Enabling Innovation and Creativity Centers in the 21st Century

Laboratories for the 21st Century 2005 Conference

October 18, 2005

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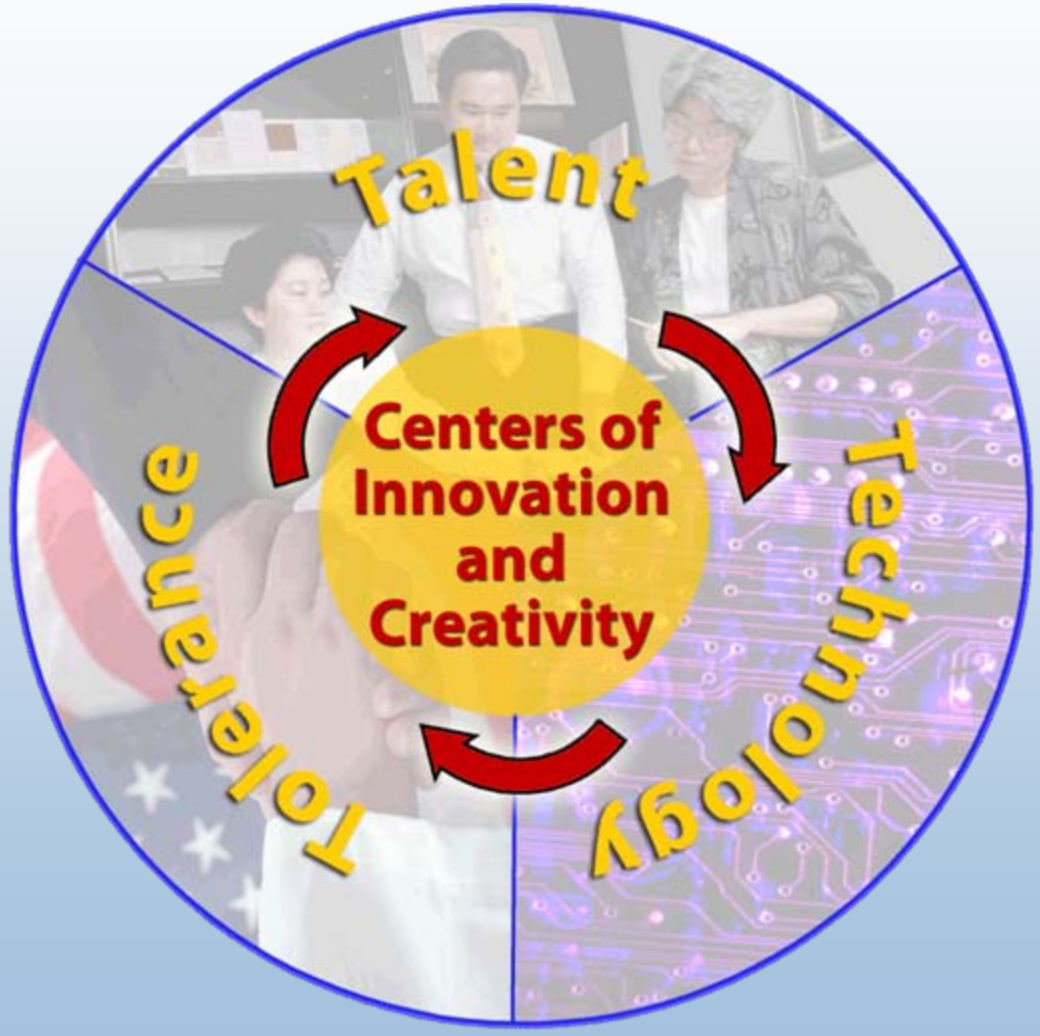
Director, National Renewable Energy Laboratory

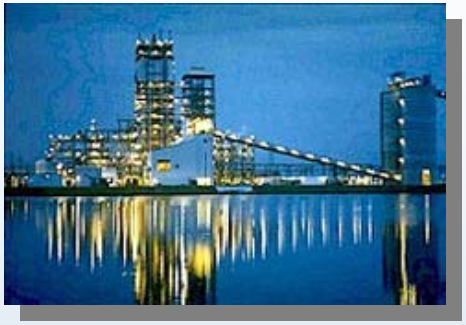
Centers of Innovation and Creativity



Adapted from Richard Florida's, "Rise of the Creative Class"

