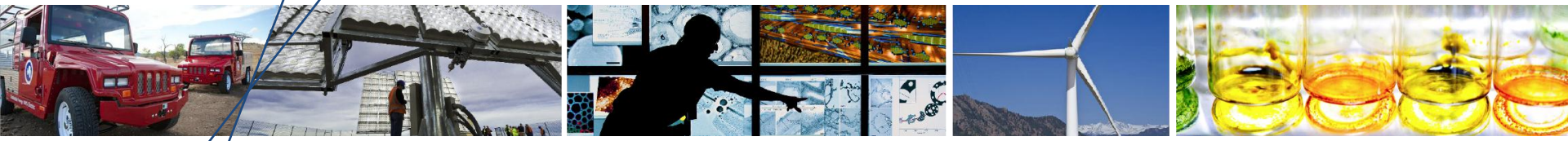
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Education Overview



Presenter: Linda Lung

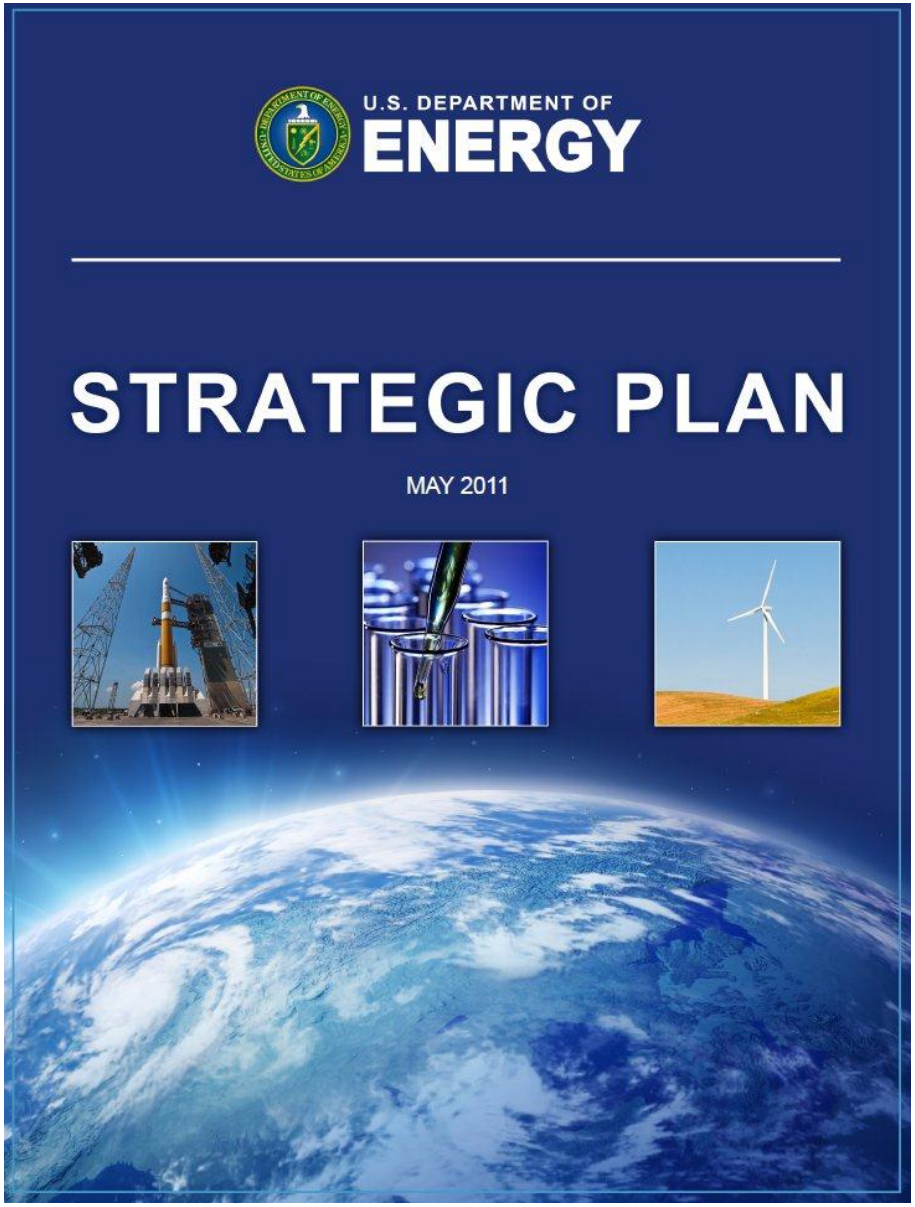
Date: April 23, 2012

NREL Education Programs

Education Mission: Help ensure that DOE, NREL and the Nation have a sustained pipeline of highly trained science, technology, engineering and mathematics (STEM) workers.

Education Priorities:

- Energizing students through programs and engineering competitions.
- Developing the next generation of scientists through undergraduate research experiences
- Renewing teacher skills and connecting NREL to classrooms through teacher workshops.
- Increase opportunities for visiting faculty to participate in energy research
- Utilize the state-of-the-art and unique research facilities at DOE national laboratories.
- Provide graduate fellowships for the pursuit of advanced degrees in scientific disciplines that prepare U.S. students for careers important to DOE and NREL's mission.
- Contribute to the national mission of improving energy literacy.



