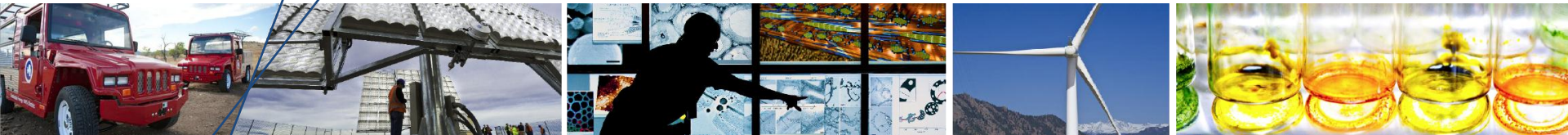


Education Overview



Presenter: Linda Lung

Date: April 23, 2012

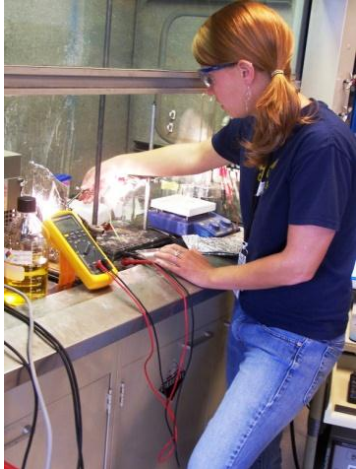
NREL Education Programs



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.





U.S. DEPARTMENT OF
ENERGY

STRATEGIC PLAN

MAY 2011



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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.

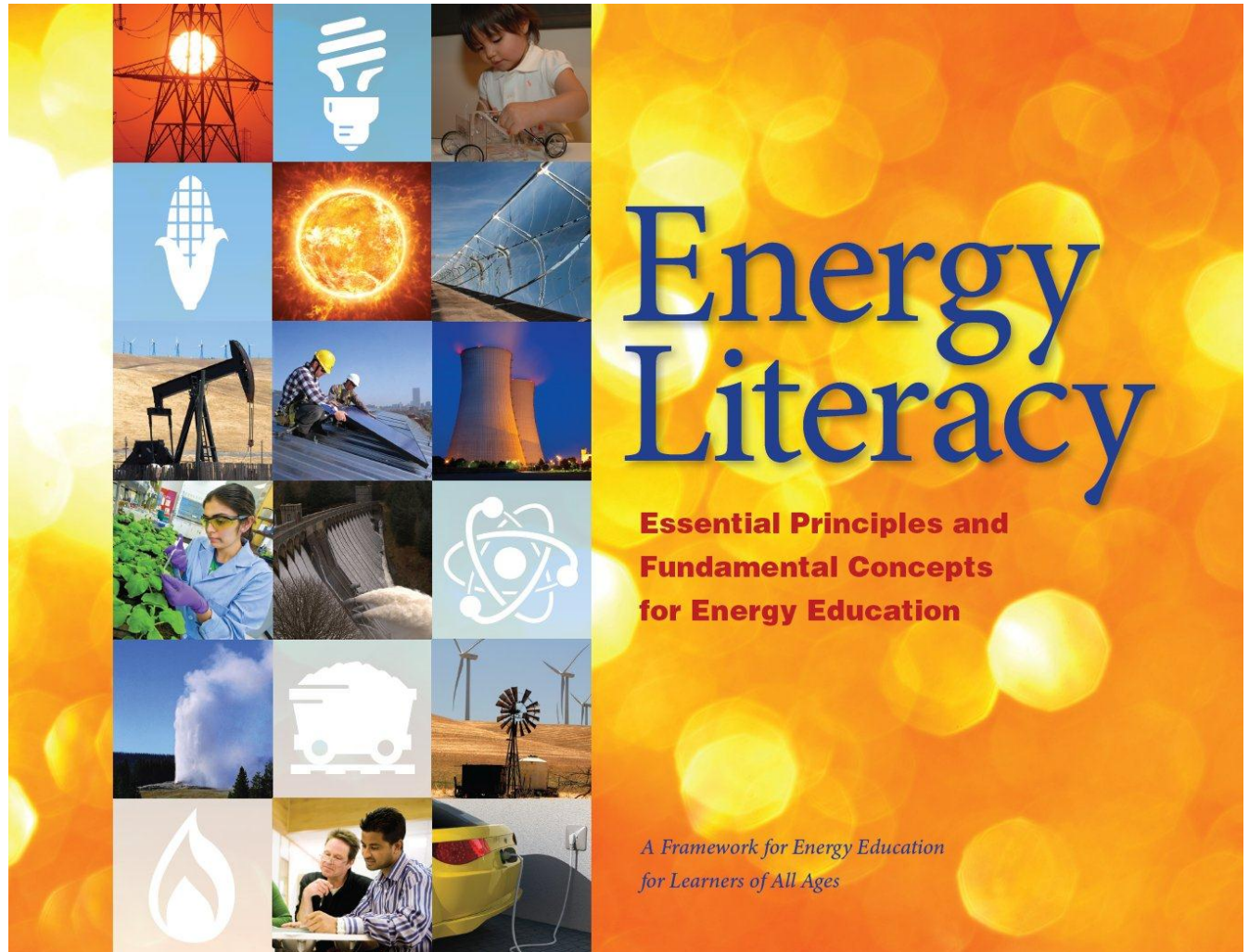
[DOE, May 2011 Strategic Plan, page 21]

