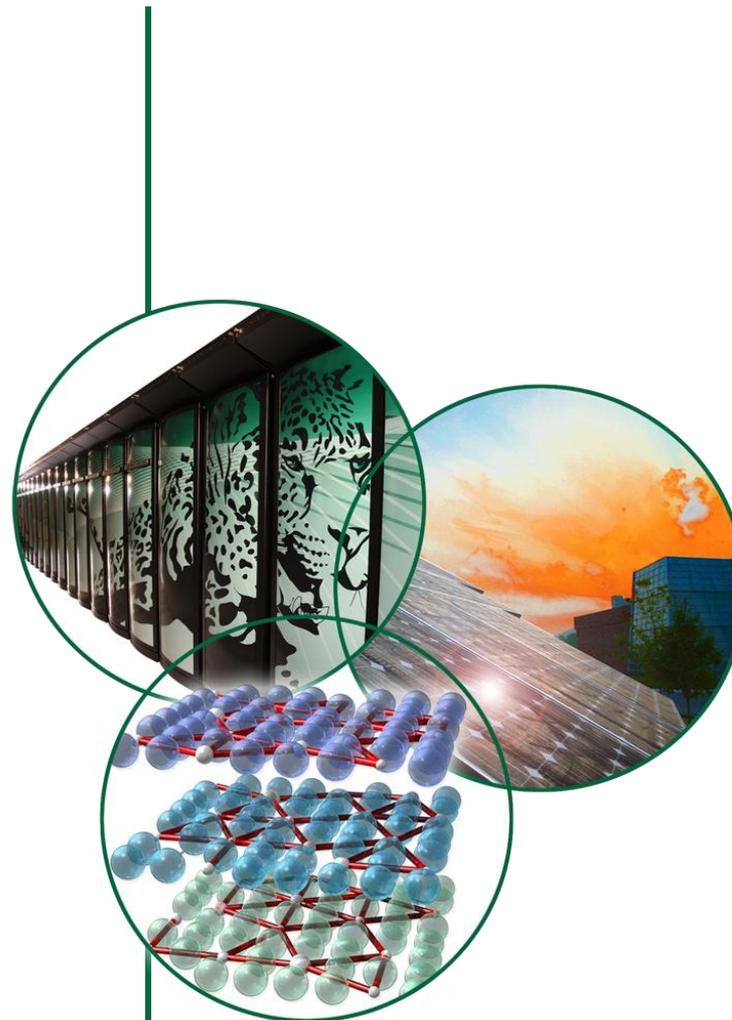


Erfaringer fra SNS Oak Ridge

Presented to
**Konferencen: Verdens bedste
mikroskop (ESS)**
En mulighed for udvikling og innovation

Ian Anderson
Oak Ridge National Laboratory

Copenhagen, Denmark
February 24, 2012

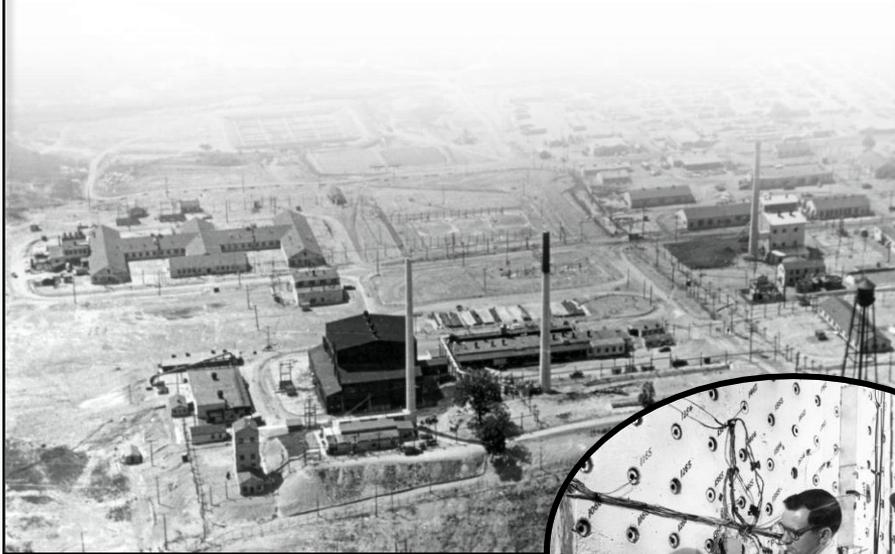


Outline

- Overview of Oak Ridge National Laboratory
- How ORNL engages with Industry and the local community
- The Spallation Neutron Source – a learning opportunity for ESS
- Developing the science and engineering work force of the future