Promote Energy Literacy

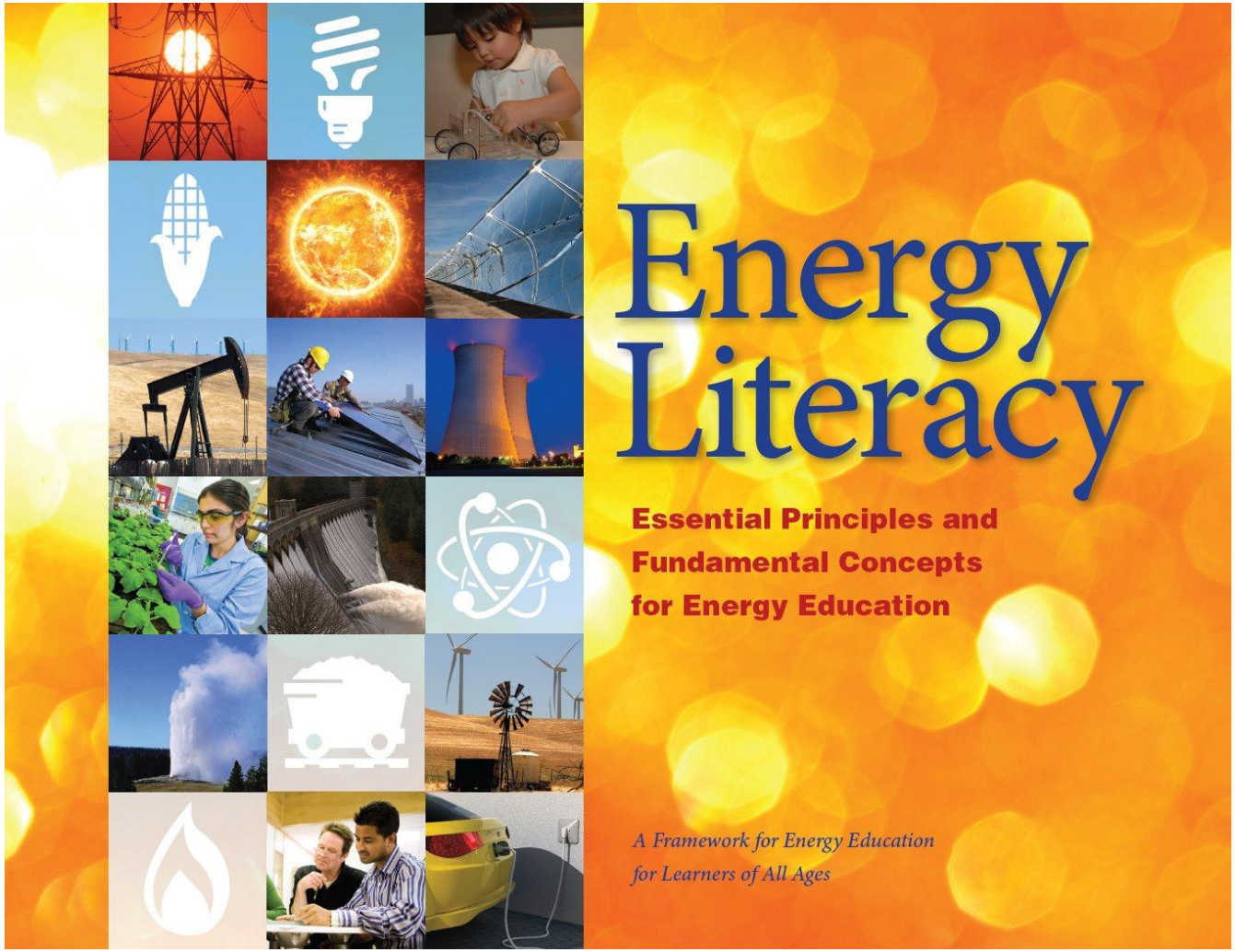
The Department will actively participate in the **development and implementation of a coordinated national energy education or "energy literacy" effort**. **A modest understanding of energy sources, generation, use and conservation strategies will enable informed decisions on topics from home energy use to international energy policy**. The Department will leverage relationships with academic institutions, other federal agencies, industry, organizations, and other stakeholders to improve awareness and understanding of energy issues.

[DOE, May 2011 Strategic Plan, page 21]

Energy Literacy
Essential Principles and Fundamental Concepts for Energy Education

An effort to define what it means to be energy literate and to identify the essential understandings that underlie this literacy.

– A guiding document that provides context, background and definitions, along with identifying the Essential Principles and Fundamental Concepts that underlie Energy Literacy.