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:

U.S. Global Change Research Program Partner Agencies:

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Energy
- Department of Health and Human Services
- Department of the Interior
- Department of State
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- The Smithsonian Institution
- US Agency for International Development



Education Partners:

- Alliance to Save Energy
- American Association for the Advancement of Science, Project 2061
- American Association of Blacks in Energy
- American Nuclear Society
- Association of Public and Land-Grant Universities
- Center of Science and Mathematics in Context, University of Massachusetts, Boston
- Chabot Space & Science Center
- Climate Literacy and Energy Awareness Network

- Cooperative Institute for Research in the Environmental Sciences, University of Colorado, Boulder
- Energy Bridge
- KQED San Francisco, QUEST
- National Center for Science Education
- National Council for Science and the Environment
- National Energy Education Development Project
- National Energy Foundation
- National Science Teachers Association
- North American Association for Environmental Education

- Otherlab
- Science Museum of Minnesota
- TERC
- WestEd
- Wisconsin K-12 Energy Education Program
- Women Impacting Public Policy

U.S. Department of Energy
1000 Independence Ave SW
Washington, DC 20585
202-586-5000
<http://www.globalchange.gov>



Energy Literacy

The Essential Principles of Energy Education:

1

Energy is a physical quantity that follows precise natural laws.



2

Physical processes on Earth are the result of energy flow through the Earth system.



3

Biological processes depend on energy flow through the Earth system.



4

Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.



5

Energy decisions are influenced by economic, political, environmental, and social factors.



6

The amount of energy used by human society depends on many factors.



7

The quality of life of individuals and societies is affected by energy choices.



Energy Literacy Document

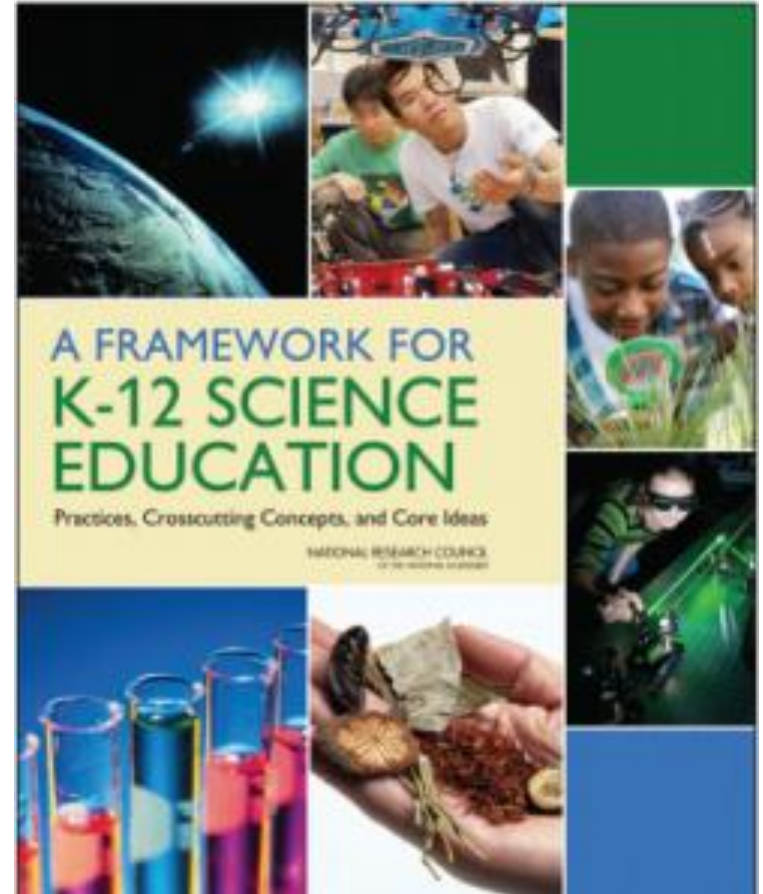
The document is available for download at:

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

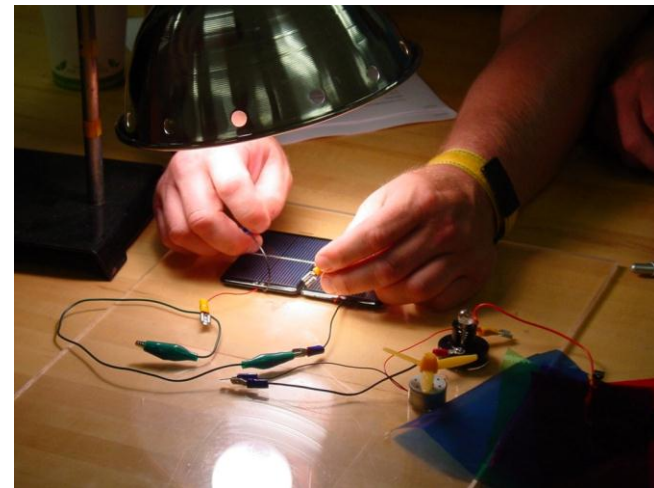
- Office of Science Graduate Fellowship Program (SCGF)
- EERE Post-doctoral Fellowship
- SunShot Initiative Fellowship Program

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



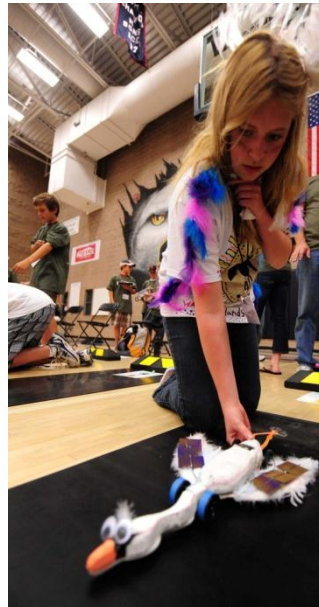
Middle School Car Competitions

- 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™

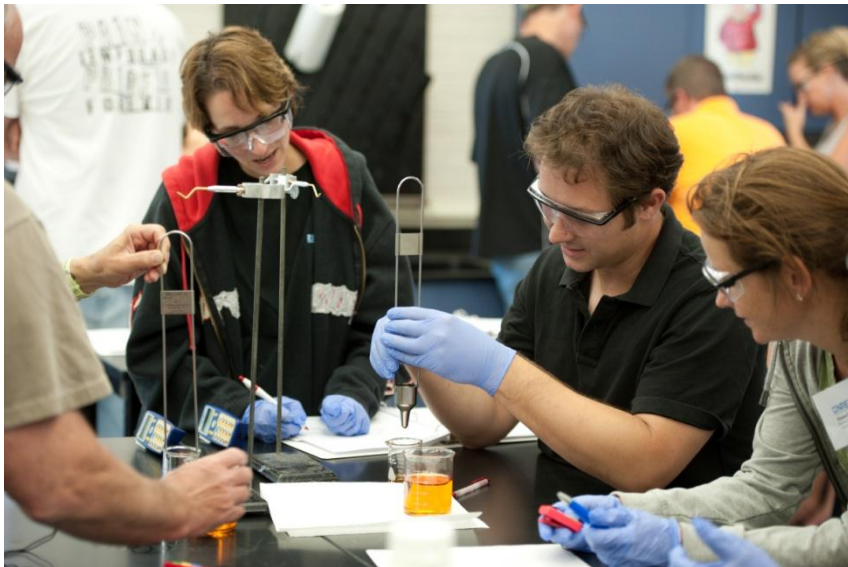
- Nationwide academic competition that tests students' knowledge in all areas of science including energy. Middle and high school students are quizzed in a fast paced question-and-answer format similar to jeopardy.
- 69 High School Teams and 44 Middle School Teams will participate in the National Science 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

