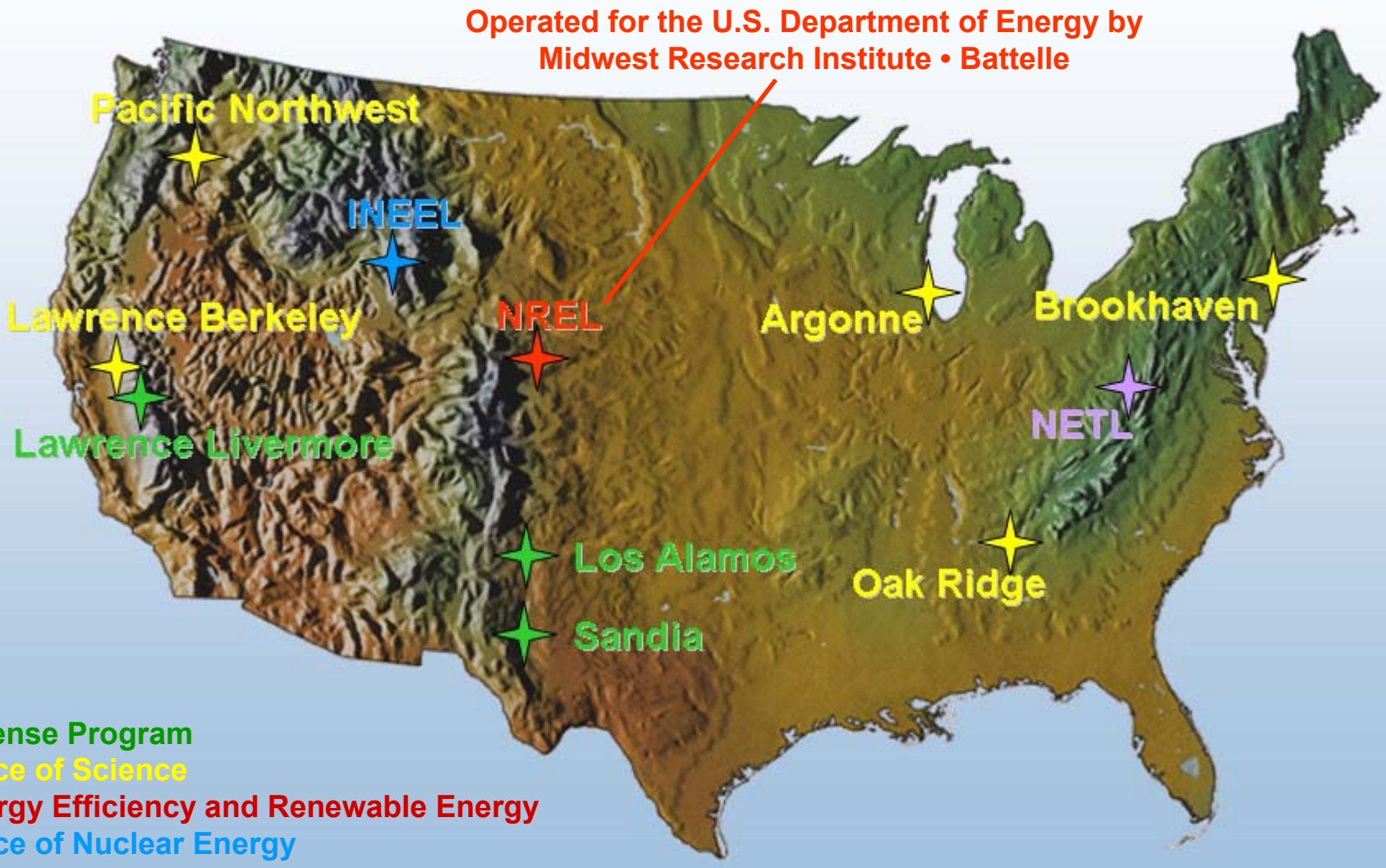
NREL Overview

DOE/National Association of State Universities and Land Grant Colleges (NASULGC) Biomass and Solar Energy Workshops

August 3, 2004

Stanley R. Bull
Associate Director, Science and Technology
National Renewable Energy Laboratory