Oak Ridge National Laboratory evolved from the Manhattan Project

The Clinton Pile was the world's first continuously operated nuclear reactor



Chemical processing techniques were developed to separate plutonium from irradiated fuel



LIFE
FILE

Today, ORNL is DOE's largest science and energy laboratory

\$1.65B
budget

4,400
employees

3,000
research
guests
annually

\$500M
modernization
investment

Nation's
largest
materials
research
portfolio

Most
powerful open
scientific
computing
facility

World's
most intense
neutron
source

World-class
research
reactor

Nation's
most diverse
energy portfolio

Managing
billion-dollar
U.S. ITER
project

Our distinctive facilities bring thousands of researchers to ORNL each year

Spallation
Neutron Source

Center for
Nanophase
Materials Sciences



BioEnergy
Science
Center



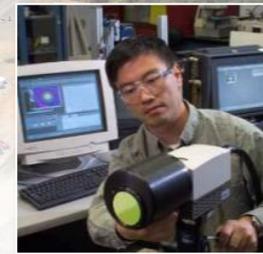
Building
Technologies
Research and
Integration Center



Oak Ridge
Leadership
Computing
Facility



High Flux
Isotope
Reactor



High
Temperature
Materials
Laboratory



National
Transportation
Research
Center

ORNL is a discriminator in recruiting industry to East Tennessee

Talent and facilities provide a unique advantage

- Volkswagen Group of America
- Wacker Chemie
- Hemlock
- Confluence Solar

Active partner in regional economic development

- Center for Entrepreneurial Growth
- Oak Ridge Science and Technology Park

Working with industry to commercialize our innovations

- AquaSentinel: SecureWaters
- LED North America
- NellOne Therapeutics



Finding new ways to work with industry

- User facilities
- Agreements to Commercialize Technology
- Collaborative research
- Sponsored research
- Technology licensing and commercialization
 - Start-up companies
 - Established firms



Example 1: Using partnerships to improve transportation sustainability

- Battery development R&D with Nissan
- Building solar electric vehicle (EV) charging stations with EPRI
- Deploying EVs and charging infrastructure with ECOtality
 - Building solar-assisted and conventional charging stations on ORNL campus
 - Adding Nissan Leaf EVs to fleet
 - Collecting and analyzing data



Example 2: BioEnergy Science Center

A multi-institutional, DOE-funded center performing basic and applied science dedicated to improving yields of biofuels from cellulosic biomass