A Quarter Century of Energy R&D Contributions

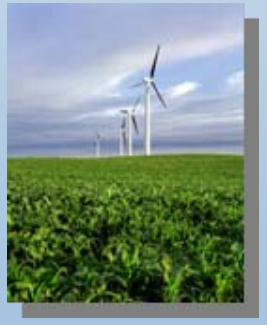
Created a commercial nuclear power option



Reduced emissions from coal-fired power plants

Enhanced oil recovery from wells

Enabled hybrid vehicles to enter the market

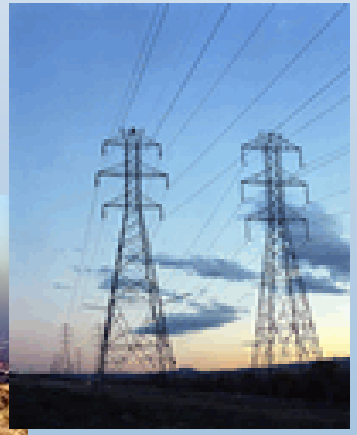


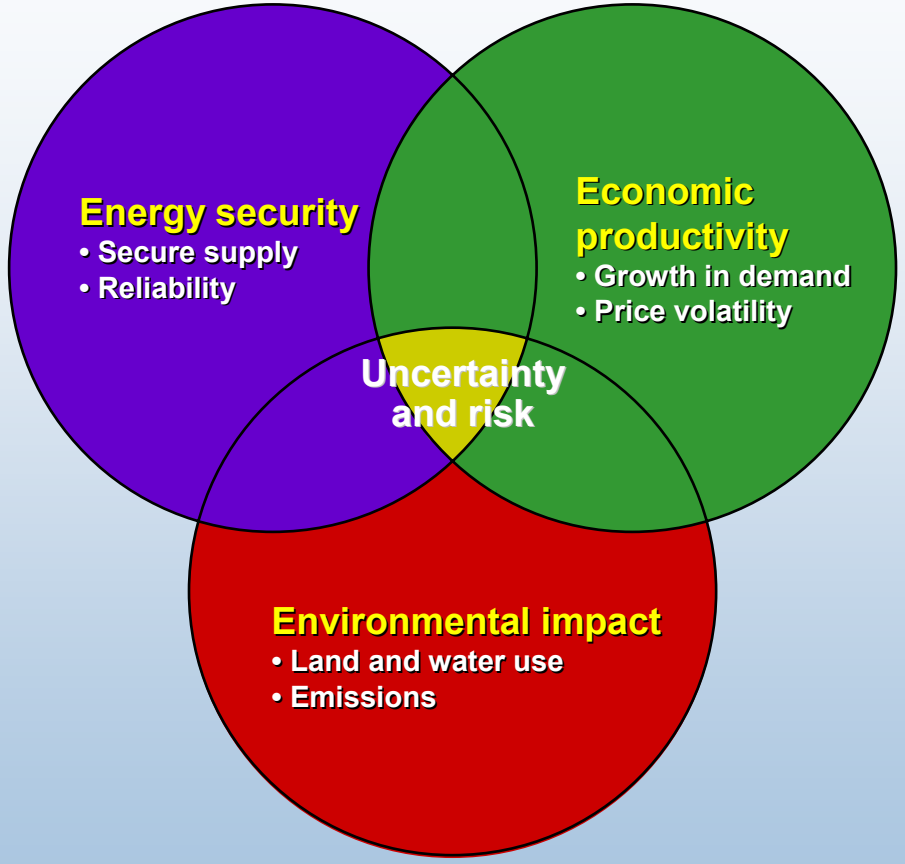
Brought utility-scale wind into our generation mix