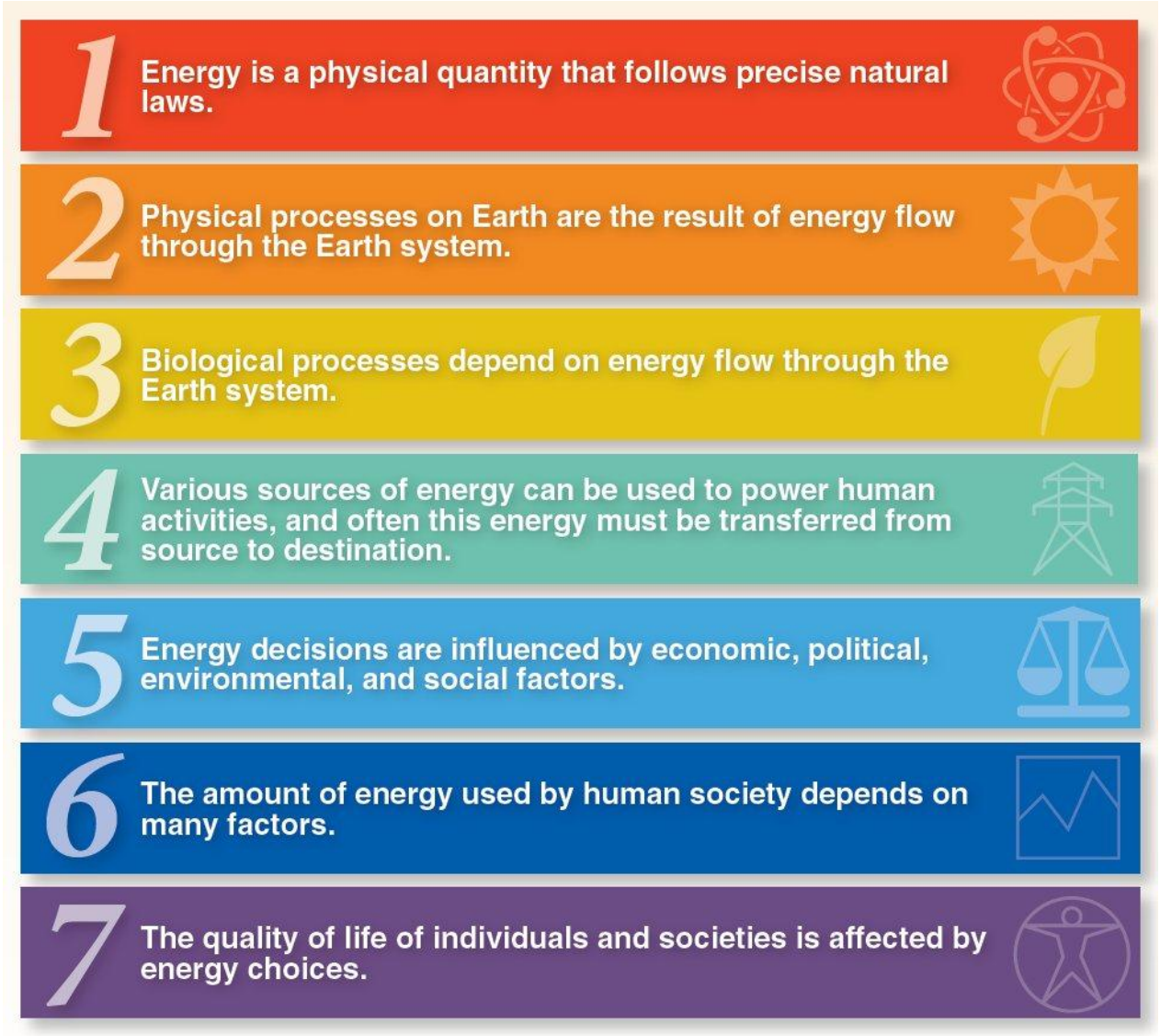


Energy Literacy

Back Cover:

Energy Literacy

The Essential Principles of Energy Education:



Energy Literacy Document

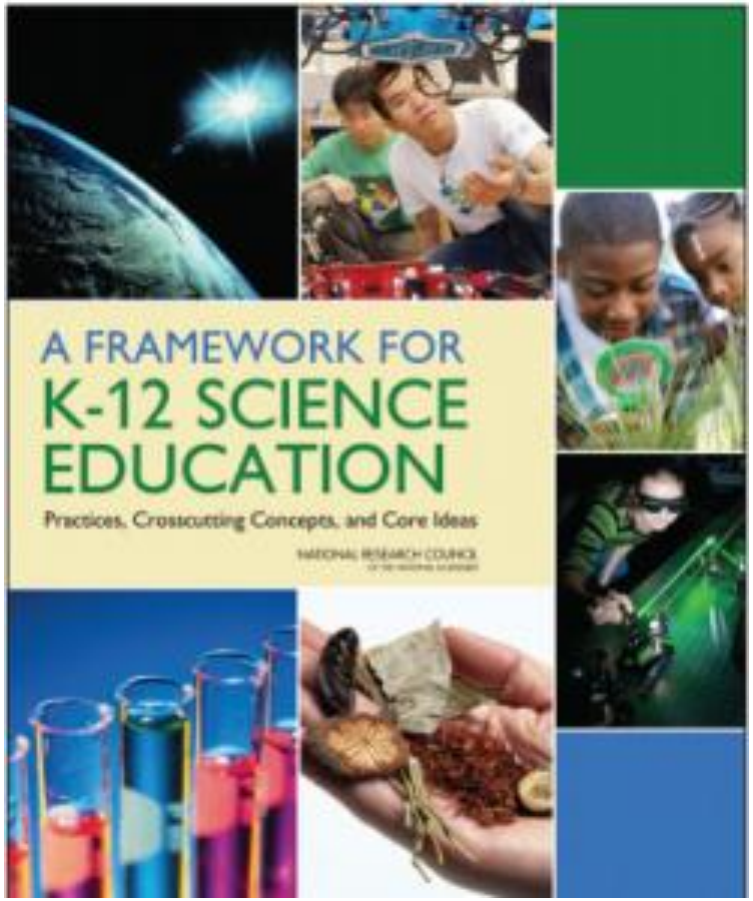
The document is available for download at:

www.globalchange.gov/resources/educators

The National Research Council's Framework for Science Education

Crosscutting Concepts

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. **Energy** and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change



Next Generation Science Standards (NGSS)

- State-led effort to develop new science standards
- Managed by Achieve, Inc. an independent, bi-partisan, non-profit education reform organization.
- Jeff Wadsworth from Battelle is on the Achieve Board of Directors.
- All Battelle labs are working with their state Dept. of Education on the review of the science standards.