Samuel Roberts Noble Foundation

National Renewable Energy Laboratory

Brookhaven National Laboratory

Cornell University

University of Minnesota

Washington State University

University of California–Riverside

North Carolina State University

Virginia Polytechnic Institute

University of California–Los Angeles

BESC headquarters at ORNL



Oak Ridge National Laboratory

University of Georgia

University of Tennessee

Dartmouth College

West Virginia University

Georgia Institute of Technology

ArborGen, LLC

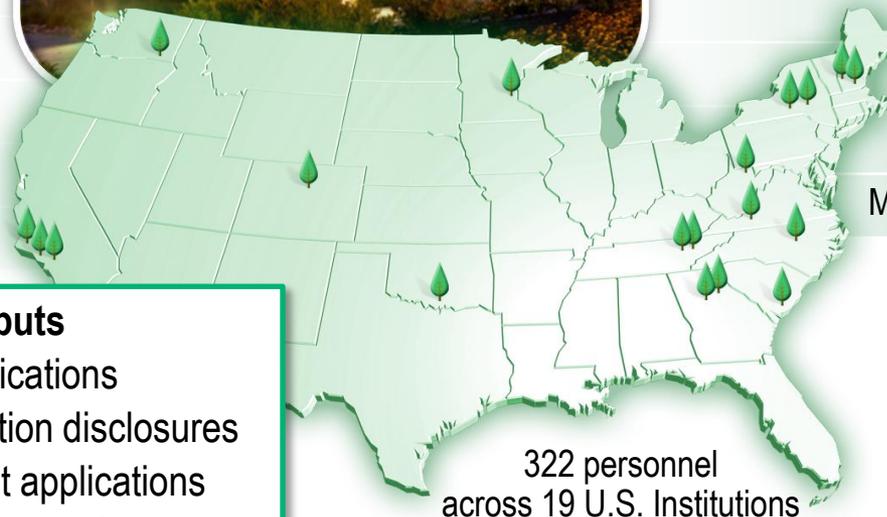
Ceres, Inc.

Mascoma Corporation

BESC outputs

- 347 publications
- 88 invention disclosures
- 28 patent applications
- 14 licenses/options

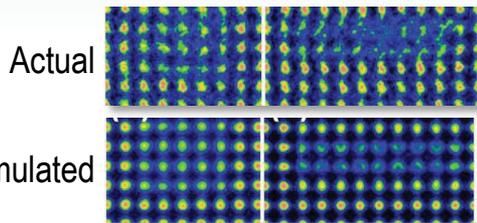
322 personnel
across 19 U.S. Institutions



Example 3: Applying petascale computing to accelerate industrial solutions

General Motors

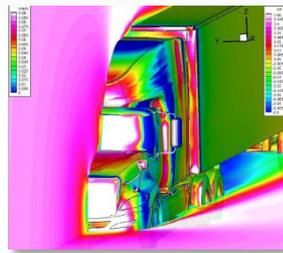
- Thermoelectric materials for higher fuel efficiency
 - Atomistic determination of PbTe-AgSbTe_2 nanocomposites and growth mechanism explains low thermal conductivity
 - DFT predictions of Ag atom interstitial position confirmed by high-resolution TEM
 - Using improved insight to develop new material



Nanoprecipitates in single crystal $(\text{AgSbTe}_2)\text{-(PbTe)}_{18}$

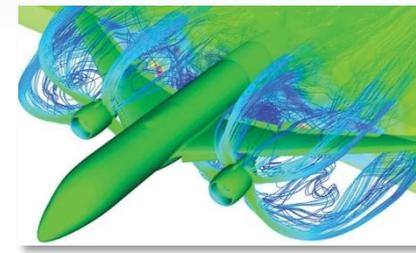
BMI Corporation

- Retrofit parts for improved fuel efficiency and CO_2 emissions for Class 8 long haul trucks
 - Simulations enable design of retrofit parts, reducing fuel consumption by up to 3,700 gal and CO_2 by up to 41 tons per truck per year
 - 7–12% improvement in fuel efficiency exceeds regulatory requirement of 5% for trucks operating in California



Boeing

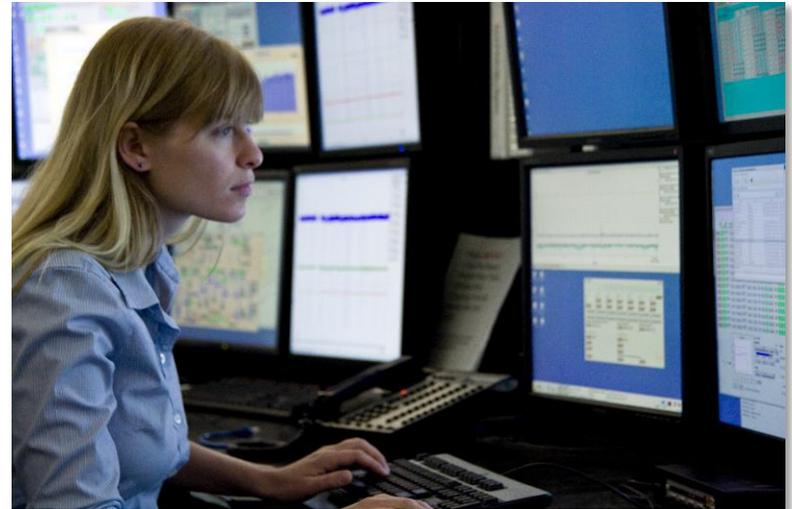
- Development and correlation of computational tools for transport airplanes
 - Reduced validation time to transition newer technology (CFD) from research to airplane design and development
 - Demonstrated and improved correlations between CFD and wind tunnel test data