Improved energy productivity

Technology innovations have had a significant impact, but…

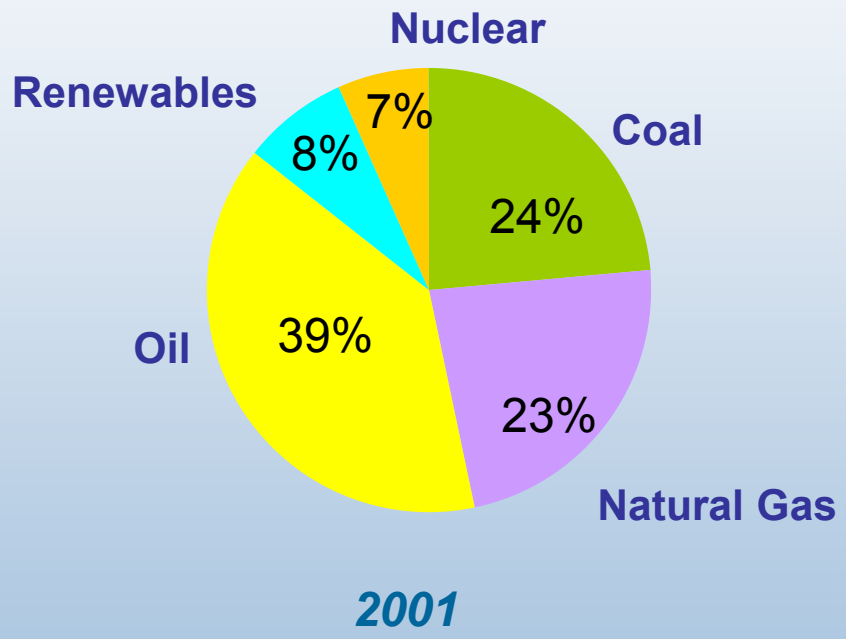
Energy Solutions are Enormously Challenging