Sustainable Centennial : Solar System Size: 44 kW DC
Generating Since: Aug 15, 2008
Data Updated: Aug 22, 2009 4:30

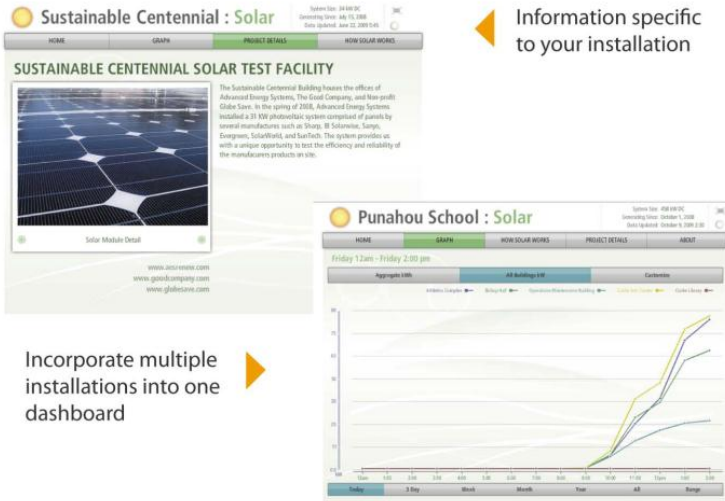
Information specific to your installation

Sustainable Centennial Solar Test Facility

The Sustainable Centennial Building houses the offices of Advanced Energy Systems, The Grid Company, and Sun Profit. GridStar, in the spring of 2008, Advanced Energy Systems installed a 21 kW photovoltaic system comprised of panels by several manufacturers such as Sharp, BP Solar, Sungev, Evergreen, SolarWatt, and SunTech. The system provides us with a unique opportunity to test the efficiency and reliability of the manufacturers products on site.

Punahou School : Solar System Size: 48 kW DC
Generating Since: October 1, 2008
Data Updated: October 2, 2009 2:00

Incorporate multiple installations into one dashboard



Sustainable Centennial : Solar System Size: 34 kW DC
Generating Since: July 15, 2008
Data Updated: June 22, 2009 4:30

HOME GRAPH PROJECT DETAILS HOW SOLAR WORKS

live data SOLAR

CURRENT SOLAR GENERATION
17.41 KW AC

39058.54
KILOWATT HOURS GENERATED TO DATE

19
17
14
11
8.3
5.5
2.8
0.0
kWh

12am 2:00 4:00 6:00 8:00 10:00 12pm 2:00 4:00

Minute Today 3 Day Week Month Year

CURRENT WEATHER
A Few Clouds

72.° F
22.° c

Humidity 30.82

Irradiance ☉ 727.5 W/m²

From the SE at 8 mph

Total Energy Generated Equals
224
60 Watt Bulbs for 1 Year of 8 Hours/Day Use

Total Energy Generated Equals
3125
Gallons of Gas Saved




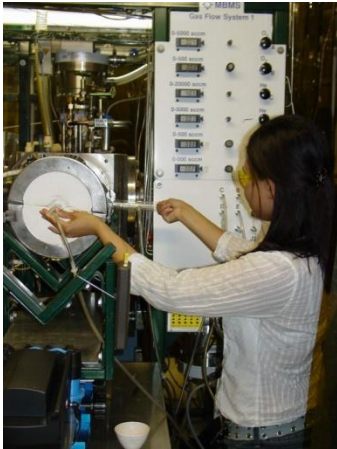

- Multi-site capabilities

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.bsccs.org/emat>**



Intern Appointments

Undergraduate	Graduate	Postgraduate	Faculty
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • DOE OS Graduate Fellowship (DOE SCGF) Program • Research Participant Program 	<ul style="list-style-type: none"> • NREL Director's Fellowships • Post-Doctoral Research Participation 	<ul style="list-style-type: none"> • 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