Today's most powerful neutron source: Spallation Neutron Source

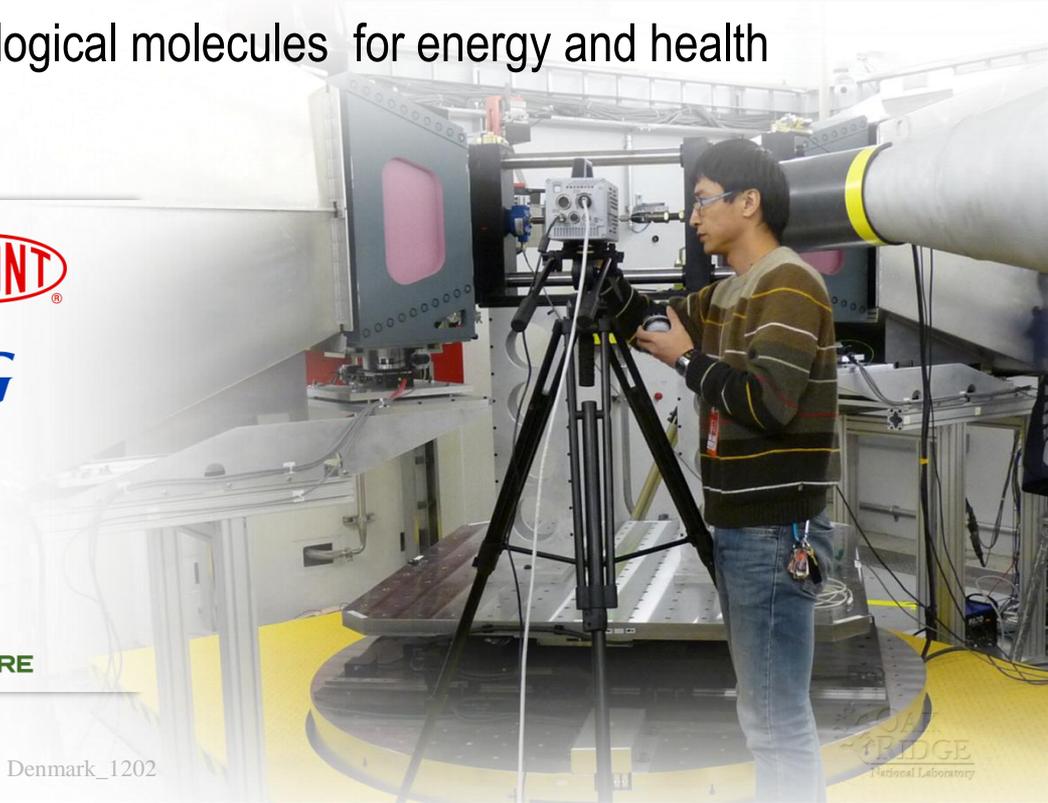
- Designed and constructed by a partnership of 6 national laboratories
- Completed in April 2006, on scope, schedule, and budget
- Total procurement: \$1,379M
 - Tennessee procurement: \$602M (43.7%)
- Offering unprecedented performance for neutron scattering research
- Delivering neutrons to hundreds of users