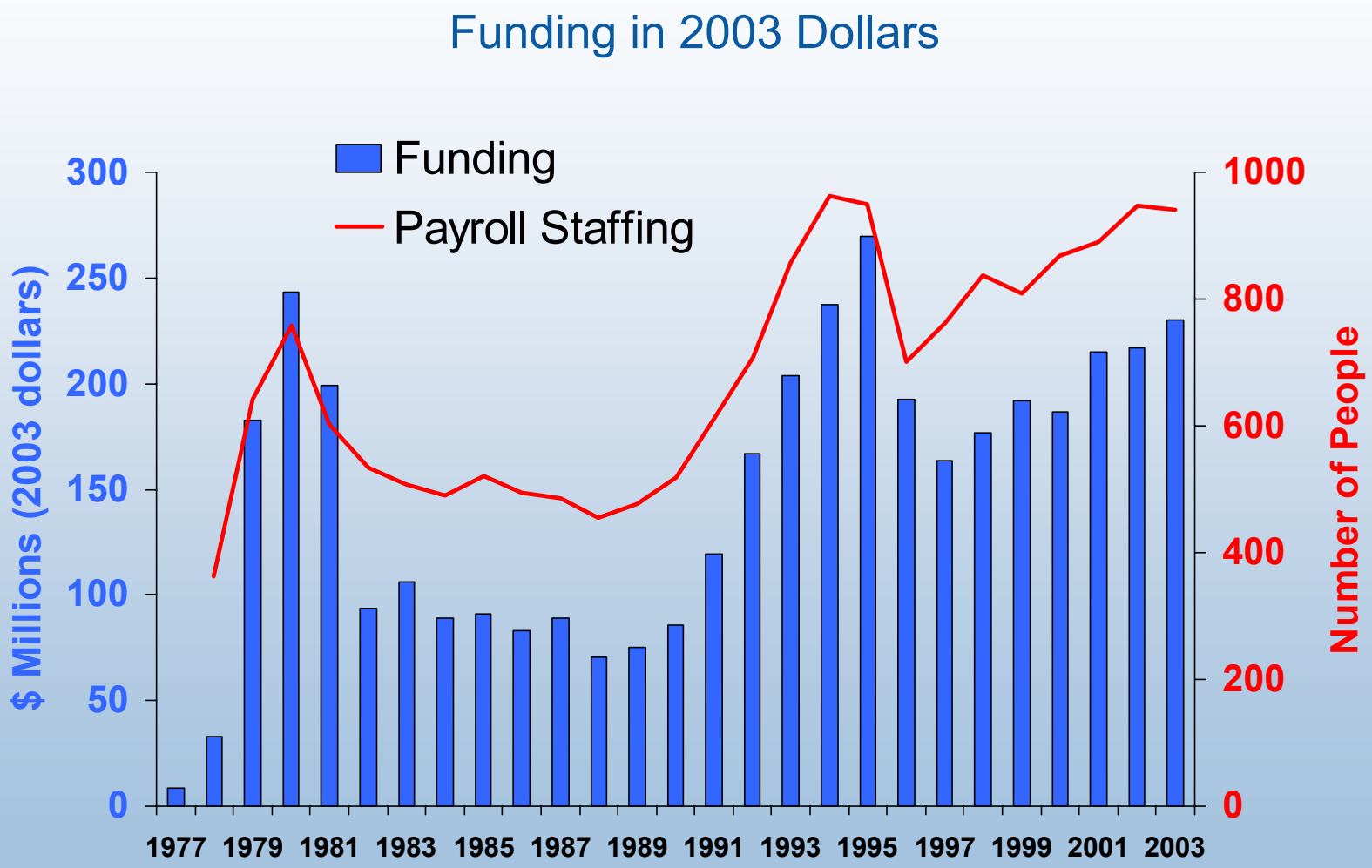
Major DOE National Laboratories



National Renewable Energy Laboratory

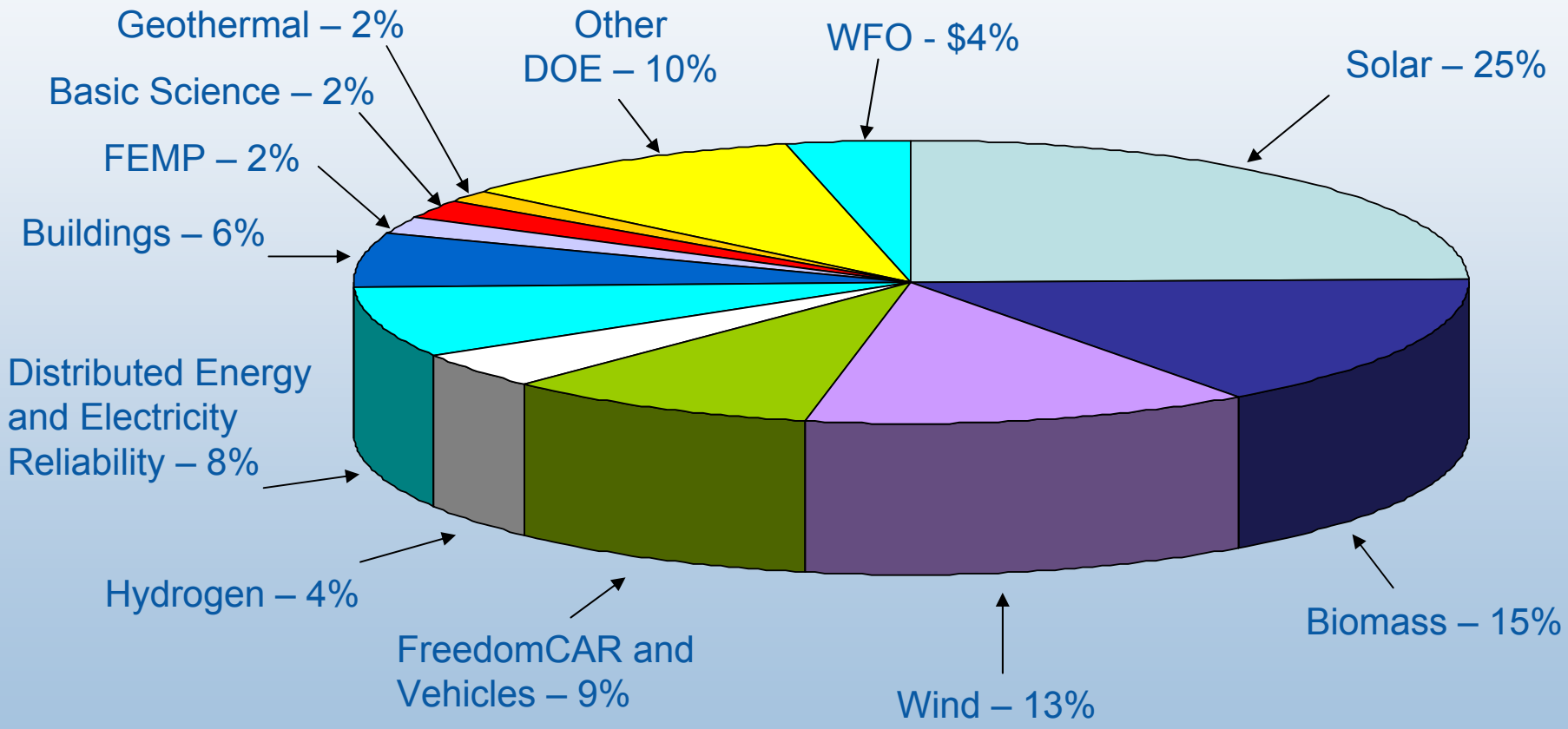
- Only national laboratory ***dedicated*** to renewable energy and energy efficiency R&D
- Research spans fundamental ***science*** to ***technology*** solutions
- ***Collaboration*** with industry and university partners is a hallmark
- Research programs ***linked*** to market opportunities