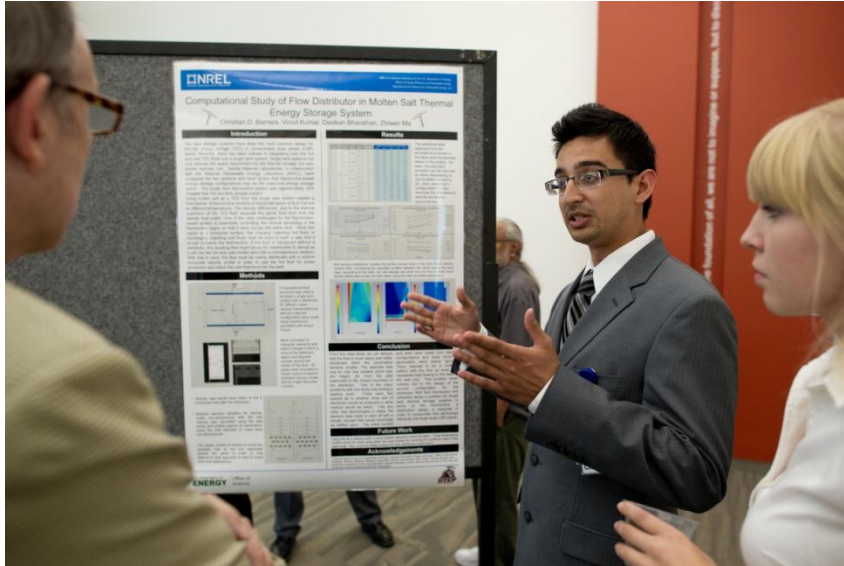


NREL Program Objectives

- 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



- 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.



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

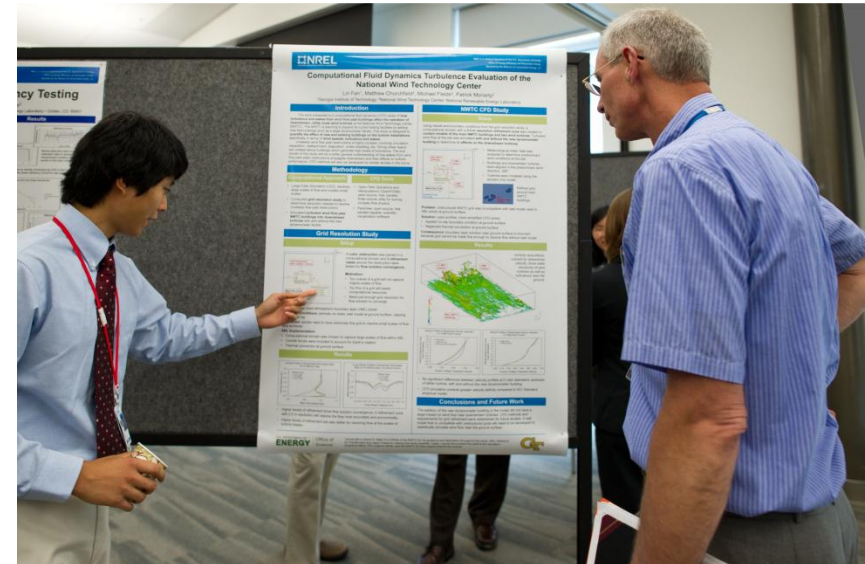
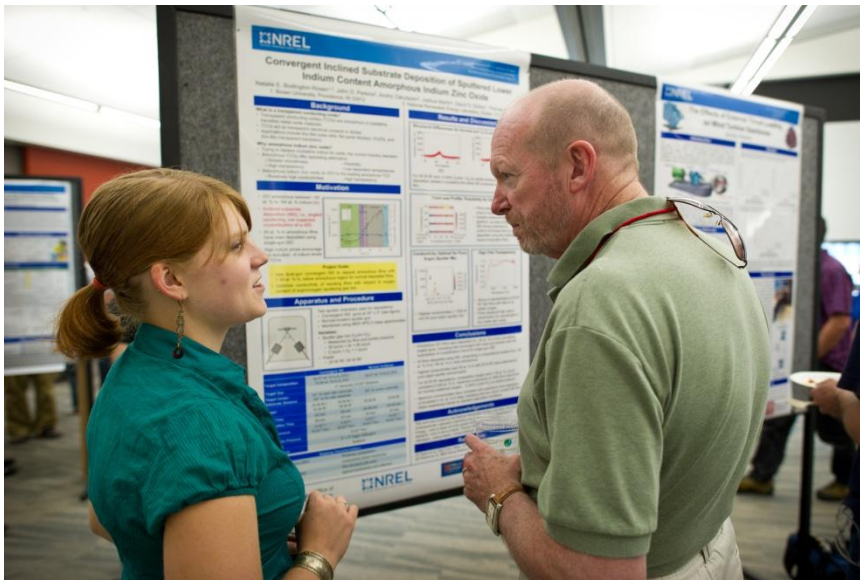
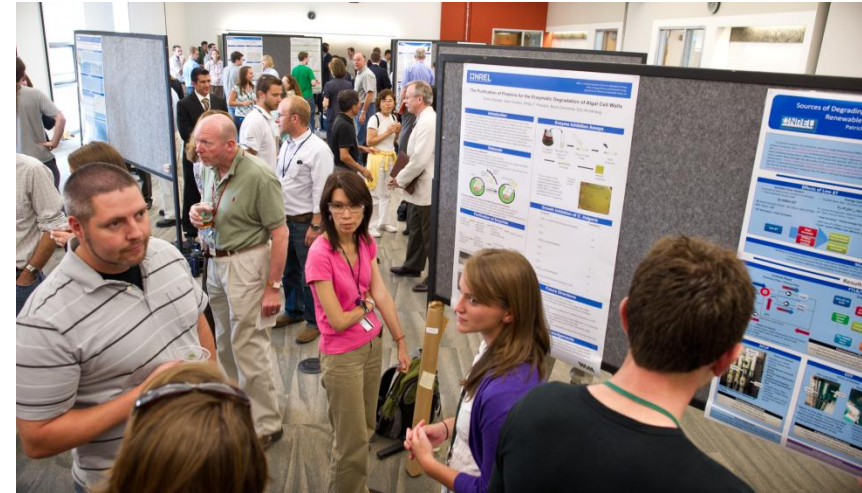
Community College Internship