	FY11
Unique users	889
Operating hours	5,940.9
Instruments	15
Availability	92%



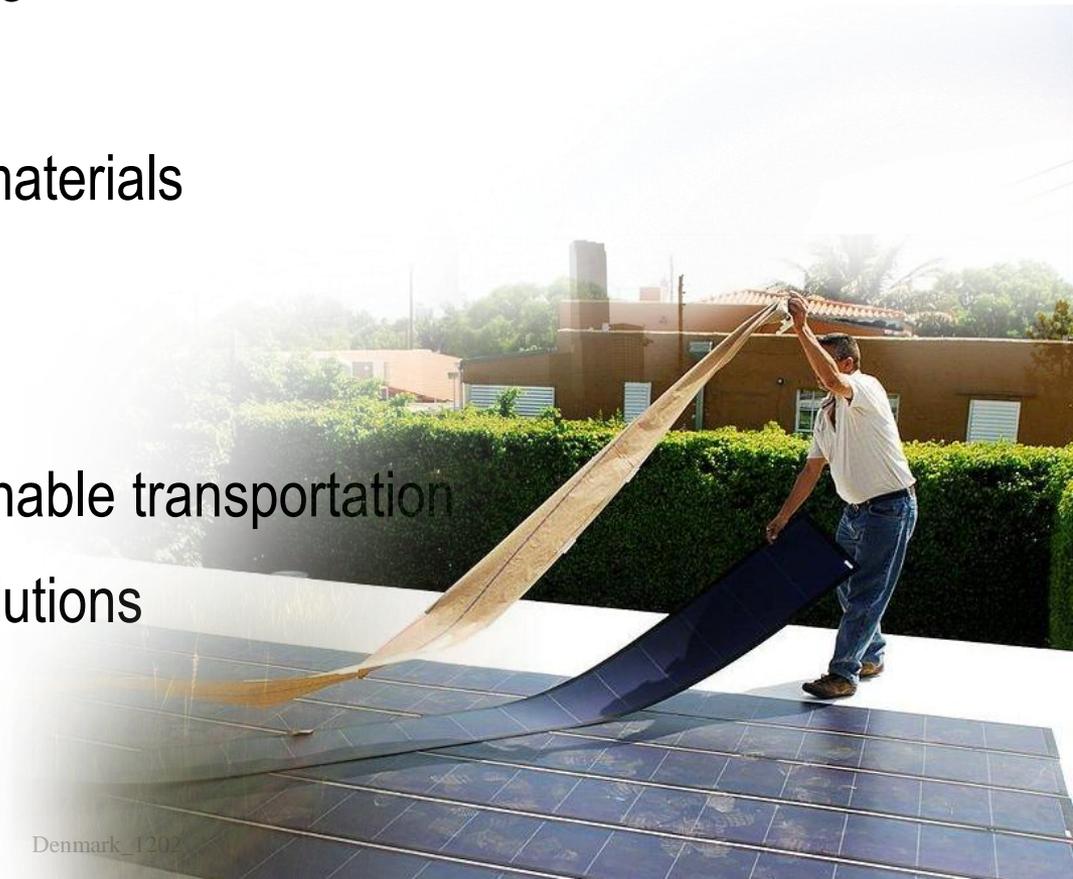
The industrial neutron user community is growing

- Large and small companies are taking advantage of the unique power of neutrons
 - Characterizing large industrial components
 - Assessing wear and tear resulting from internal stresses
 - Developing advanced materials for energy applications
 - Understanding, and mimicking, biological molecules for energy and health
- Most research is nonproprietary



Neutron scattering is providing insights for energy solutions

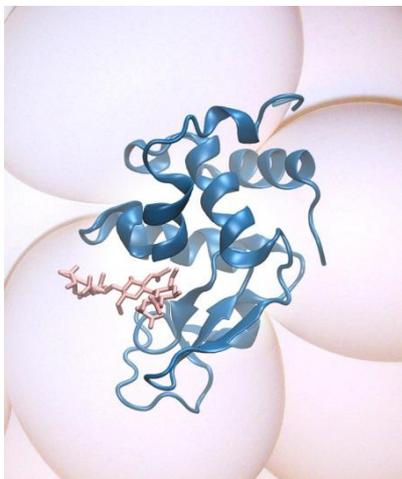
- High-temperature superconductors
- Environmentally friendly catalysts
- Biofuels and bioproducts from lignocellulosic biomass
- Thermoelectric materials
- Batteries and Energy Storage materials
- Fuel cell membranes
- High-performance superalloys
- Lightweight materials for sustainable transportation
- Carbon capture and storage solutions