NREL Funding and Staffing

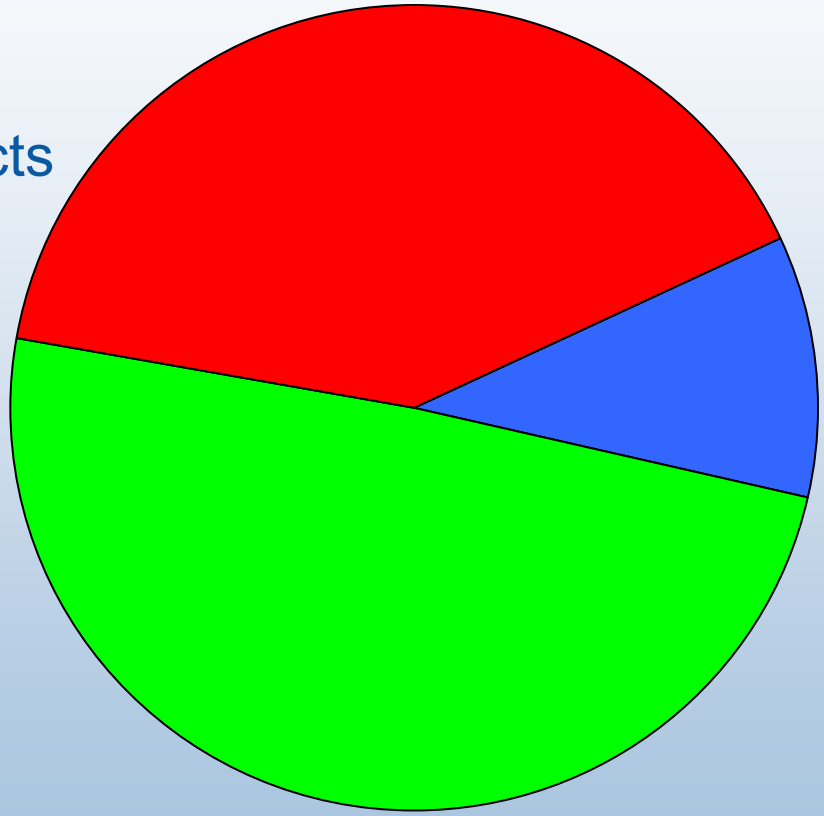


NREL FY 2003 Program Portfolio

$230 Million

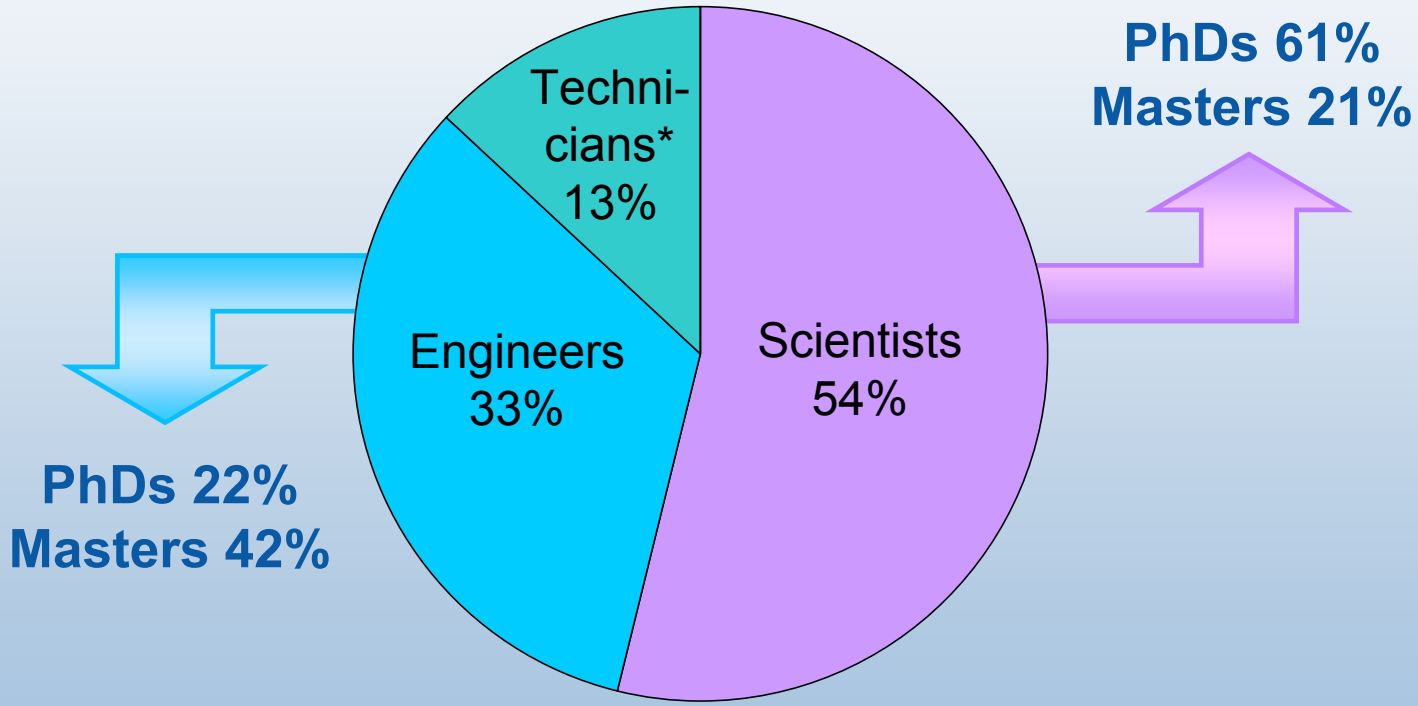


Where NREL's Funding Goes



NREL Technical Staff

Disciplines and Education



*Includes research technicians
Source: McCorkell, 04/31/04

South Table Mountain Site

South Table Mountain Site

Solar Energy
Research Facility

PIX 01347

Visitors Center

PIX 00738

Field Test Laboratory Building

PIX 03852

South Table Mountain Site

Outdoor Test Facility PIX 00650

Outdoor Test Area PIX 00651

Thermal Test Facility PIX 04117

PIX 03654