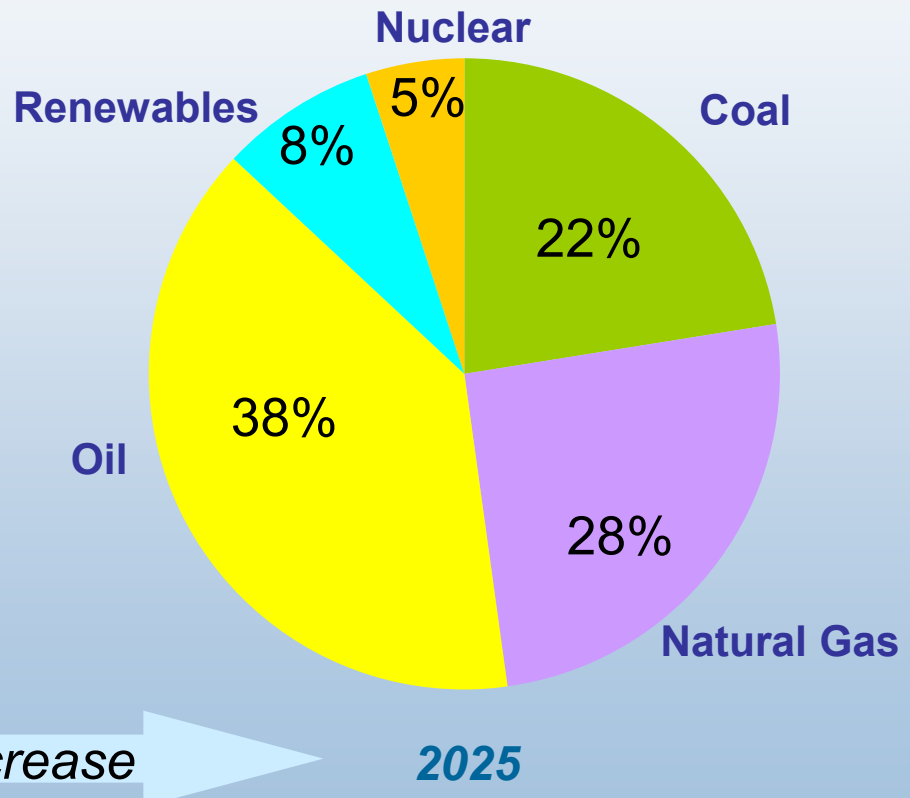




We need a balanced portfolio of options

Worldwide Energy Consumption by Source

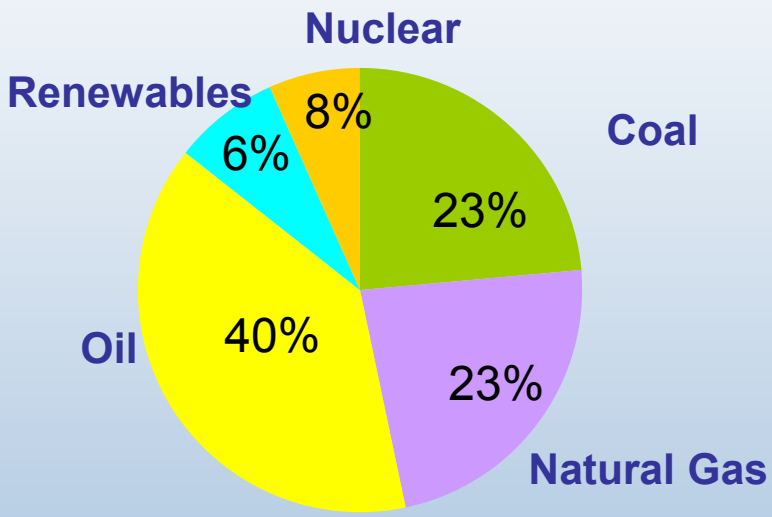




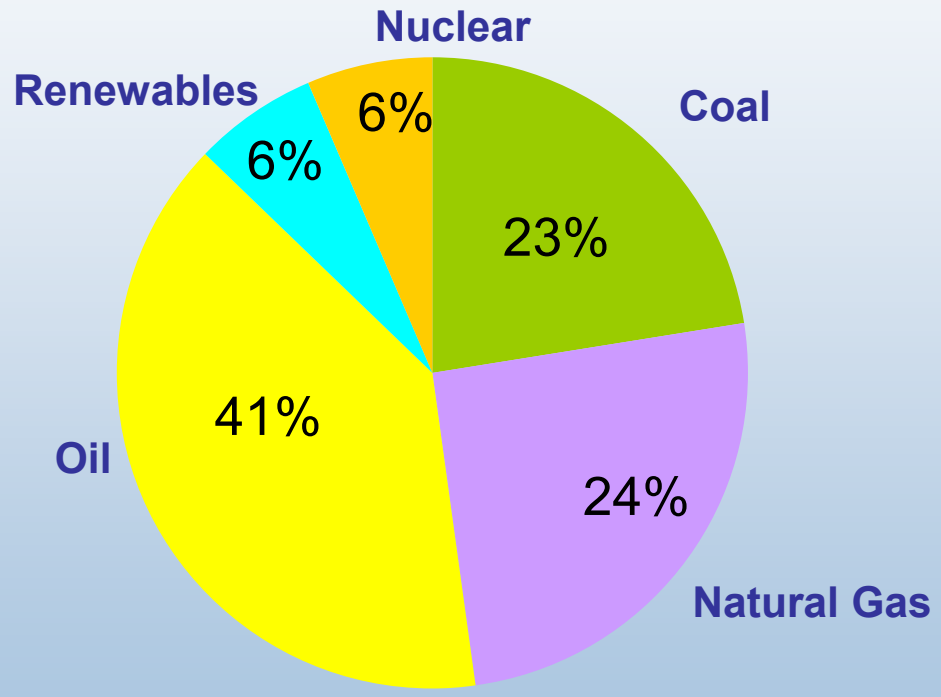
54% increase

Source: Energy Information Administration, *International Energy Outlook 2005*

U.S. Energy Consumption by Source



2003

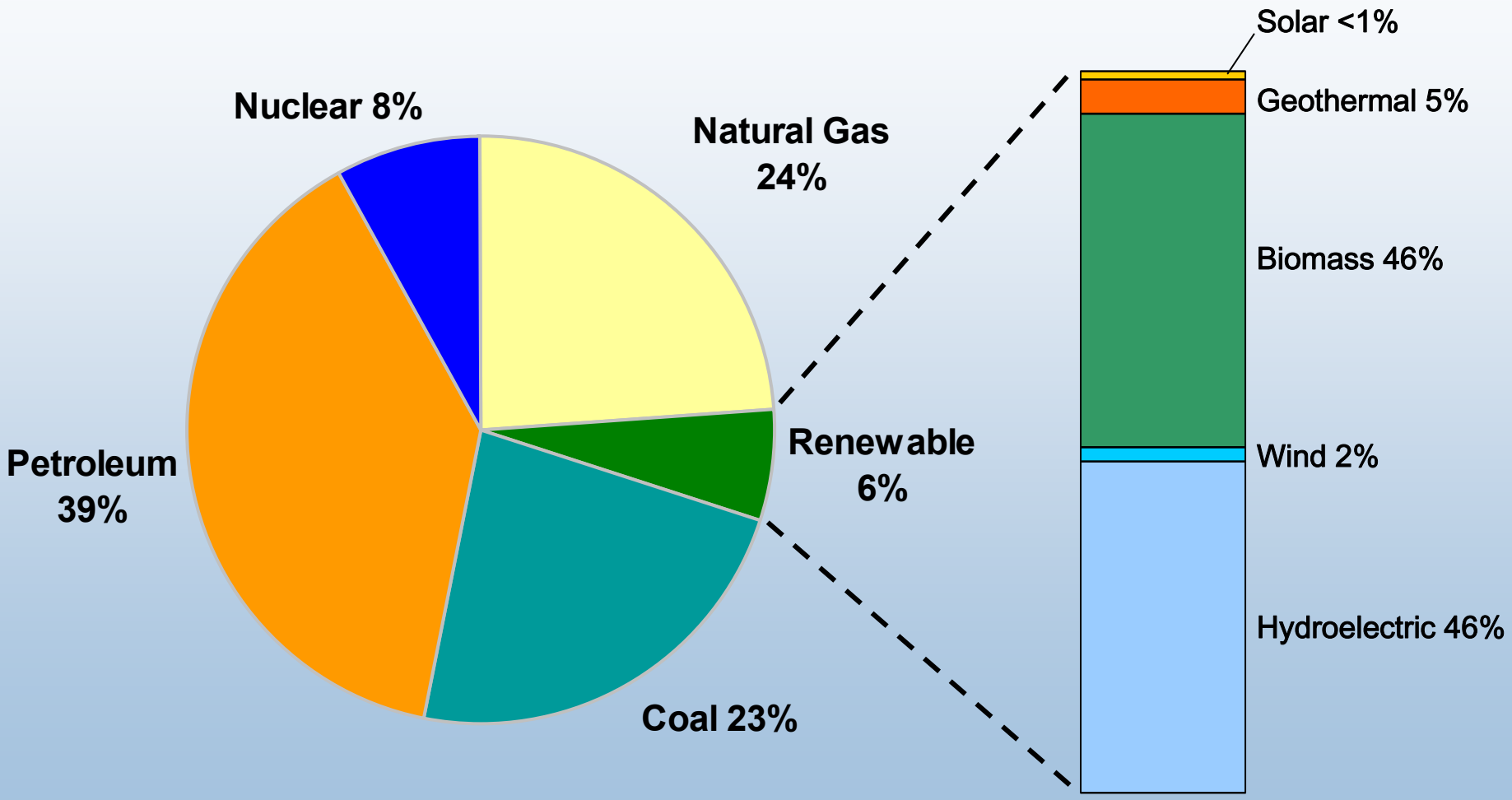


36% increase

2025