Petascale computing and neutron investigation – a formidable combination

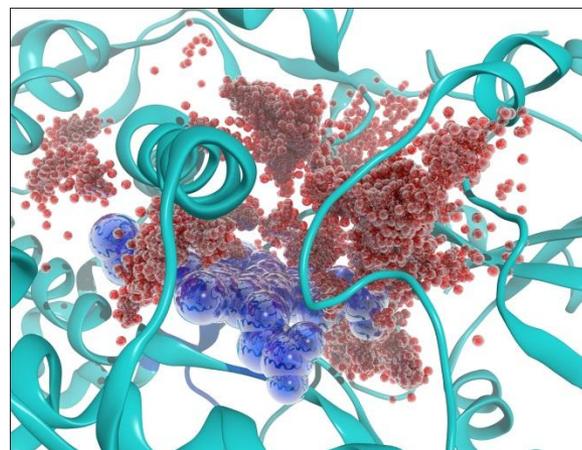
How Proteins work

Lysozyme (shown in blue) – a natural enzyme found in tears saliva and whites – can break down bacterial cell walls (shown in pink). Together computer simulations and neutron experiments clarify the complicated motions of proteins such as lysozyme into three distinct classes

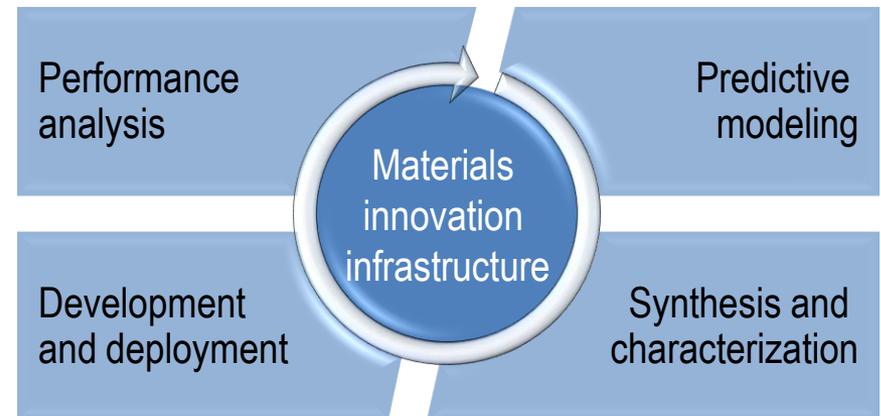
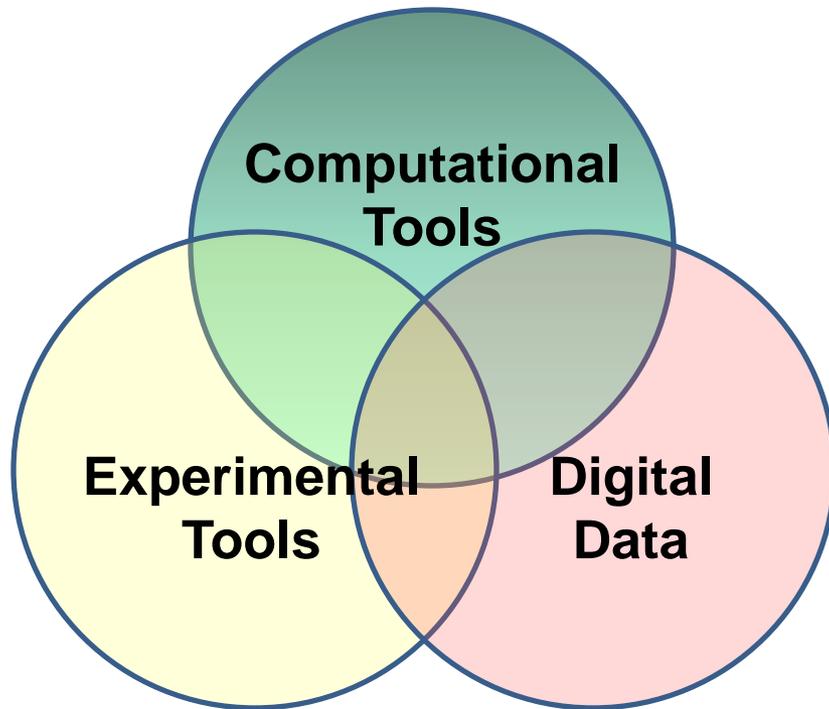
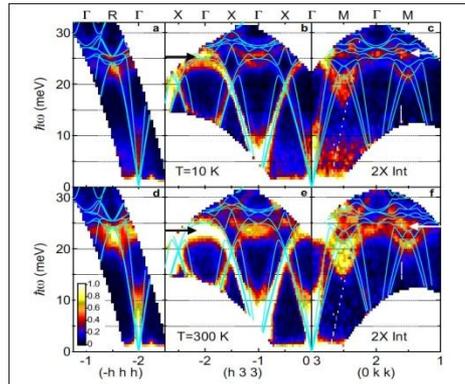