Alternative Fuels User Facility

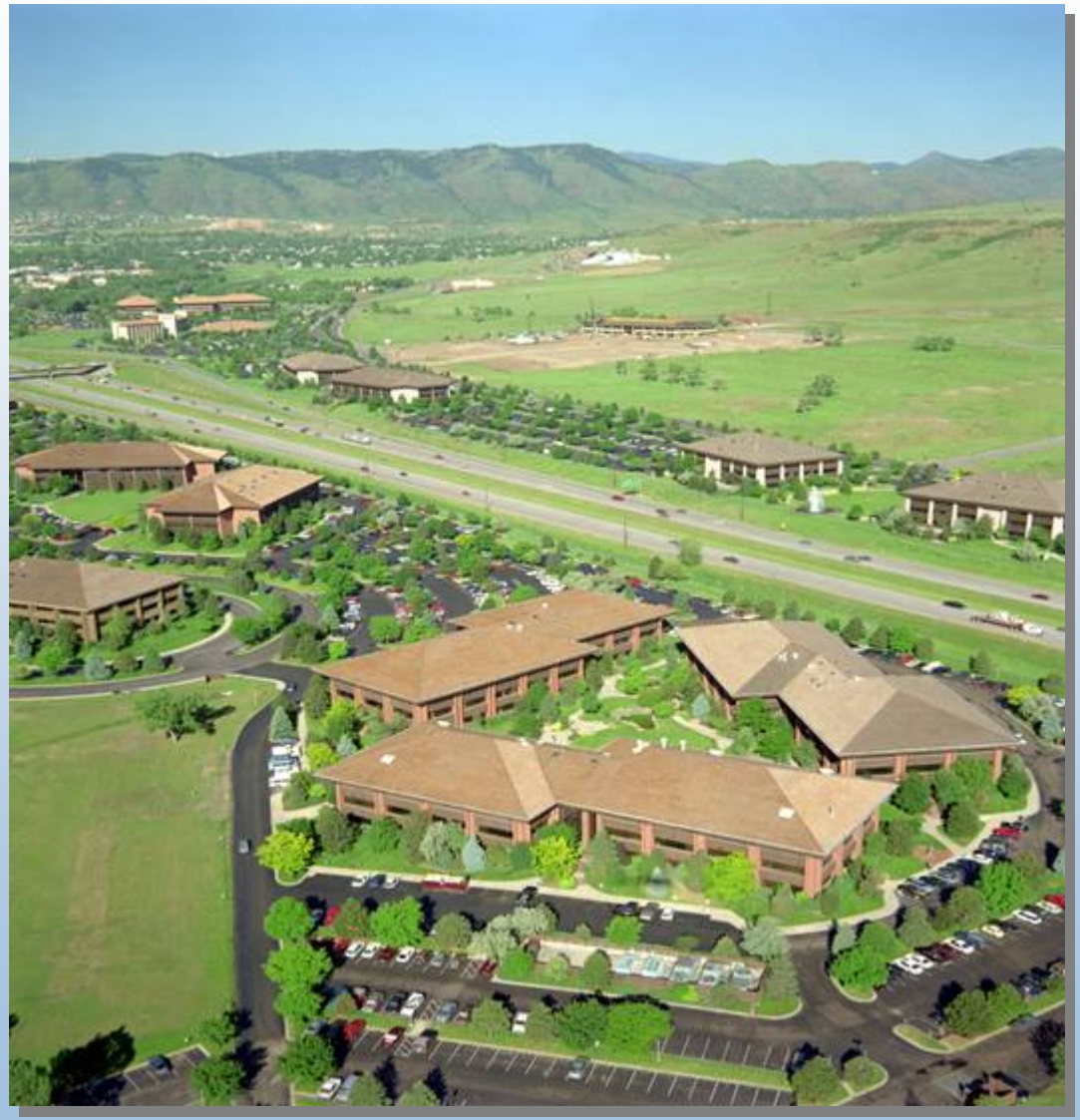
South Table Mountain Site

Mesa Top Test Area

Shipping and Receiving

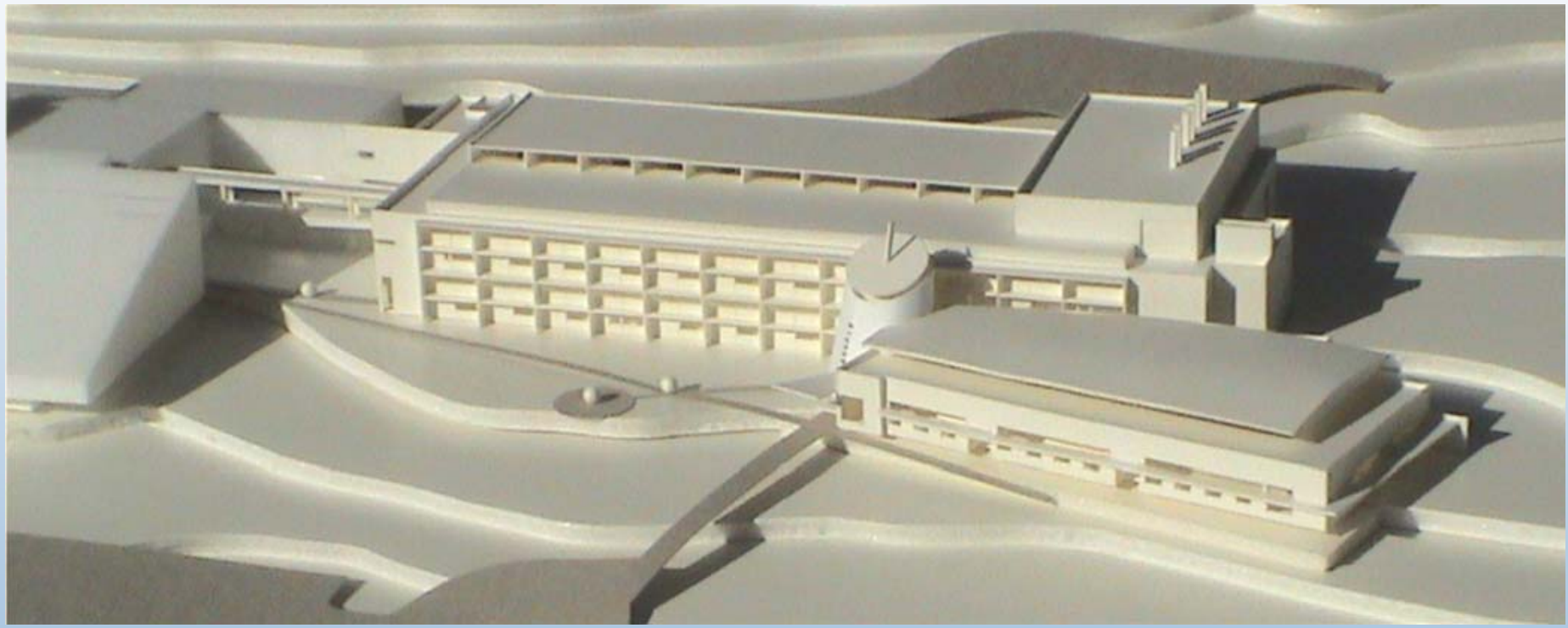
PIX 04906

Denver West Leased Facilities



National Wind Technology Center

Science and Technology Facility



University Relations

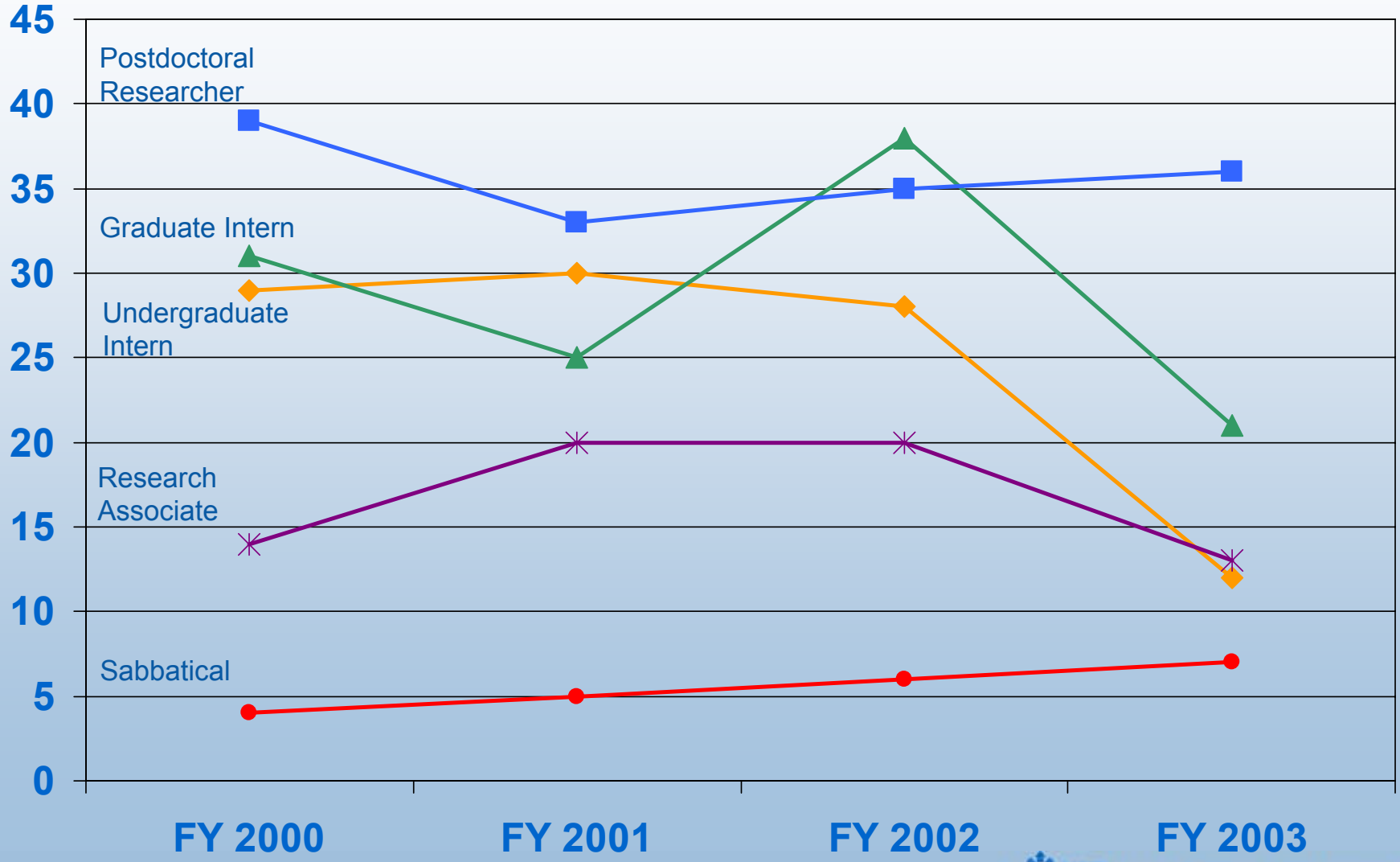
Students, Post Docs, and Professionals

Adjunct Faculty Appointments

University Advisory Committees

University Subcontracts

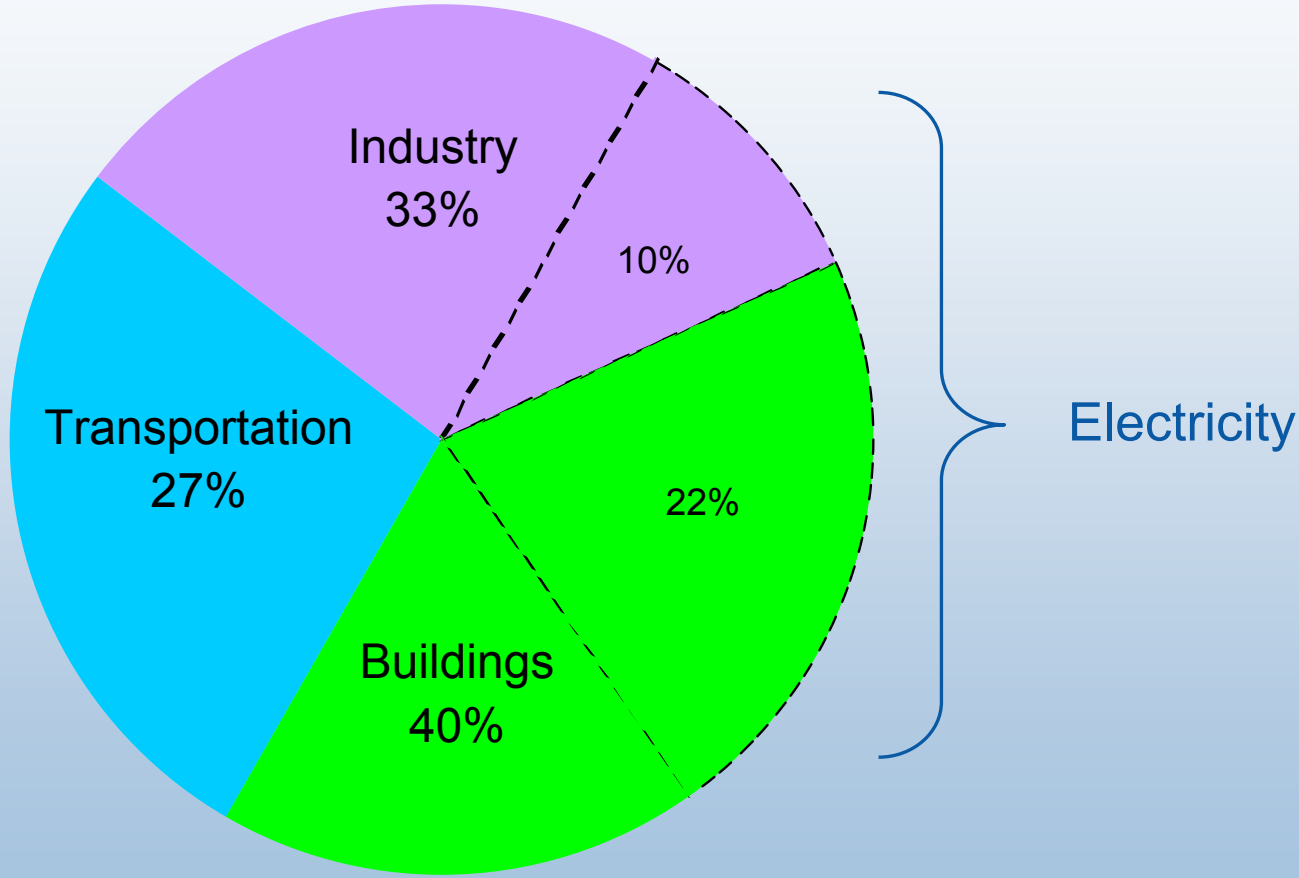
Total Students, Post Docs, and Faculty at NREL



