

Oak Ridge National Laboratory:

Report to the Community, 2007



Presented to
Friends of ORNL

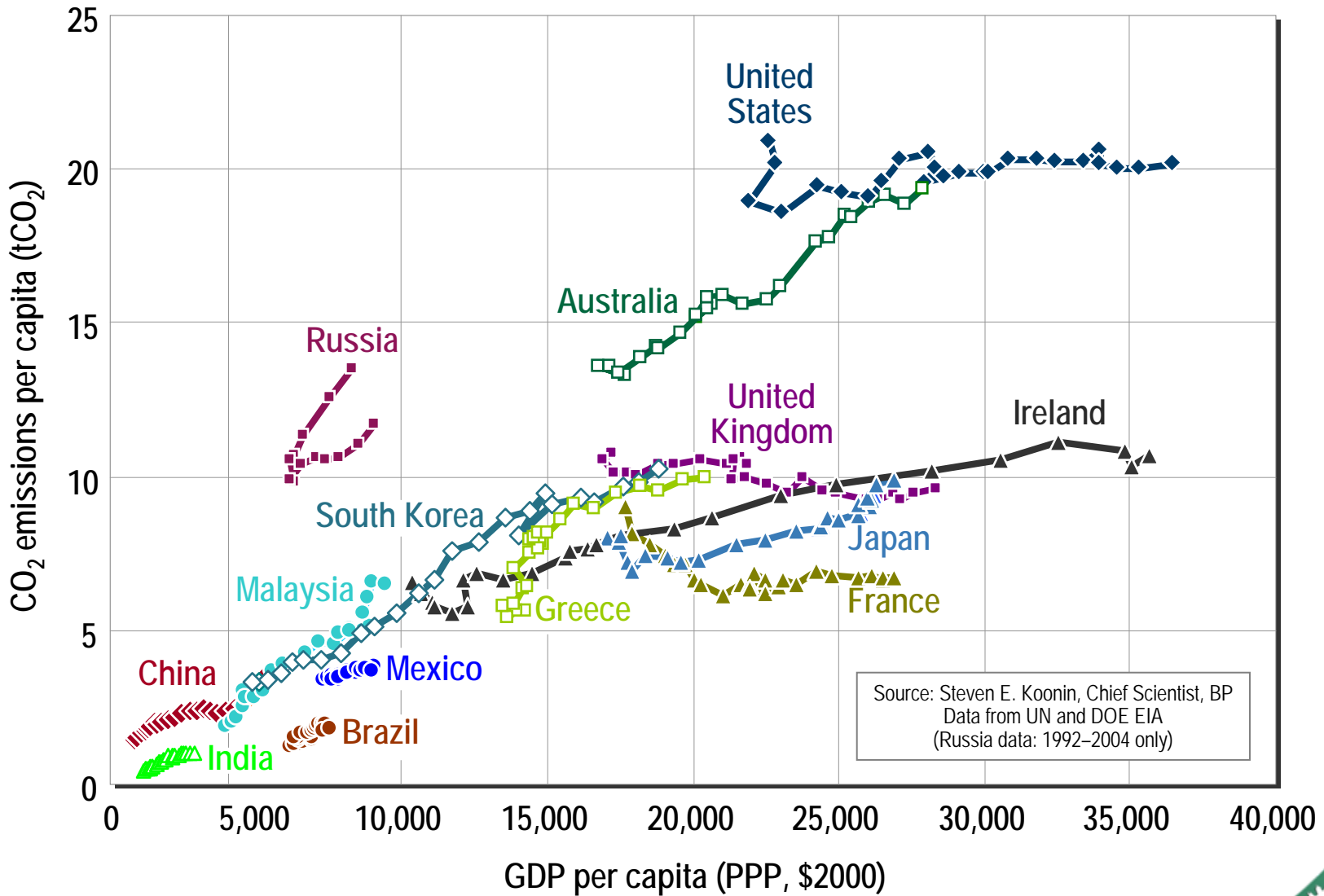
Thomas E. Mason
Laboratory Director

Oak Ridge, Tennessee
October 4, 2007

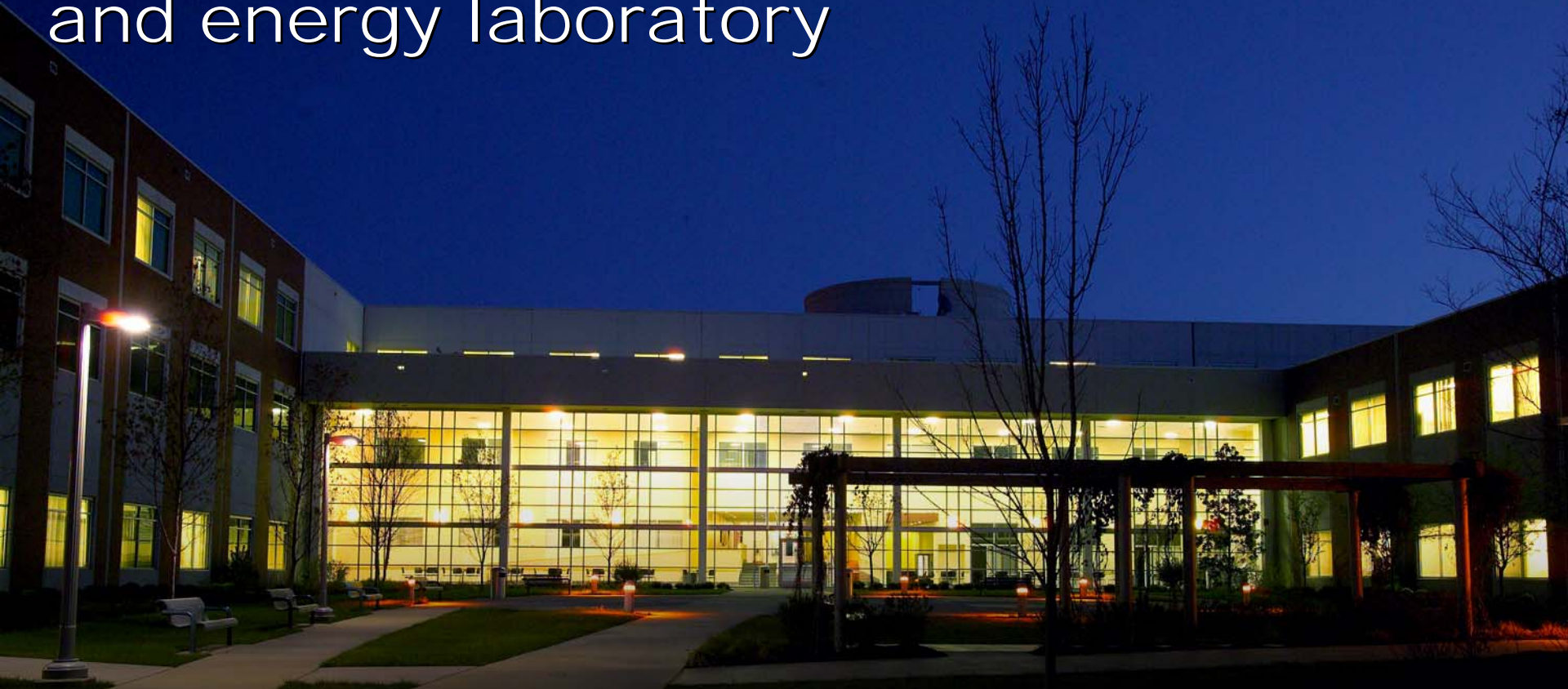
Energy has moved to the top of the international policy agenda

- **Public and policy dialogue are increasingly focused on energy, broadly defined**
 - Energy generation, distribution, and consumption
 - Environmental impacts of energy use
 - National security implications
 - Economic consequences
- **Addressing these issues provides an enduring mission for the DOE national laboratories**
 - A “very big and difficult problem” (Weinberg)
 - Similar to the national security mission that resulted in the birth of the DOE complex
 - Critically dependent on the best science and technology

CO₂ emissions and GDP per capita (1980–2004)



ORNL is DOE's largest science and energy laboratory



- **\$1.1B budget**
- **4,200 employees**
- **3,000 research guests annually**
- **\$350 million invested in modernization**

- **World's most powerful open scientific computing facility**
- **Nation's largest concentration of open source materials research**

- **World's most intense pulsed neutron source**
- **Nation's most diverse energy portfolio**
- **Managing the billion-dollar U.S. ITER project**

The last few months have brought us a phenomenal amount of good news

May

- HFIR restarted with new cold neutron source and world-class instrumentation

June

- ORNL-led team awarded a \$125M Bioenergy Science Center
- Cray XT4 Jaguar ranked second in the world

July

- Researchers at ORNL win 6 R&D 100 awards, more than any other national laboratory