Drug Detoxification

Simulations combined with inelastic neutron scattering reveal how water molecules (seen in red) move in and out of the active site (seen in blue) of a P450 enzyme. This class of enzymes is responsible for detoxifying a large fraction of drugs taken by humans



Materials Innovation Infrastructure: An opportunity for the region



Helping to develop the next generation of scientists and engineers

- Providing educational and research experiences for students and faculty at all levels
 - Graduate education programs with an emphasis on interdisciplinary energy science and technology
 - Prestigious postdoctoral fellowships
- Investing in facilities and teachers for area schools
- Participating in regional education and workforce development efforts



University partnership and educational programs at ORNL reach thousands of students and faculty each year

Research experiences	ORNL events	Classroom outreach	New graduate program
<ul style="list-style-type: none"> • 40+ programs serve ~1,800 students and faculty (K–12 through postgraduate) each year • Many programs supported by ORAU, our science education partner 	<ul style="list-style-type: none"> • Tours, National Lab Day, etc., bring ~5,000 K–12 and university students to ORNL each year • Human Resources and Communications supports many of these activities 	<ul style="list-style-type: none"> • Tens of thousands of K–12 students participate each year <ul style="list-style-type: none"> – “Farming for Fuels” – National Geographic JASON Project, “Tectonic Fury” – SNS in the classroom 	<ul style="list-style-type: none"> • UT-ORNL Interdisciplinary PhD program in energy-related science and engineering • Establishing graduate education partnerships with multiple universities

- The majority of these programs (except K–12) are integrated with our mission work and paid for with research funds
- Individual research groups determine their level of involvement
 - Staff commitment makes the program work

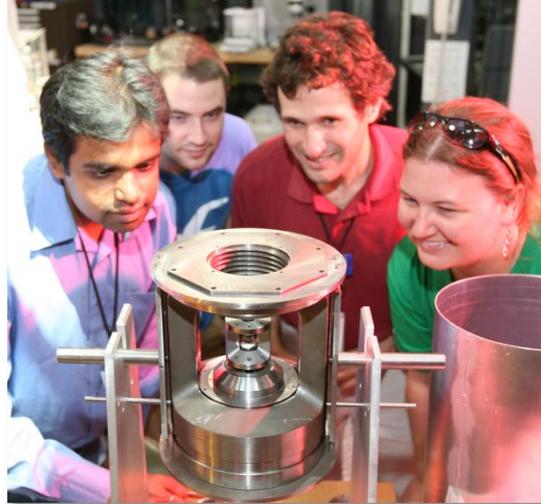
ORNL graduate research and education initiative: Our vision

Multidisciplinary



Expand student research opportunities in multidisciplinary science and engineering, leveraging ORNL staff, programs, and facilities

Entrepreneurial



Incorporate entrepreneurial experiences, including opportunities to develop business plans for accelerating technology deployment

Transformational



Engage students in large-scale, problem-oriented programs, enabling scientific discoveries and innovative solutions to energy-related challenges

Contributing to continuing growth across the Innovation Valley