Source: Energy Information Administration, *International Energy Outlook 2005*

The Role of Renewables in the U.S. Energy Supply - 2003



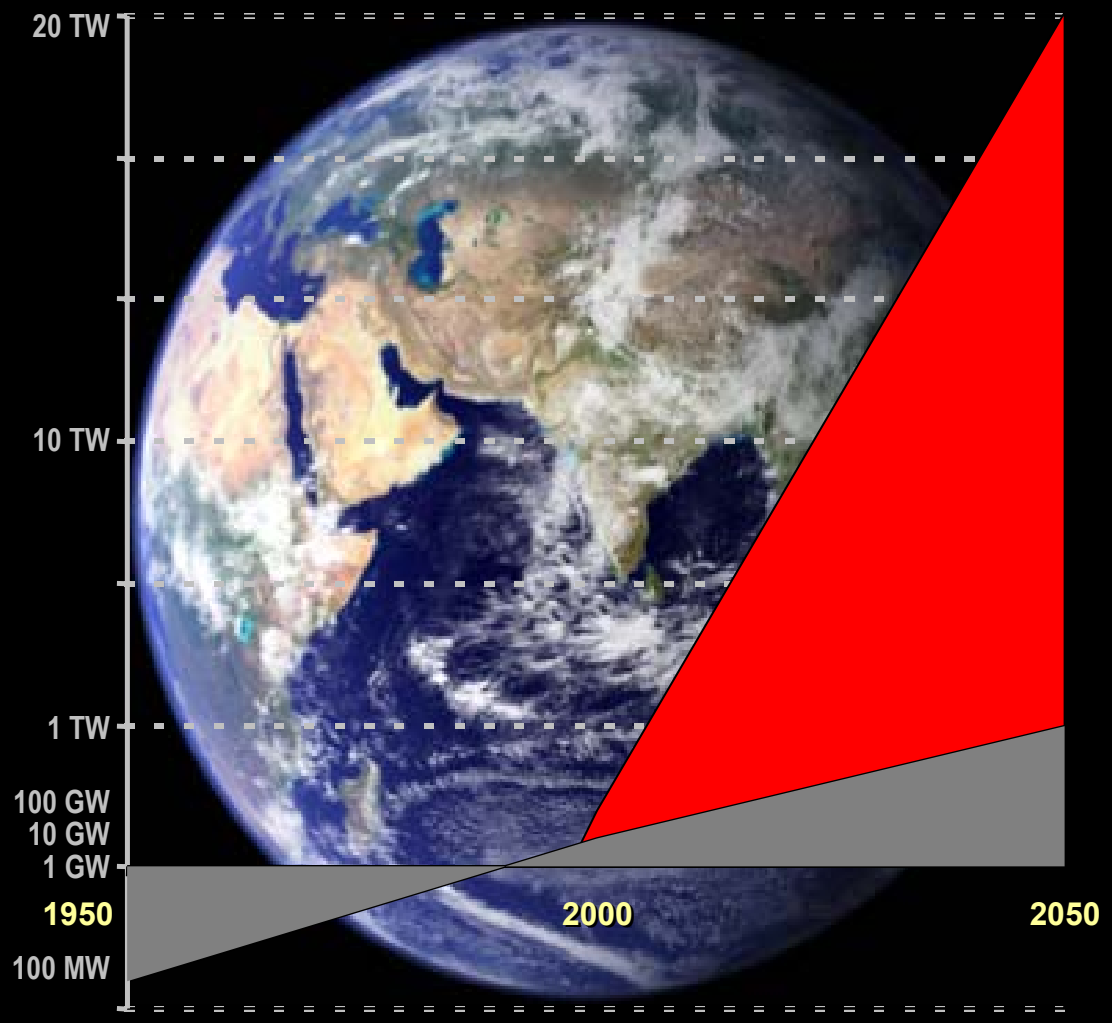
Source: AEO 2004 tables (released in December 2003) based on US energy consumption. Overall breakdown Table A1 (Total Energy Supply and Disposition), and Renewable breakdown Table A18 (Renewable Energy, Consumption by Section and Source).