Portfolio of NREL Programs

K-12 Programs

- Middle School Car competitions
- DOE National Science Bowl®

Teacher Programs

- Science Teacher and Researcher (STAR)
- Energy Teacher Workshops
- Energy: A Multidisciplinary Approach for Teachers (EMAT)
- Solar on Schools

Undergraduate Programs

- Science Undergraduate Laboratory Internships (SULI)
- Community College Internships (CCI)
- Research Participant Program (RPP)

Graduate Programs

Office of Science Graduate Fellowship Program (SCGF)

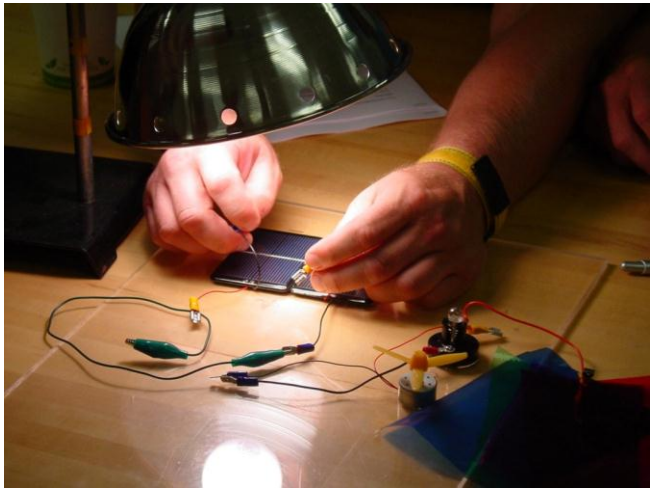
- EERE Post-doctoral Fellowship
- SunShot Initiative Fellowship Program

Faculty Programs

- Visiting Faculty Program (VFP)

Renewable Energy Materials Research Science and Engineering Center (NSF)

- The National Science Foundation sponsors the Renewable Energy Materials Research Science and Engineering Center (REMRSEC) at the Colorado School of Mines.
- NREL and CSM research staff is building a world-class renewable energy research center at CSM. As part of this NSF grant there is an education component.
- Two-week summer elementary teacher workshop
- Introduce teachers to the applications of STEM science content with an emphasis on renewable energy and energy efficiency
- Topics: History of energy, science of energy, electric circuits, measuring electricity, energy efficiency, bioenergy, solar, hydrogen/fuel cells, wind, etc.
- Graduate student support throughout the academic year
- Teachers receive science kits with the lessons



Middle School Car Competitions

- The Junior Solar Sprint, Hydrogen Fuel Cell, and Lithium Ion Battery car competitions for 6th - 8th grade students
- Engineering challenge where students use scientific know-how, creative thinking, experimentation, and teamwork to design and build high-performance model vehicles
- Strategy: get renewable energy technologies into the hands of future scientists and energy decision makers.

National Car Competitions

- Nationally there are 42 regional sites in 26 states that participate in the car competitions. NREL manages the national lithium ion battery car competition for DOE's National Science Bowl.

National Science Bowl™

- Nationwide academic competition that tests students' knowledge in all areas of science including energy. Middle and high school students are quizzed in a fast paced question-and-answer format similar to jeopardy.
- 69 High School Teams and 44 Middle School Teams will participate in the National Science Bowl in 2012.
- Each year over 20,000 middle and high school students participate in the science bowl event.

Taking Renewable Energy Back To The Classroom

- The course blends renewable energy and energy efficiency components into existing courses that the teachers are already instructing in subjects ranging from chemistry and physics to biology and environmental science classes.
- During the week long workshop, teachers participate in a variety of activities tied to NREL research including
  - Building and testing wind turbine blades utilizing multimeters and water pumps
  - Testing solar panels creating current voltage curves using rheostats and multimeters
  - Determining the optimum form of lighting based on the bulb's brightness (tested using lux meters and color temperature meters), its cost and its power requirements.
  - Making and testing biodiesel