Summary of NASULGC Participation in EERE's FY 2003 Portfolio

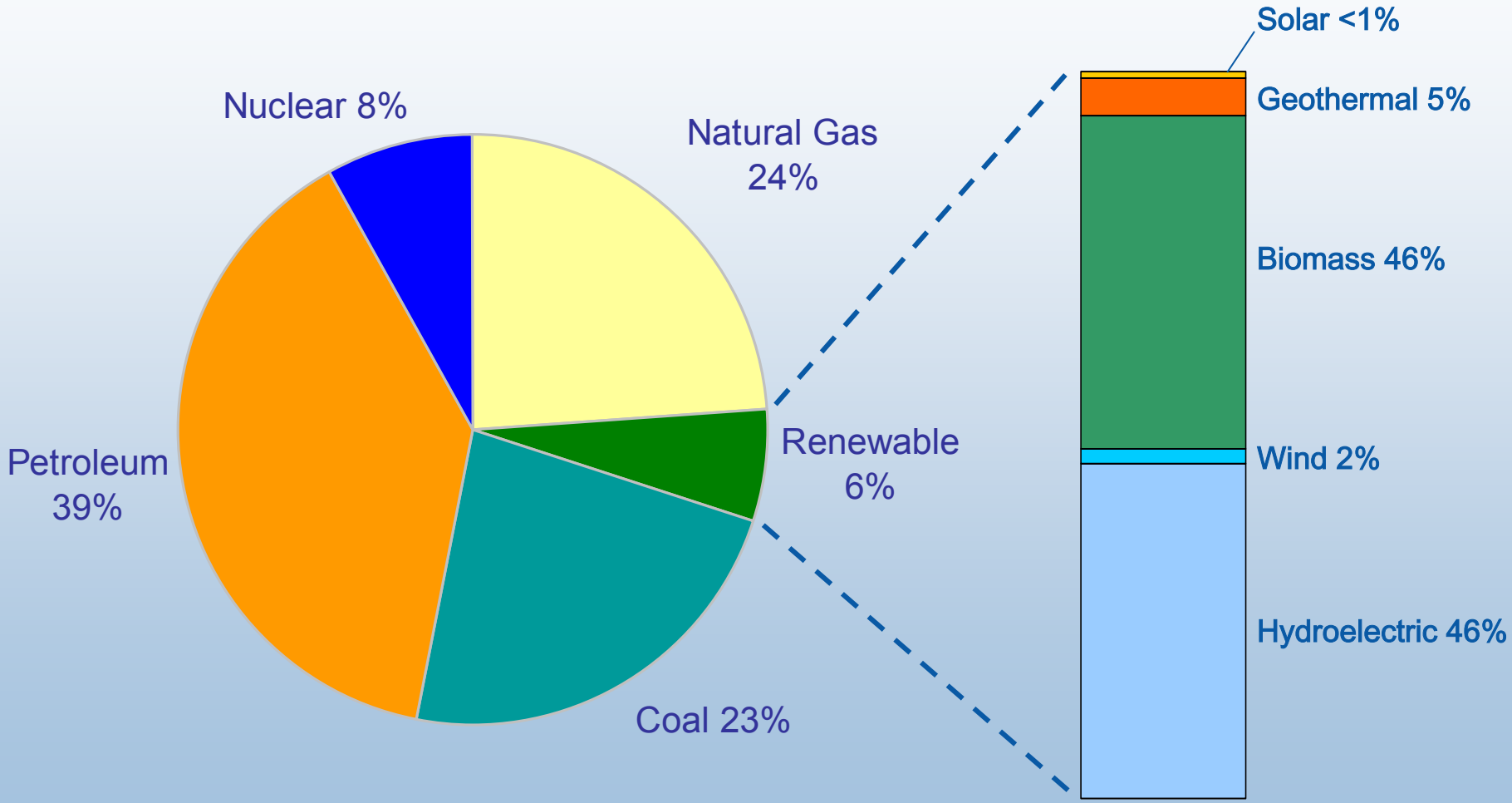
Method of Participation	NASULGC Institutions Participating	Awards to NASULGC Institutions
NREL to Institution	51	257

U.S. Energy Consumption by Sector - 2002



Source: Energy Information Administration / Annual Energy Review 2002 Tables 2.1a-2.1d

U.S. Energy Consumption by Fuel – 2002



Source: AEO 2004 tables (released in December 2003) based on US energy consumption. Overall breakdown Table A1 (Total Energy Supply and Disposition), and Renewable breakdown Table A18 (Renewable Energy, Consumption by Section and Source).