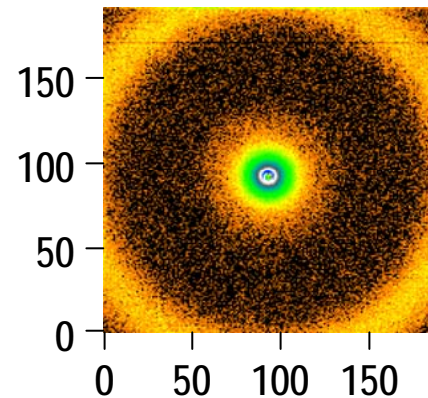
August

- Joint Institute for Computational Sciences receives \$65M from NSF to develop and deploy a petascale computer
- SNS sets world record for beam power on target



HFIR is now operating with the cold neutron source

- HFIR has completed 3 reactor cycles since the cold neutron source was completed
- Commissioning of two new small-angle neutron scattering (SANS) instruments is going well
 - Best in the nation
- A full user program is under way
 - More than 100 users during first 3 cycles
- Isotope production, neutron activation analysis, and material irradiation experiments are also being conducted



Two-dimensional scattering pattern of a polymer blend taken on the new HFIR SANS instrument

BESC leverages the Tennessee Biofuels Initiative

- **UT took the lead in proposing this \$72M initiative to State government**
 - JIBS construction: \$11.6M
 - Research equipment: \$3M
 - Joint UT-ORNL research: \$10M
 - 3 Governor's Chairs: \$3M–\$5M
 - 5M-gal/year pilot plant: \$40M
 - Agricultural price supports: \$8M
- **With commitments from other BESC partners, we have a total investment of roughly a quarter of a billion dollars**

BESC provides DOE with an integrated biofuels resource: Fundamental science through pilot-scale demonstration