- 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.

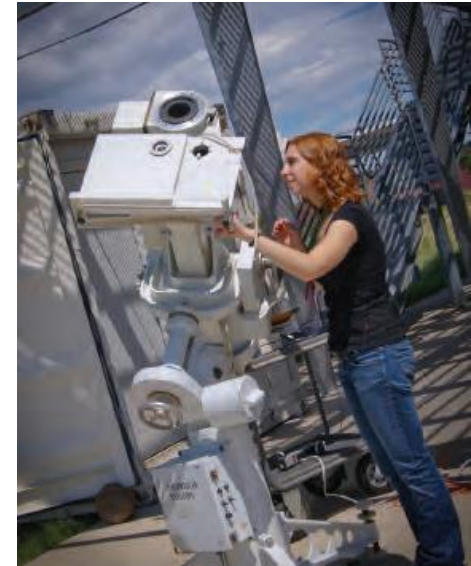
Science Teacher And Researcher (STAR)

- 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



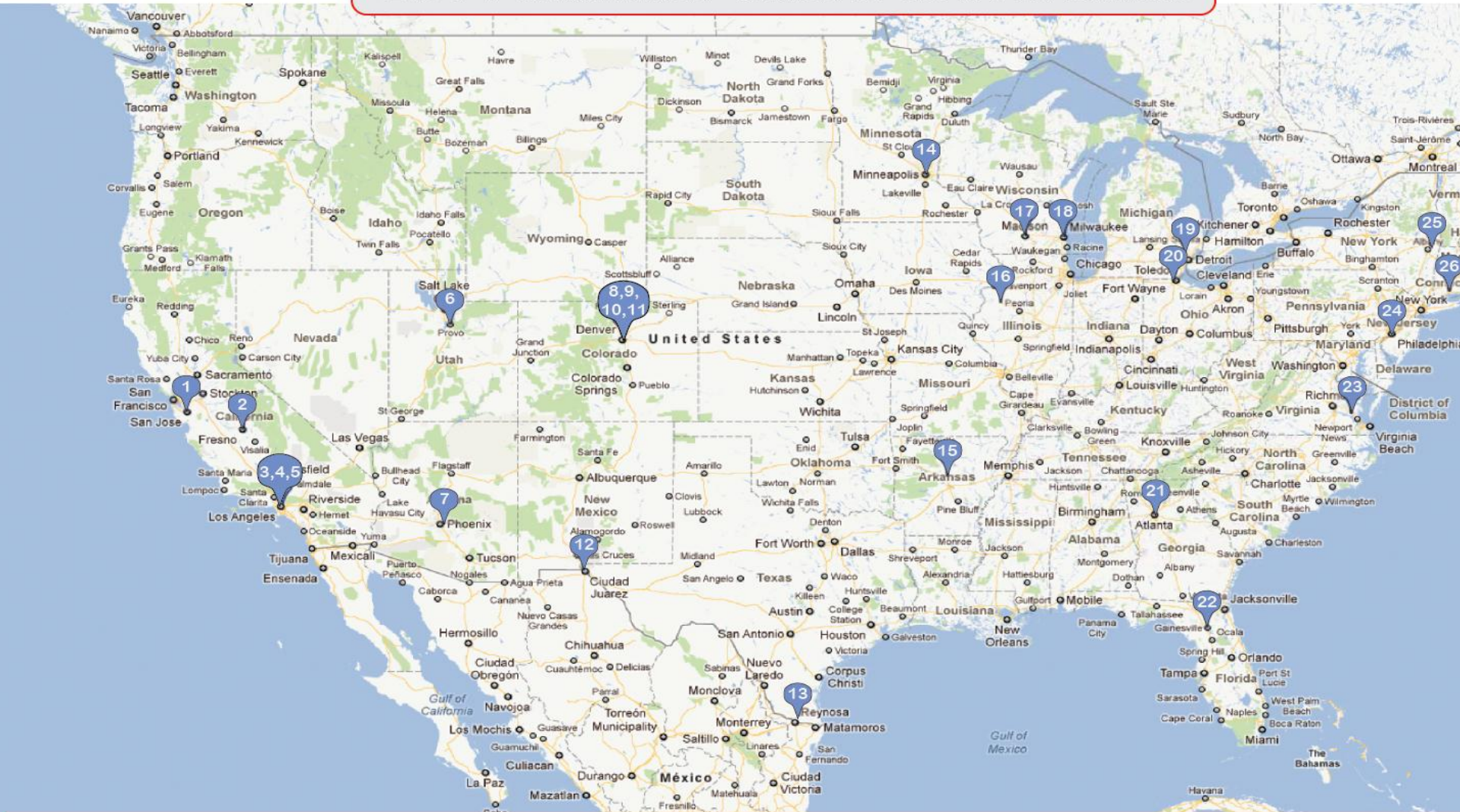
SULI : Blue

