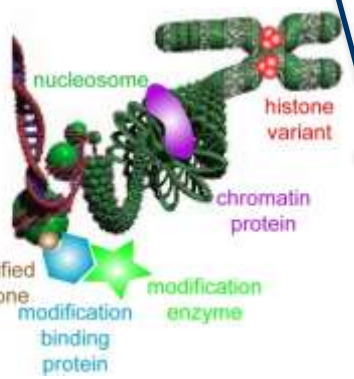
Understand how damage to normal tissues leads to cancer

Elucidating normal and cancer genome form and function

Systems biology approaches to cancer management

Translating approaches to the clinic





Genomics (JGI)

Life Sciences

Physical Biosciences

Special People, Unique Facilities

Human Capital: Sustainability & Diversity

- **Recruiting a Chief Sustainability Officer**
- **Recruiting a new Manager of Diversity & Inclusion**
  lbl.gov/Workplace/WFDO/
- **Women Scientist and Engineers group has grown, program has expanded**
  lbl.gov/Workplace/WFDO/WSEC/

Presidential Early Career Award for Scientists and Engineers (PECASE)

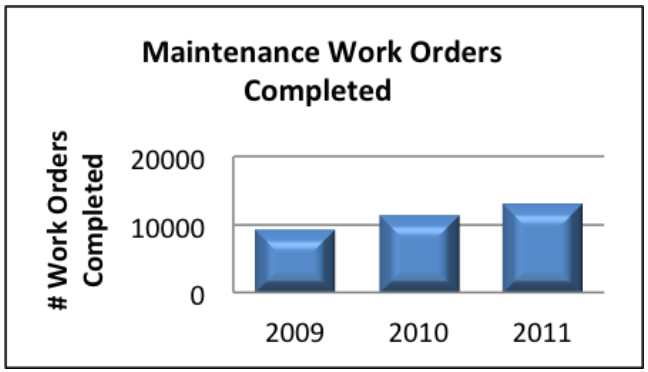
2011: Christian Bauer, Feng Wang
2010: Gavin Crooks, Trent Northen
2009: Cecilia Aragon, Jeff Neaton, Sanjay Kumar

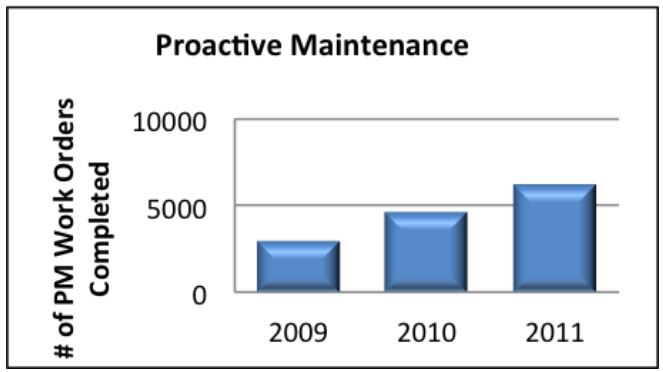
Congratulations to our 9 Early Career Award winners

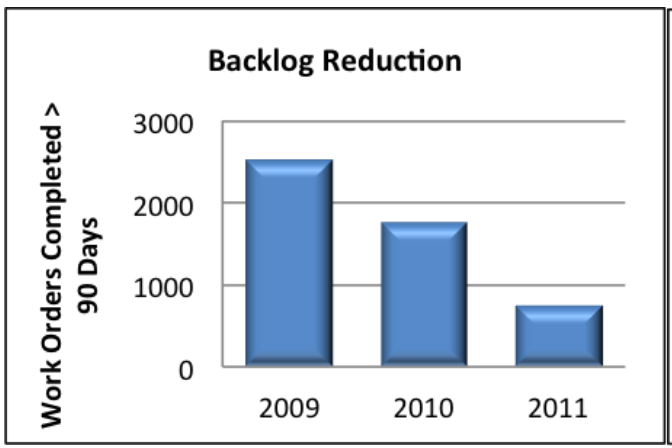
Efficiency: Two big trends affecting cost of doing business

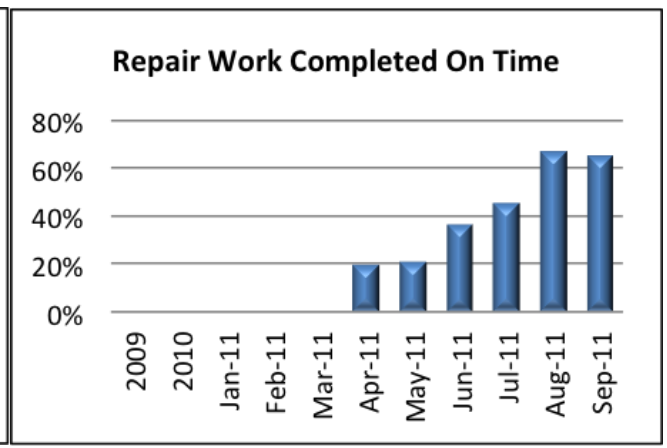
- **Pension and Health Benefit increases**
  - UC requires increased participation from employees and the lab
  - Cost of a person will increase above inflation in each of the next few years
  - With flat budget this will impact us
- **Modernization of business systems**
  - External peer reviews identified this as a major area for efficiency gains
  - HR recruitment and hiring system upgraded this year
  - Financial Management System modernization
  - Integration of databases

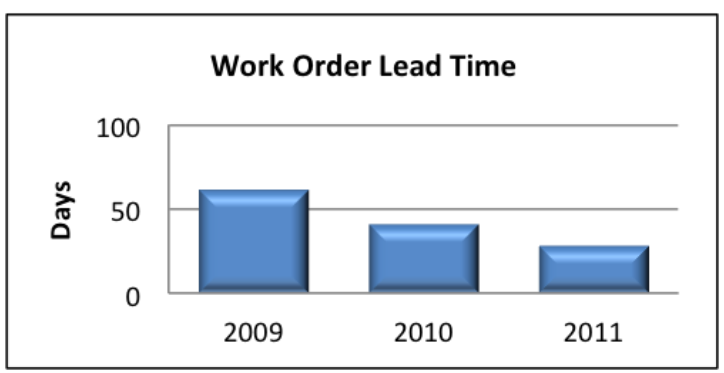
Process Improvements in Facilities











Facilities Performance Summary

- Work Output ↑ 41%
  Preventive Work ↑ 52%
  Backlog ↓ 70%
  Work Orders Completed On Time ↑ from 0% to 65%
  Work order lead time ↓ 54%
  Facilities budget ↓ $3M

Community Relations – Receiving continued emphasis

- Community Advisory Group
- Science at The Theater
- Director's Letters to the Community
- Support for Community Projects
- East Bay Green Corridor
- Open House
- Public Tours
- "Cool Your School"

Next Step: Expanded science education program

Societal needs for technical solutions to energy and environment problems will intensify

Measurement tools will open new realms of inquiry

The biology revolution will deepen and impact other disciplines

Reliance on computation will expand while massive data sets will challenge

Physics Chemical Sciences Materials Science Mathematics

A Foundation of Basic Science

Thank You