**BESC:
\$125M + \$10M**

**TBI:
\$72M**

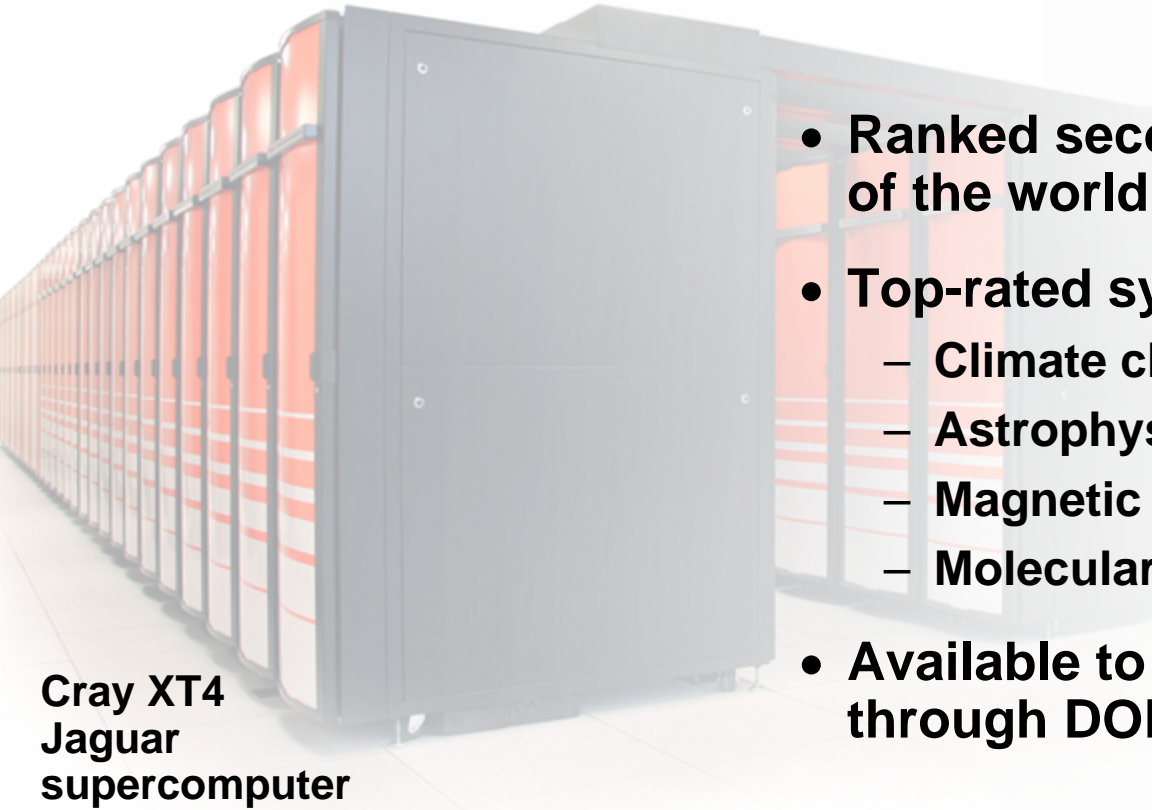
**Other partners:
~\$20M**

Breaking the biological barriers to cellulosic ethanol

- **Our goal is to revolutionize how biomass is processed by:**
 - Improving overall yields
 - Simplifying operations through consolidated bioprocessing (CBP)
 - Decreasing (or eliminating) the need for costly chemical pretreatment
- **We will do this by applying a systems biology approach and new higher-throughput pipelines to:**
 - Reduce recalcitrance by targeted modification of plant cell wall composition and structures
 - Develop single microbes or microbial consortia to enable CBP for low-cost cellulose hydrolysis and fermentation
 - Provide a synergistic combination of modified plants and CBP for even more cost-effective biofuel production



ORNL Jaguar supercomputer advances to second in the world



**Cray XT4
Jaguar
supercomputer**

- **Ranked second on the Top500 List of the world's fastest computers**
- **Top-rated system for open science**
 - **Climate change**
 - **Astrophysics**
 - **Magnetic fusion**
 - **Molecular biology**
- **Available to the scientific community through DOE's INCITE program**

The world's most powerful system for open science

ORNL innovations have been recognized with 6 R&D 100 awards

Piranha, a knowledge discovery engine



Pharos, a small low-power neutron detection system



Cast nickel aluminide for improving the productivity of steel heat-treating furnaces



High-performance LMO-enabled, high-temperature superconducting wires



Large Area Imager for Standoff Detection, an instrument for locating radiation sources



Armstrong Process CP Ti and Ti Alloy Powder and Products, for low-cost production of titanium powder



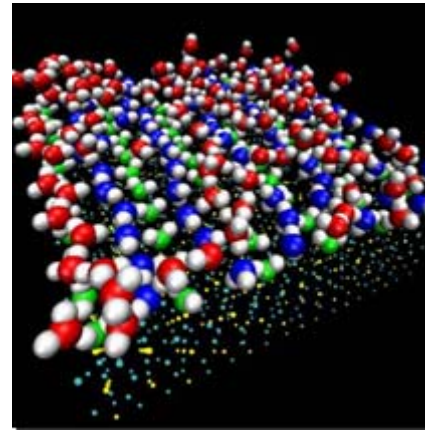
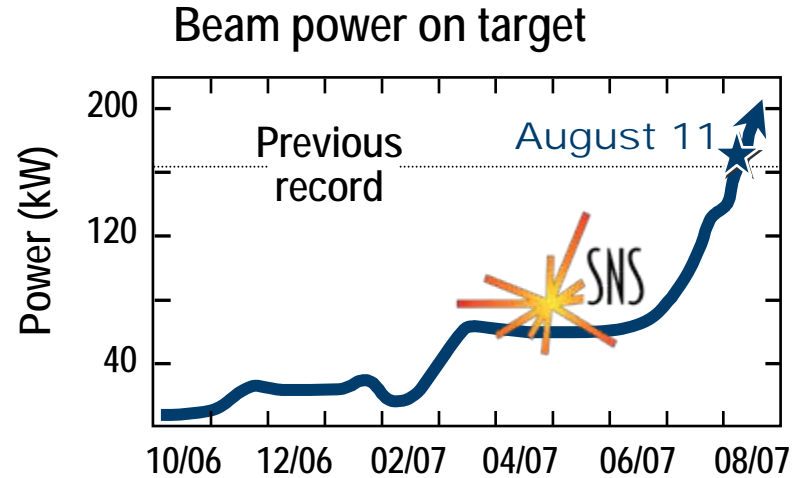
Partnering with UT to support the NSF Track 2 initiative

- **\$65M over 5 years to the Joint Institute for Computational Sciences**
 - Largest grant in UT history
 - Other partners: Texas Advanced Computing Center, National Center for Atmospheric Research, ORAU, and core universities
- **1 of up to 4 leading-edge computing systems planned to increase the availability of computing resources to U.S. researchers**
- **A new phase in our relationship with UT**
 - Engagement with the scientific community
 - Research, education, and training mission