Solar on Schools Program

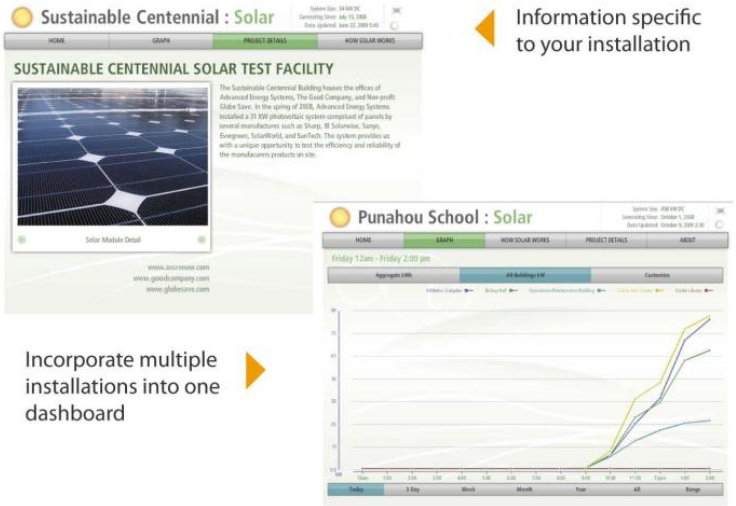
Everitt Middle School

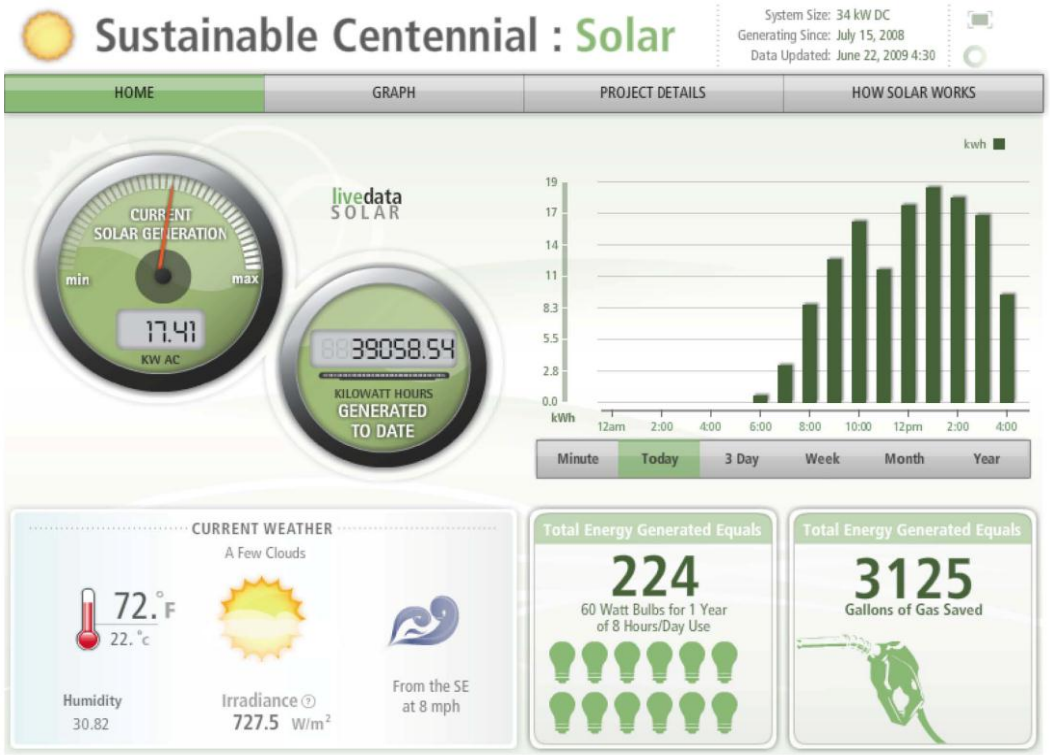
Courtesy: SEI
Carbondale Elementary School

- Jefferson County School District in Colorado installed 100 kW (~21 average homes) solar systems on 30 schools.
- NREL is providing standards based renewable energy lesson plans that fit within the existing curriculum
- Integrating the data monitoring system so the teachers can incorporate the actual real time data into science and math classes.
- The photovoltaic system becomes a learning laboratory and an exciting learning tool plus the school benefits from all of the clean, renewable electricity it produces.
- Educate students, teachers and community members about the science of energy and benefits of renewable energy technology.
- Community Showcase: increase the visibility, energy literacy, and public understanding of renewable energy.

System Components – Monitoring

- **High quality web-based monitoring as standard feature**
- **Real-time environmental benefits & operational diagnostics**





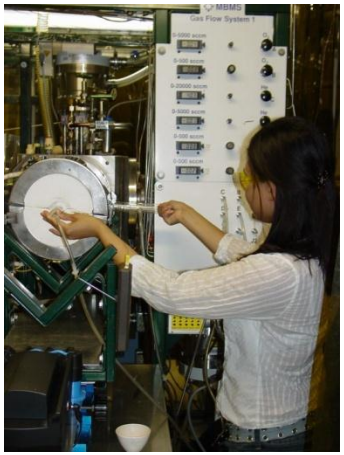
- **Multi-site capabilities**

Energy: A Multidisciplinary Approach for Teachers EMAT

- BSCS is developing the EMAT course in collaboration with Oregon Public Broadcasting (OPB), the National Teachers Enhancement Network (NTEN) of Montana State University, the National Renewable Energy Lab (NREL), and the Great Lakes Bioenergy Research Center (GLBRC).
- Energy: A Multidisciplinary Approach for Teachers (EMAT) is an online professional development course that addresses three major energy concepts. The first unit will investigate the generation of electrical energy from coal, while the remaining units will investigate the generation of electrical energy using alternative energy sources (nuclear, solar, biofuels, wind, and geothermal energy).
- Project goal is to enhance teaching and learning of energy concepts for thirty-five 9-12 science teachers from across the nation.
- WE are recruiting teachers to participate in this 2 year course, http://www.bscs.org/emat

Intern Appointments

Undergraduate	Graduate	Postgraduate	Faculty
• DOE OS Science Undergraduate Laboratory Internship • DOE OS Community College Institute • Research Participant Program • DOE EERE Minority Universities Research Associates • NSF Science Teacher and Researcher	• DOE OS Graduate Fellowship (DOE SCGF) Program • Research Participant Program	• NREL Director's Fellowships • Post-Doctoral Research Participation	• DOE OS Visiting Faculty Program • Sabbaticals and Faculty Appointments



Internship Programs

Mission:

-Provide undergraduate, graduate students and faculty with direct access to state-of-the-art laboratory equipment, facilities, and staff through research experiences.

Outcomes:

-Encourage workforce development

-Provide content knowledge in science and technology.