Major NREL Thrusts

Wind

Solar

- Photovoltaics
- Solar Thermal

Biomass

- Biorefineries
- Biosciences

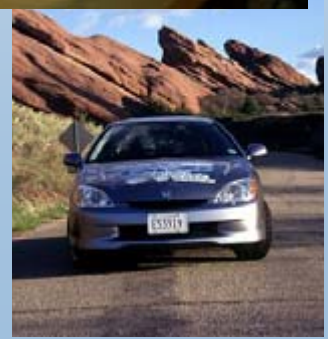
Geothermal

Hydrogen

- Production
- Storage
- Delivery and End Use
- Systems Integration

Distributed Energy

- Distribution and Interconnection
- Thermal Systems
- Superconductivity



Vehicle Technologies

- Hybrid Vehicles
- Alternative Fuels Utilization

Building Technologies

- Building Efficiency
- Zero Energy Buildings

Federal Energy Management

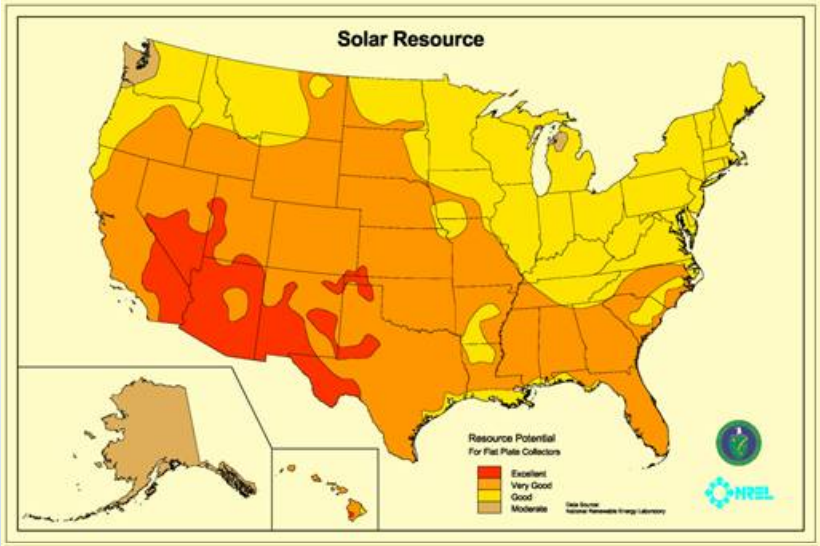
Basic Energy Science

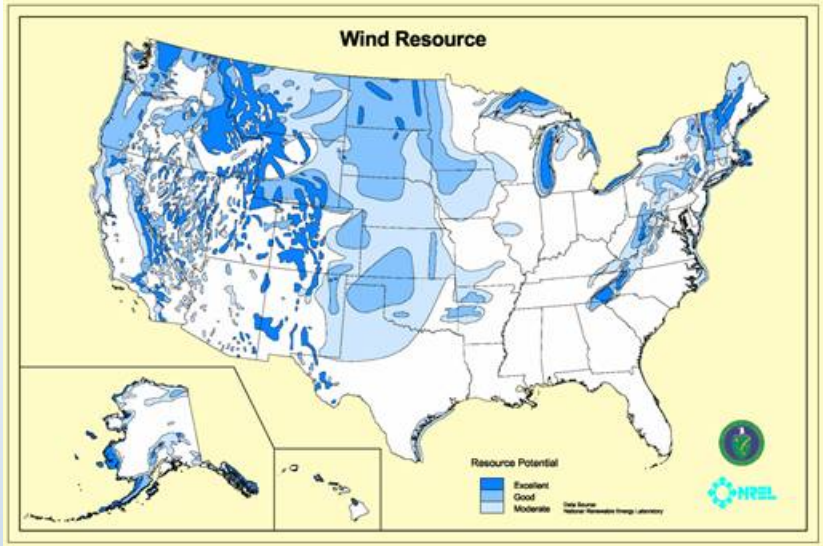
- New Materials
- Chemical and Biological Sciences

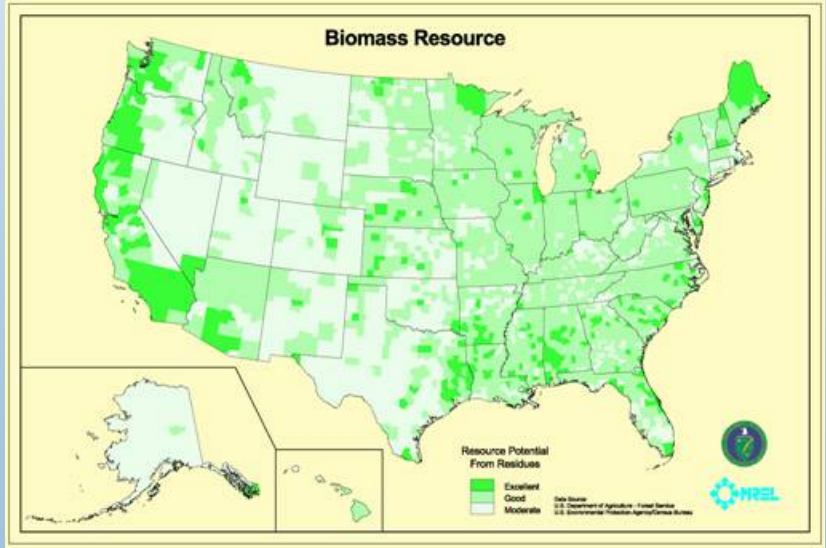
Analytical Studies

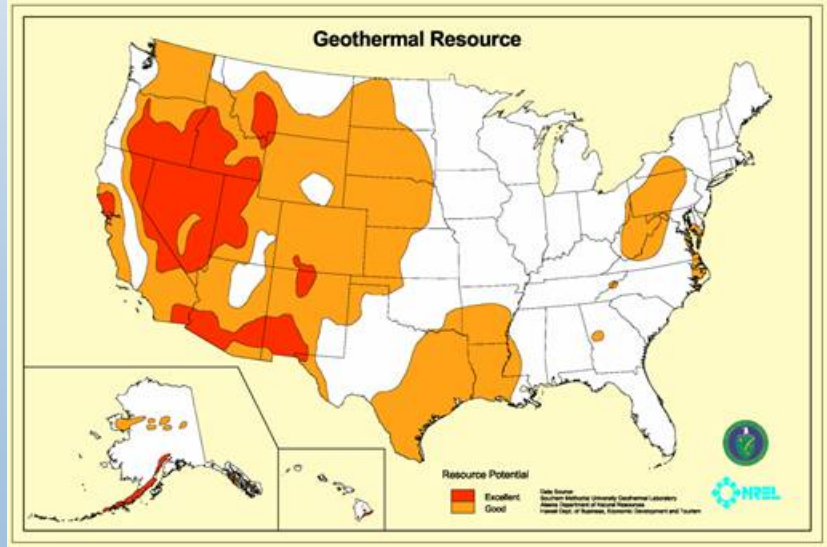
International

U.S. Renewable Energy Resources









Research Focus in Wind

- Low-windspeed turbines
- Advanced power electronics
- Better aerodynamic blades, new materials
- Technology transfer to ocean-based systems