Power increases at SNS are ahead of schedule

- **We exceeded beam production goals for FY07**
- **3 instruments in full operation**
 - Wide Angular-Range Chopper Spectrometer received neutrons on September 7
- **More than 30 user proposals were received in response to a call for experiments on the first 3 operational instruments**
 - 13 proposals were accepted
 - 74 beam days were awarded
- **SNS is delivering science**
 - First paper submitted: Dynamics of water on rutile
 - CNMS users studying polymer scaffolds for bio-inspired membranes



Molecular dynamics simulation of hydration water on rutile

The transformation of ORNL continues

- **West Campus: Joint Institute for Biological Sciences will be operational in November**
- **Chestnut Ridge:**
 - User Housing Facility construction will start this year
 - Joint Institute for Neutron Sciences design is out for bid
- **Expanding chillers and electrical infrastructure to support computing**



Going forward, our modernization strategy has three major elements

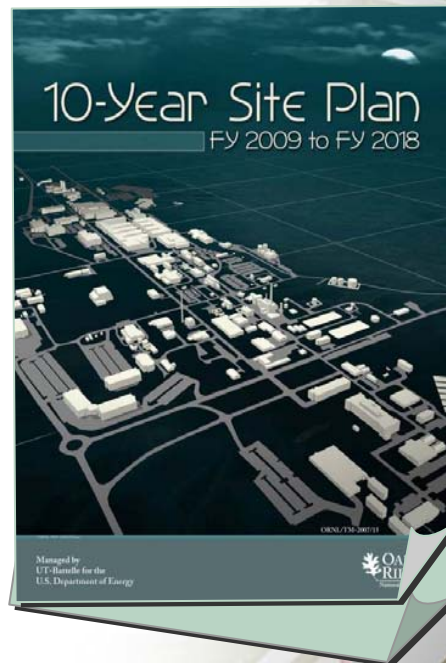
- **Science Laboratory Infrastructure (SLI) reconfiguration:**

- Replacement for laboratories in Building 4500
- CD-0 approved

- **Integrated Facilities Disposition Project**

- Cleanup of ORNL Central Campus
- CD-0 approved

- **Oak Ridge Science and Technology Park**



How are we getting ready for the future?

- **Focusing on the scientific exploitation of our capabilities**
- **Pursuing new initiatives to ensure that we remain at the forefront**
 - What do we want to be doing in 10 or 15 years?
 - What must we do today in order to be ready?
- **Looking for new and better ways of working across organizational boundaries to increase our impact**

Delivering science:

We have the tools, the opportunity,
and the responsibility

- **Deliver advances in the synthesis, characterization, design, and modeling and simulation of nanoscale materials**
- **Deliver world-leading neutron science at SNS and HFIR**
- **Advance our computing power to 250 TF and enable high-impact science**
- **Execute a growing ITER program**
- **Expand our role in the growing national nuclear energy program**
- **Deliver biofuels science**
- **Develop a climate strategy**
- **Sustain our national security program in a changing environment**

**Our FY 2008
challenges in
science and
technology**

ORNL is uniquely positioned to deliver science and technology for energy

We have an extraordinary set of assets

- **Outstanding tools for materials R&D**
- **World's most powerful system for open scientific computing**
- **Bioenergy Science Center**
- **The nation's broadest portfolio of energy programs**
- **Unique resources for nuclear technology**
- **Robust national security programs**

**Our challenge:
Use these assets
to deliver results
that are significant
on both the
national and the
international scale**



We expect to play a major role

- **Broadest program in the DOE system**
- **Exceptional facilities for R&D**
- **Well connected to industry and universities**
 - TVA partnership: New grid visualization and modeling program
 - Automotive Research Alliance

- **Energy Efficiency and Renewable Energy**
 - Largest market share in Transportation and Industrial Technologies
 - 200% growth in hydrogen/fuel cell and biomass technologies
- **Electricity Delivery and Energy Reliability**
 - Largest market share in high-temperature superconductivity
 - 200% growth in grid visualization and modeling
- **Fossil Energy**
- **Nuclear Energy**
- **DOE science programs: Basic energy sciences, bioenergy, fusion**



New solar photovoltaic system at ORNL



Tennessee Valley:

Demonstrating energy for the Nation's future

Bioenergy

- EERE and other DOE
- State of Tennessee
- Industry

Renewables

- TVA: Hydro
- EERE: Solar

Fusion

- DOE-SC
- ITER
- Industry

Buildings

- EERE
- Walden Reserve
- Whirlpool

Grid

- DOE-OE
- TVA
- DHS

Transportation

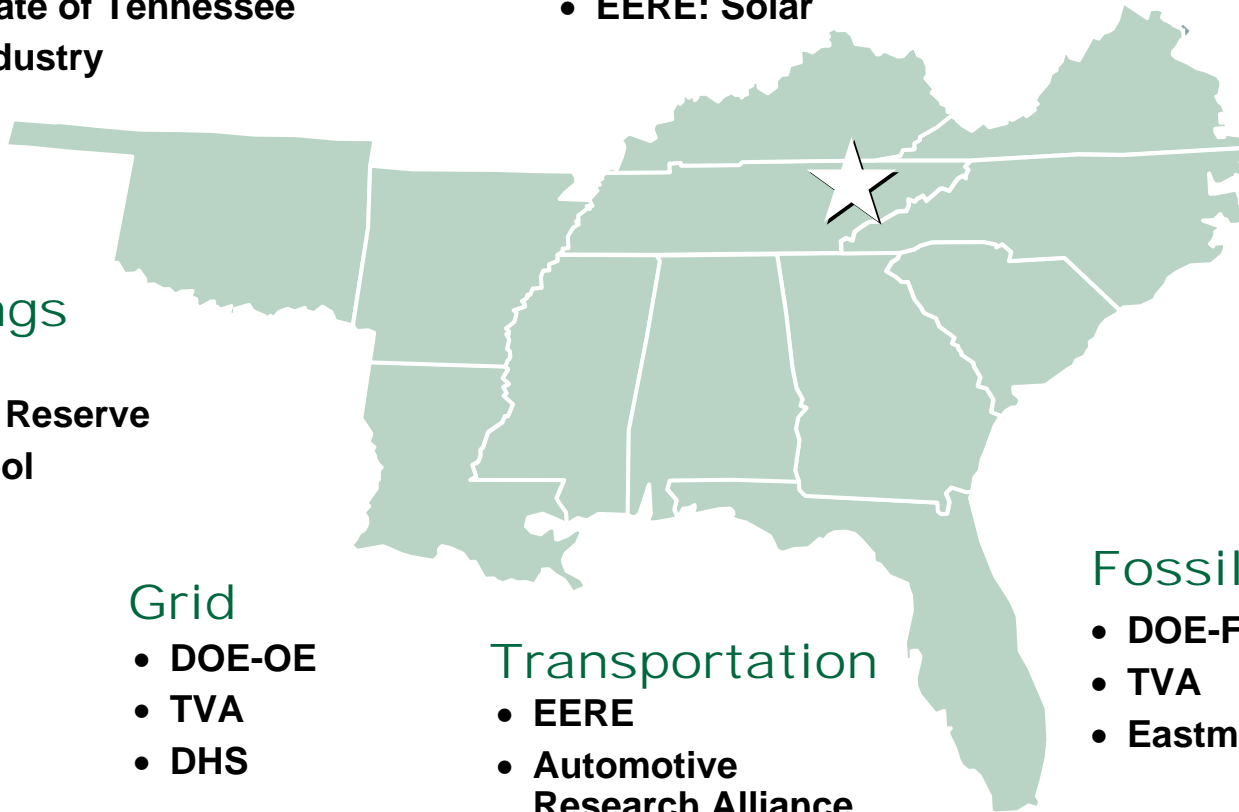
- EERE
- Automotive Research Alliance
- NTRC

Fossil

- DOE-FE
- TVA
- Eastman

Nuclear

- DOE-NE
- TVA: AFCD
- USEC



We are actively pursuing new programs

"Science to Energy"	<ul style="list-style-type: none">• Basic Energy Sciences: "Use-inspired research"
Neutron science	<ul style="list-style-type: none">• SNS power upgrade and second target station• Instrumentation
Energy and climate	<ul style="list-style-type: none">• Nuclear renaissance• Fusion science and technology• Transportation• Industrial technologies• 21st century electric grid• Bioenergy• Carbon management• Climate modeling, field experiments, ecogenomics
Homeland security and national defense	<ul style="list-style-type: none">• Nonproliferation• Counterterrorism• Knowledge discovery• Geographic information science and technology
Ultrascale computing	<ul style="list-style-type: none">• Enabling scientific discovery• Moving toward the exascale



We will continue our engagement with the community

- **Developing a regional education initiative**
- **Sustaining our community outreach programs**
- **Developing new strategies for commercialization**



**America COMPETES Act:
New opportunities to help educate
the next generation of scientists
and engineers**



**Supporting United Way
in helping our neighbors**

We have important work to do



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