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.

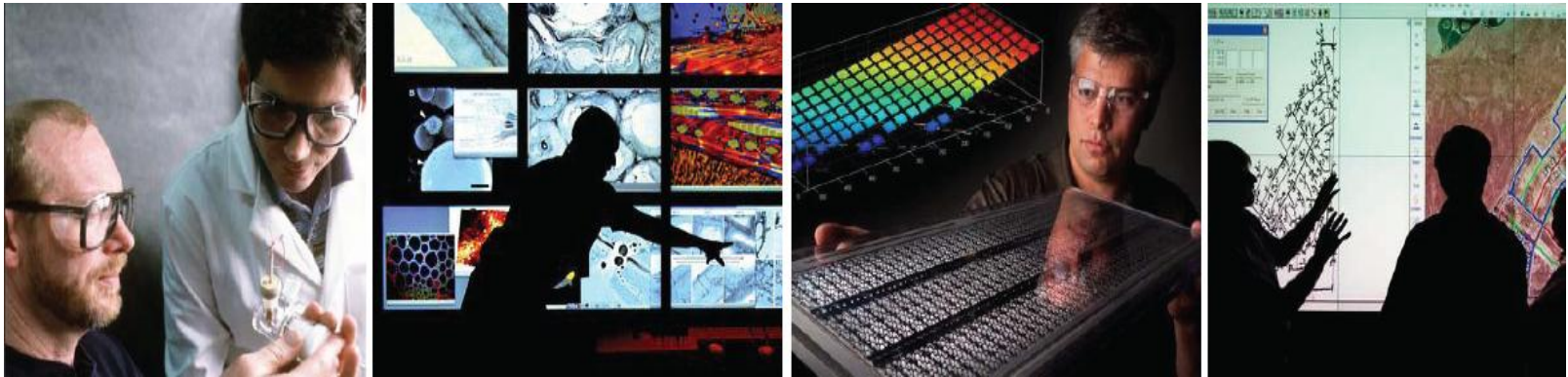
The NREL Outstanding Mentor Award recipients are recognized by senior management at the Intern and Mentor Summer Kick-Off Luncheon each year.

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?