National Wind Technology Center

NWTC Research Building 251

01251

Blade Test Facility

Turbine test field

01497

2.5 MW Dynamometer
Test Bed Facility

08573

Research Focus in Solar

- Higher efficiency devices (cells, collectors, etc.)
- New nanomaterials applications
- Predictive solid-state theory
- Advanced manufacturing techniques
- Higher component reliability

National Center for Photovoltaics Facilities

Solar Energy Research Facility

Outdoor Test Facility

Outdoor Test Area

SunLab Facilities

06096

Heliostat at the National Solar Thermal Test Facility (Sandia)

00865

High-Flux Solar Furnace (NREL)

Approved by Tom Williams, 11/4/98

Research Focus in Biomass

- The Biorefinery – new thermochemical and biochemical conversion technologies
- Solutions to under-utilized waste residues
  - Agriculture
  - Forestry
  - Urban
- Advanced agriculture (energy crops) enabled by plant genomics and bioscience

NREL Bioenergy Facilities

Alternative Fuels User Facility

Thermochemical Process Development Unit

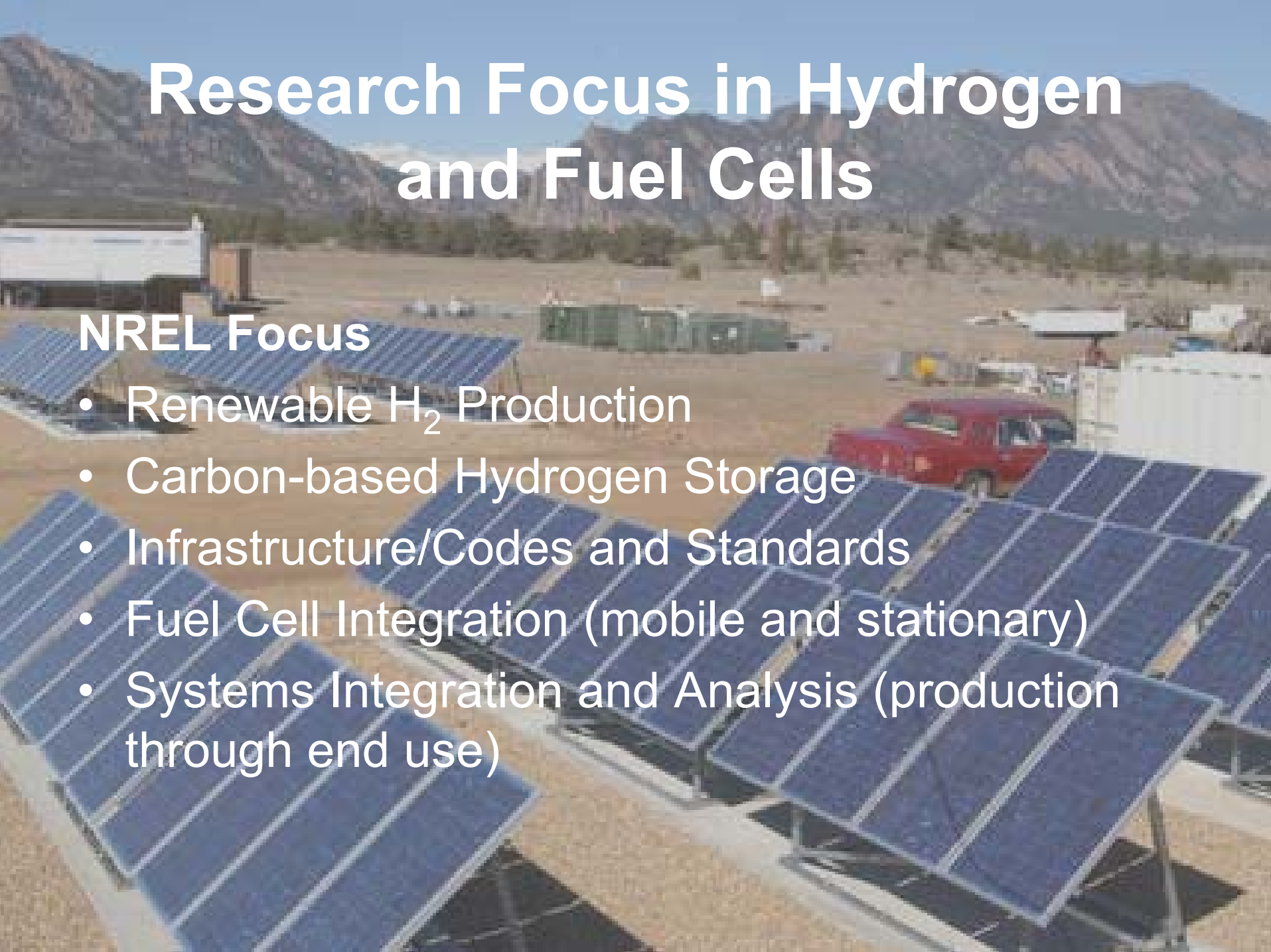
Bioethanol Process Development Unit

Field Test Laboratory Building

Research Focus in Geothermal

- More accurate, less expensive drilling
- Gains in conversion efficiency
- Corrosion resistant components
- Reservoir engineering (aquifer recharge, etc.)

Research Focus in Hydrogen and Fuel Cells

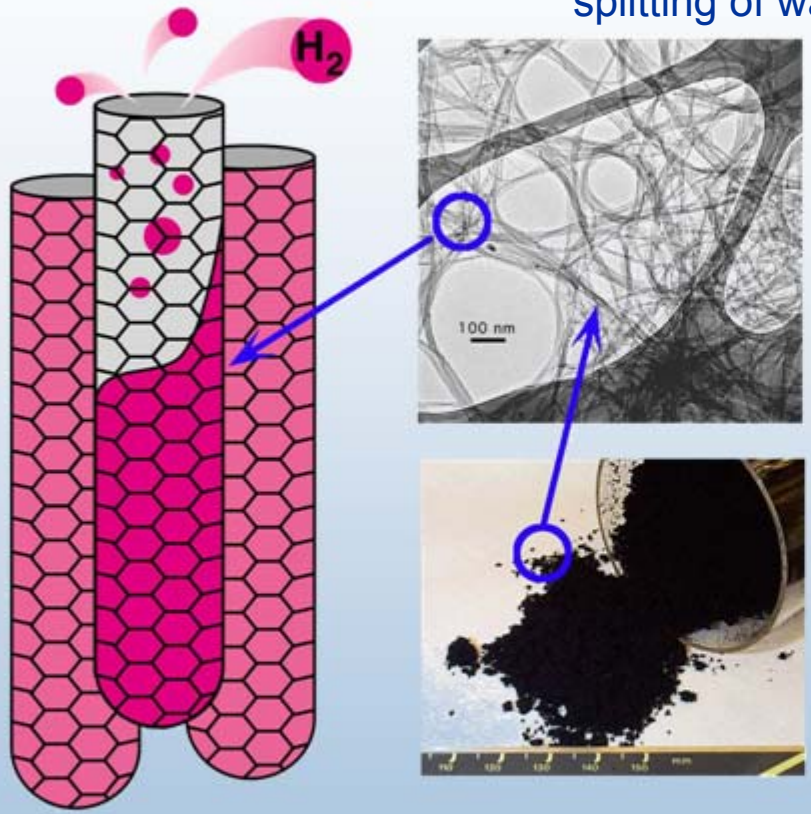


NREL Focus

- Renewable H_2 Production
- Carbon-based Hydrogen Storage
- Infrastructure/Codes and Standards
- Fuel Cell Integration (mobile and stationary)
- Systems Integration and Analysis (production through end use)