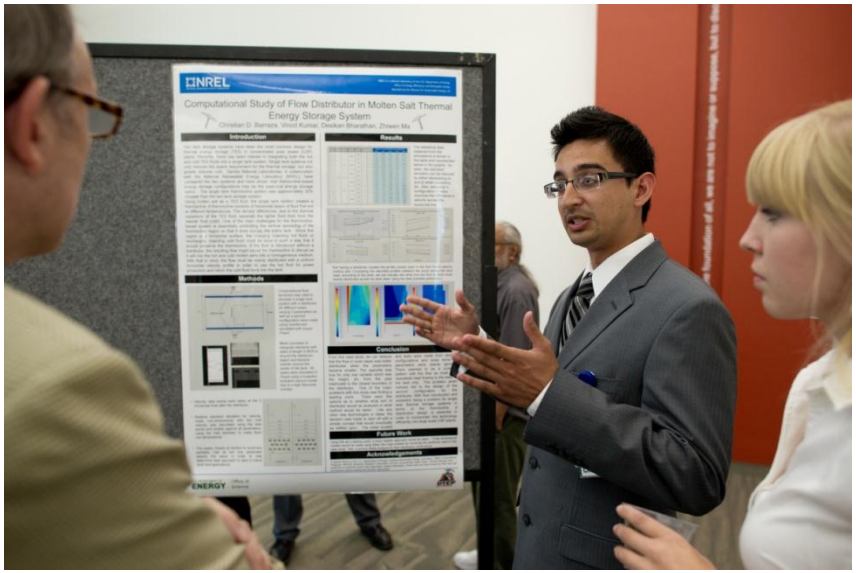
Professional Development

- Featured Speakers
- Tours
- Professional Skills: Technical Writing, Powerpoint presentations
- Technical Skills: PV installation
- Scientific lectures and seminars

NREL Program Objectives

- Bring STEM undergraduates into NREL for an intensive research experience with a mentor scientist
- Develop a pool of highly motivated scientists and engineers
- Create a seamless education and training pipeline for high potential STEM students
- Create a talent pool that will help DOE meet its science mission goals
- Create new advocates that understand renewable energy and efficiency technologies

Minority University Research Associates (MURA) Program



Provides research opportunities for minority students to excel in science and technology while helping these students reach their educational and career goals.

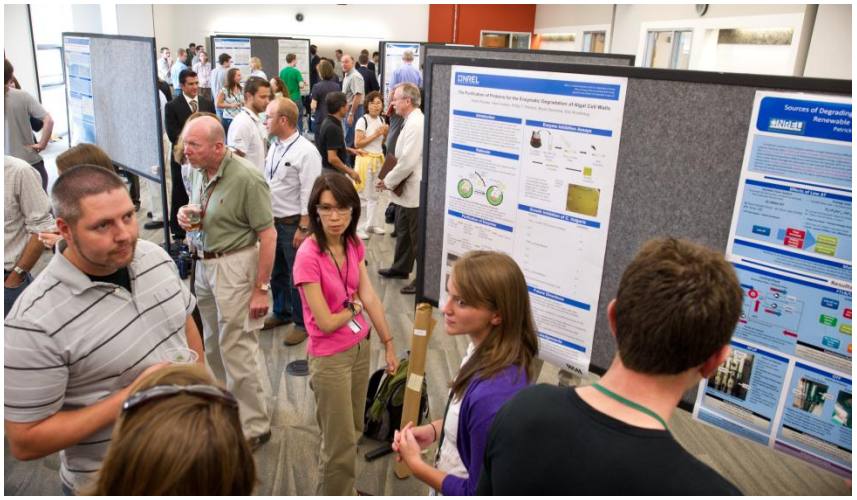
- Funded by the Solar Energy Technologies Program, MURA is a competitive research program where universities submit proposals to perform solar energy research projects during the academic year at their designated universities.
- Help to achieve DOE's goal of making solar cost-competitive with conventional sources of electricity.
- The MURA Program contributes to the development of a diverse and competent workforce ready to support the nation's growing clean-energy industry.
- Encourages minority students to pursue careers in science and technology.