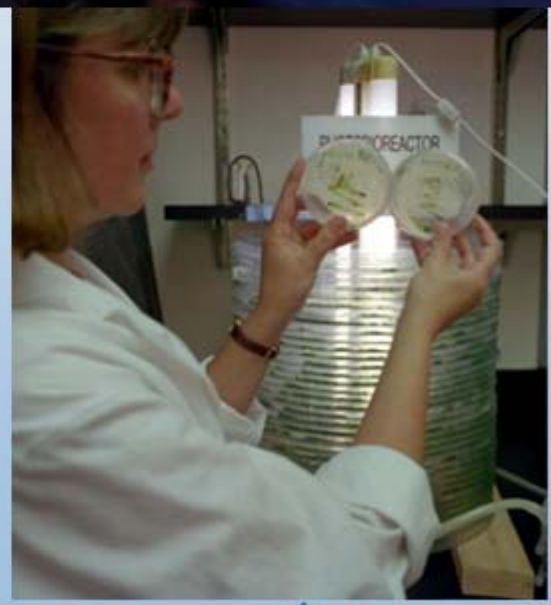
Hydrogen Research

Hydrogen from photoelectrochemical splitting of water



Carbon nanotubes for storage

06225



Mutant algal strains used to split water and produce hydrogen in the photobioreactor pictured in the background

03595

Research Focus in Electric Infrastructure

- Interconnection standards and testing
- Grid/distribution system integration
- Hybrid systems optimization

Research Focus in Transportation (FreedomCAR)

- Transition – hybrids, then fuel cells
- Systems modeling (digital functional vehicle)
- Cleaner lubricants, improved fuels
- More efficient/comfortable cabin environment

Transportation Technologies and Systems Center

Engine Dynamometer

Chassis Dynamometer

Research Focus in Buildings

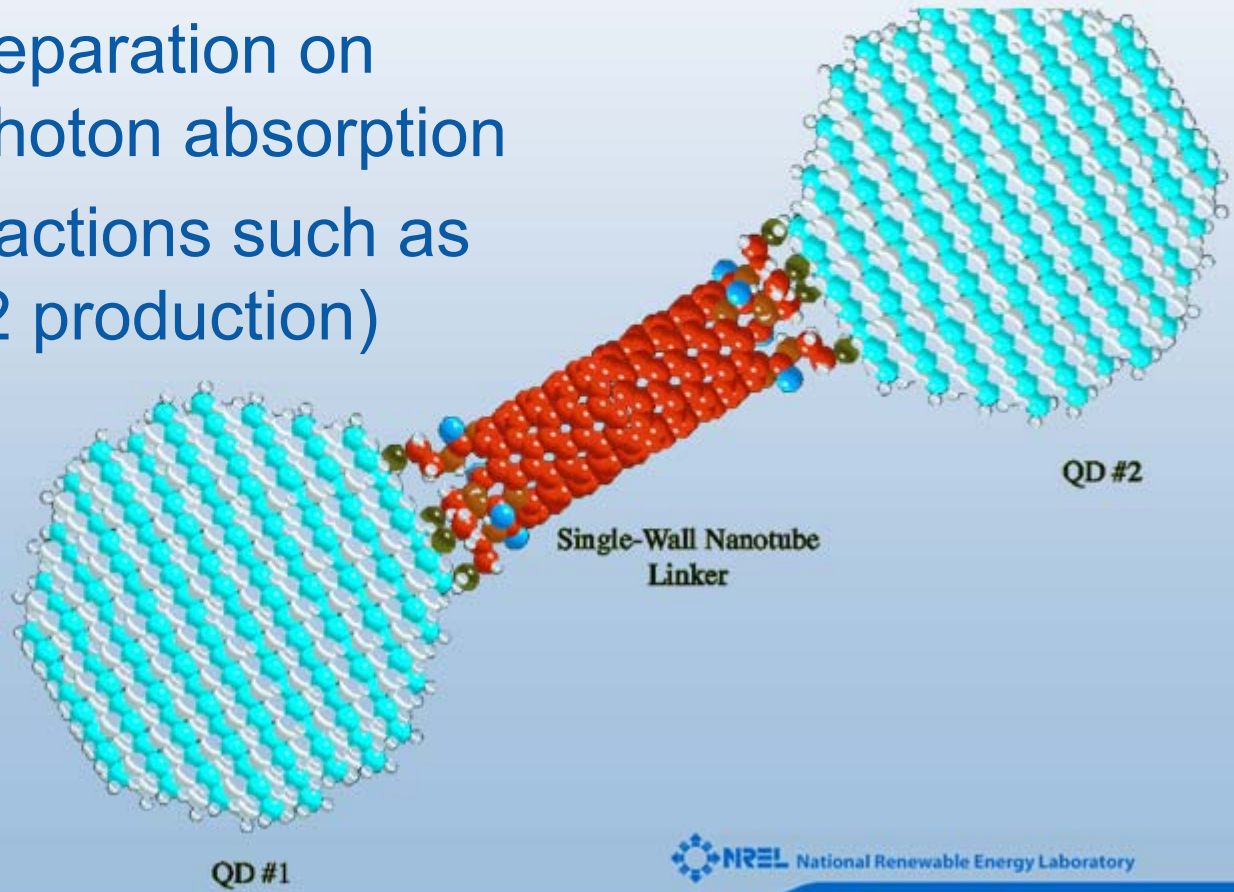
- Zero-energy homes
- High-performance commercial buildings
- Emerging technologies
  - Solid state lighting, prismatic lenses
  - Building envelope research
  - Advanced windows

Buildings and Thermal Systems Center

Desiccant Loop

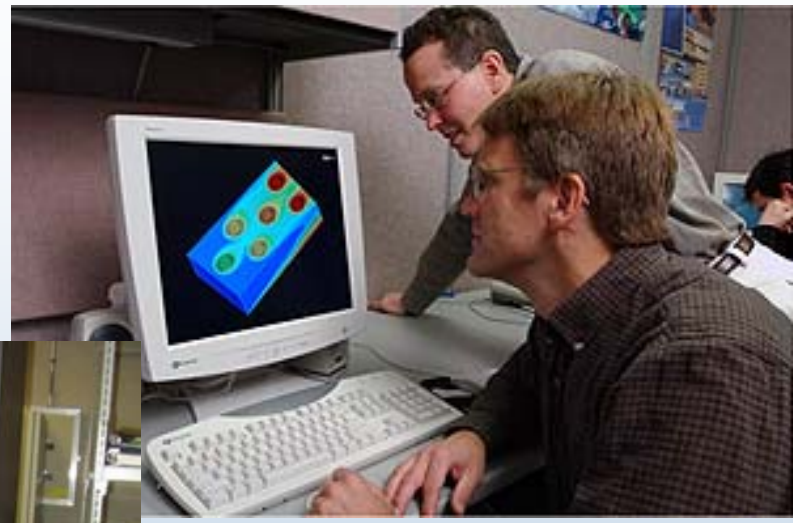
Research Focus in Basic Sciences
Nanoscience

- Quantum dots linked by single-wall nanotube segments
- Perform charge separation on nanoscale after photon absorption
- Drive chemical reactions such as water splitting (H2 production)



Computational Sciences

Computer cluster in NREL's computer room



Computational science simulation

The U.S. Department of Energy's

National Renewable Energy Laboratory

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