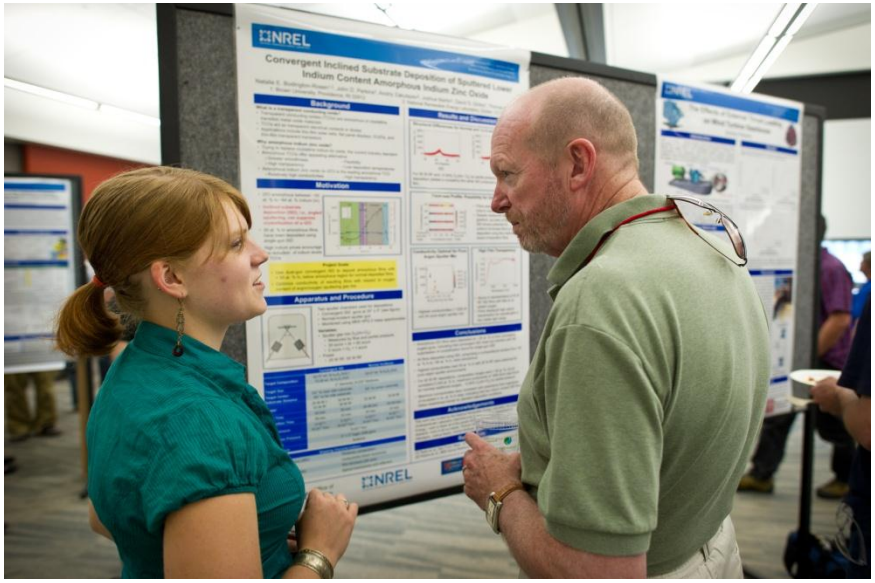
Community College Internship

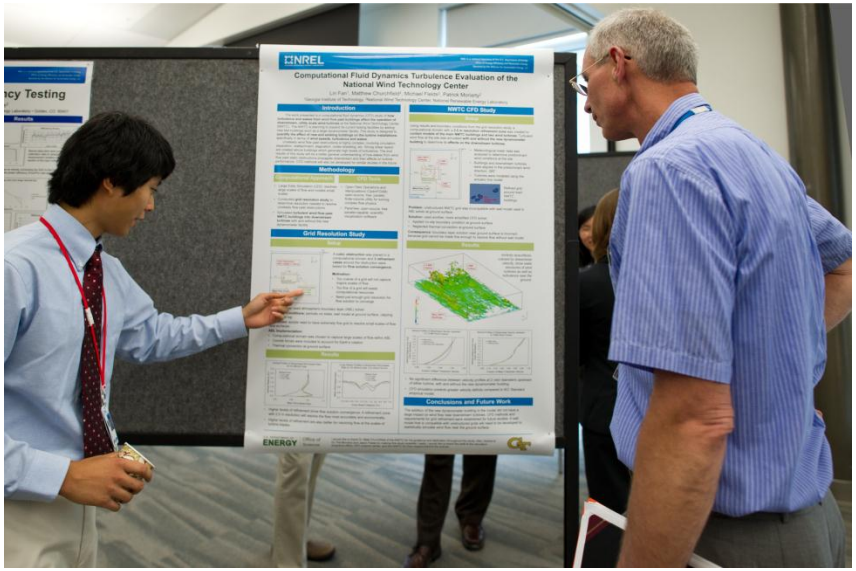
- The Community College Internship (CCI) program provides technical training experiences for community college students to enter technical careers relevant to the DOE mission
- Work on technologies or instrumentation projects related to DOE's ongoing R&D programs

Undergraduate Deliverables

- Written 6 – 8 page research project report
- Poster Presentation
- Pre-Post Evaluations







Research Participant Program

Postdoctoral Researchers

Eligibility

- ✓ Must be a recent Ph.D. graduate.

Undergraduate & Graduate Internships

Eligibility

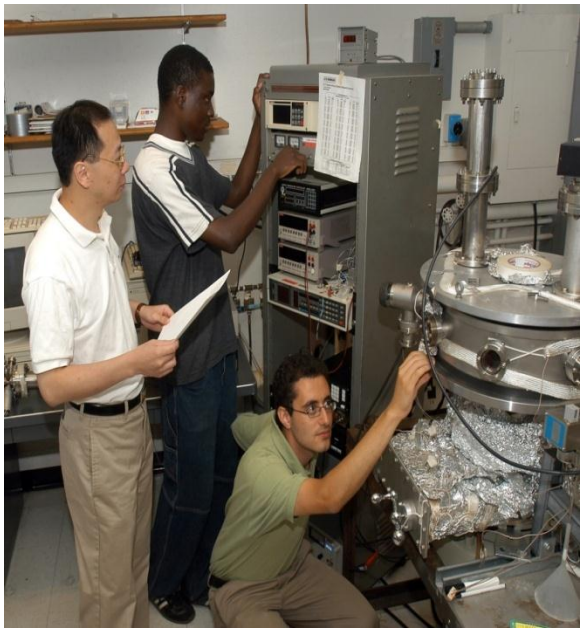
- ✓ Must be enrolled in a minimum of 12 credit hours as an undergraduate and 9 credit hours as a graduate student.
- ✓ Must be U.S. citizen or U.S. permanent resident.

Sabbaticals and Faculty Appointments

Eligibility

- ✓ Senior scientist, engineer, or other professional who are on leave from their home institution

Visiting Faculty Program (VFP)



- The Visiting Faculty Program supports the professional development of current faculty members who want to increase the competitiveness of their own independent research
- All VFP faculty applicants submit a research project proposal co-developed with NREL research staff.

Science Teacher And Researcher (STAR)

- STAR is funded by a grant from the National Science Foundation through Cal Poly. The Robert Noyce Teacher Scholarship Program was created to respond to the critical need for K-12 teachers of science, technology, engineering, and mathematics (STEM).
- NREL provided research experiences for students interested in becoming 6-12 science, technology, engineering or mathematics (STEM) teachers.
- All STAR interns are required to complete two years of teaching in a high-need school district for each year of support.

STAR

- Allows pre-service teachers to learn about the applied world of science, mathematics, and technology.

- NREL provided context and opportunities for STAR Fellows to consider how the "doing of science" may be translated into the "teaching of science."

NREL Summer Interns 2011

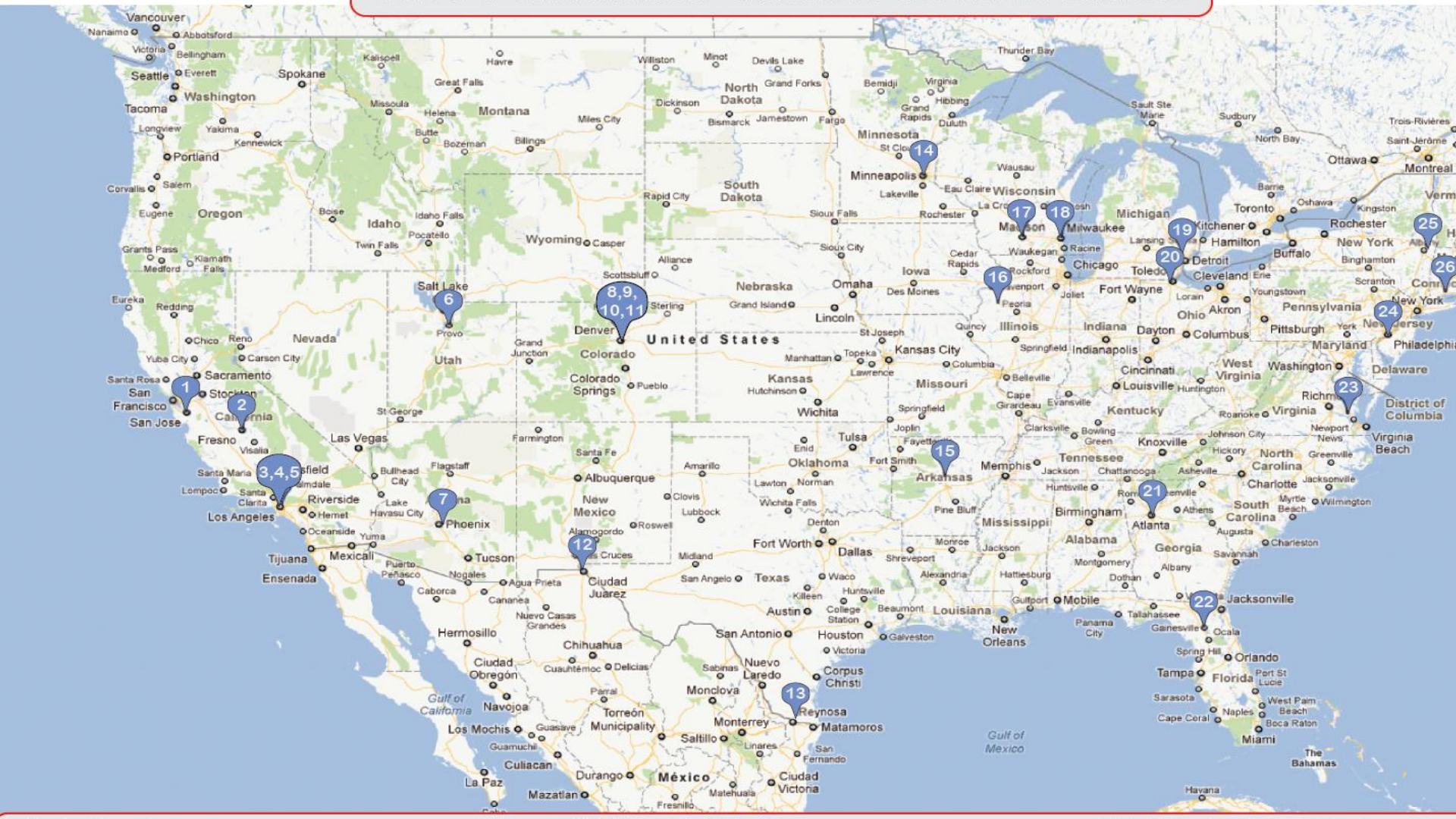
SULI : Blue

FaST: Green

MURA: Yellow

STAR: Red

2011 Summer Intern Universities



1) Santa Clara University
2) California State, Fresno
3) Loyola Marymount University
   2 Students, 1 Faculty
4) Pitzer College
5) University of California, Irvine
6) Brigham Young University
7) Arizona State University
8) University of Northern Colorado
9) University of Colorado at Boulder
   4 students
10) Colorado School of Mines
    2 Students
11) University of Denver
    2 Students
12) University of Texas, El Paso
    2 Students, 1 Faculty
13) University of Texas, Pan American
14) University of Minnesota, Twin Cities
15) Hendrix College
16) Knox College
17) University of Wisconsin
18) Milwaukee School of Engineering
19) Lawrence Technological University
20) The University of Toledo
21) Georgia Institute of Technology
    2 Students
22) University of Florida
23) College of William and Mary
24) University of Pennsylvania
25) Rensselaer Polytechnic Institute
26) Yale University
27) Brown University

NREL Outstanding Mentor Awards

From this distinguished mentor list, Amy Curtis, Todd Deutsch and Kyle Benne are past SULI interns.

The NREL Outstanding Mentor Award recipients are recognized by senior management at the Intern and Mentor Summer Kick-Off Luncheon each year.

NREL recognizes and highlights the importance and value of mentoring the next generation of scientists and researchers.

Individual Awards: Joe Berry; Jeff Blackburn; Matthew J. Churchfield; Amy Curtis; Todd G. Deutsch; Huyen Dinh; Gary Jorgensen; Larry Kazmerski; Hal Link; Matt Lloyd; Patrick Moriarty; Matthew Muller; and David Young

Team Awards: Kyle Benne and Larry Brackney; Michael Deru and Alberta Carpenter; and Melvin Tucker and Hui We. To date, over 72 NREL mentors have been honored and several have received awards multiple times.

Director's Fellowship

The National Renewable Energy Laboratory (NREL), is proud to announce the **NREL Director's Postdoctoral Fellowship Program.** The fellowships are designed to attract the next generation of exceptionally qualified scientists and engineers with outstanding talent and credentials in renewable energy research and related disciplines.

EERE Postdoctoral Fellowship Program

- Offers recent Ph.D recipients the opportunity to conduct applied research at universities, national laboratories and other research facilities.

- Create the next generation of scientific leaders in energy efficiency and renewable energy.

- Attract the best scientists and engineers to pursue breakthrough technologies in a two year program.

- Designed to advance the development of clean energy technologies in energy efficiency for buildings, industry and vehicles; and renewable energy using biomass, hydrogen/fuel cells, geothermal, solar and wind power

- 80% time dedicated to a research core project and 20% of their time on an innovation project.

EERE/Science & Technology Policy SunShot Fellowship Program

- Fellows will take a key leadership role in research and development to reach the DOE goal of $1/W installed photovoltaics by 2020.
- Either recent Masters or Ph.D graduates will focus on critical technology innovations to reduce the total cost of solar energy systems by 75% so they are cost competitive with other forms of energy without subsidies by the end of the decade
- Re-establish U.S. leadership in the global market for solar
- Work on policy related projects in the DOE Solar Energy Technologies Program in Washington, DC.

Visitor's Center

- Open to the public
- Hands-on science exhibits
- Hosts student groups
- Demos
- Science activities
- Scavenger hunts
- Hosts Power lunch series

Questions?