Technology-based Solutions:

There is no single nor simple answer

- Energy efficiency
- Renewable energy
- Non-polluting transportation fuels
- Separation and capture of CO_2 from fossil fuels
- Next generation of nuclear fission and fusion technology
- Transition to smart, resilient, distributed energy systems coupled with pollution-free energy carriers, e.g. hydrogen and electricity

Magnitude of Challenge Requires Global Action and a Change in Trajectory



Advanced technologies must help fill this gap

Today's optimistic forecast for renewable energy

A Systems Perspective is Needed
Long-Term View of the Future

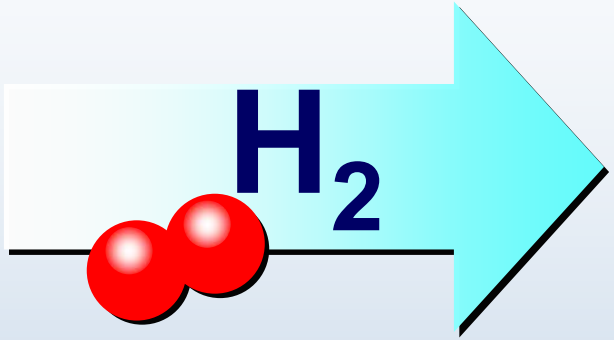
Clean, Diverse & Secure

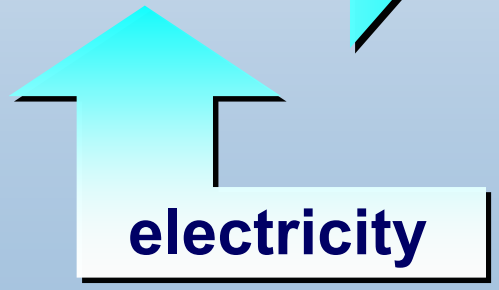
Near-Zero Emission Hydrocarbons

Advanced Nuclear

Renewable Energy

Intelligent, Resilient, Flexible & High Capacity





Efficient & Integrated

Fuel Cell Vehicle

Near-Zero Energy Buildings

Industry

Distributed Resources

Technology advances are required

Energy Efficiency & Renewable Energy Technology Development Programs

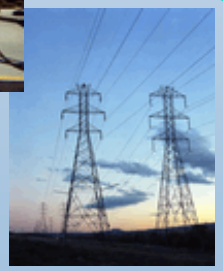
NREL R&D Portfolio

Renewable Resources

- Wind
- Solar
- Biomass
- Geothermal

Efficient Energy Use

- Vehicle Technologies
- Building Technologies
- Lab/Industrial Technologies



Energy Delivery & Storage

- Electricity Transmission & Distribution
- Alternative Fuels
- Hydrogen Delivery and Storage

Foundational Science

Technologies

- High technology
- Mass production

Policies

- Incentives & mandates

Markets

- Conventional energy prices
- Green markets

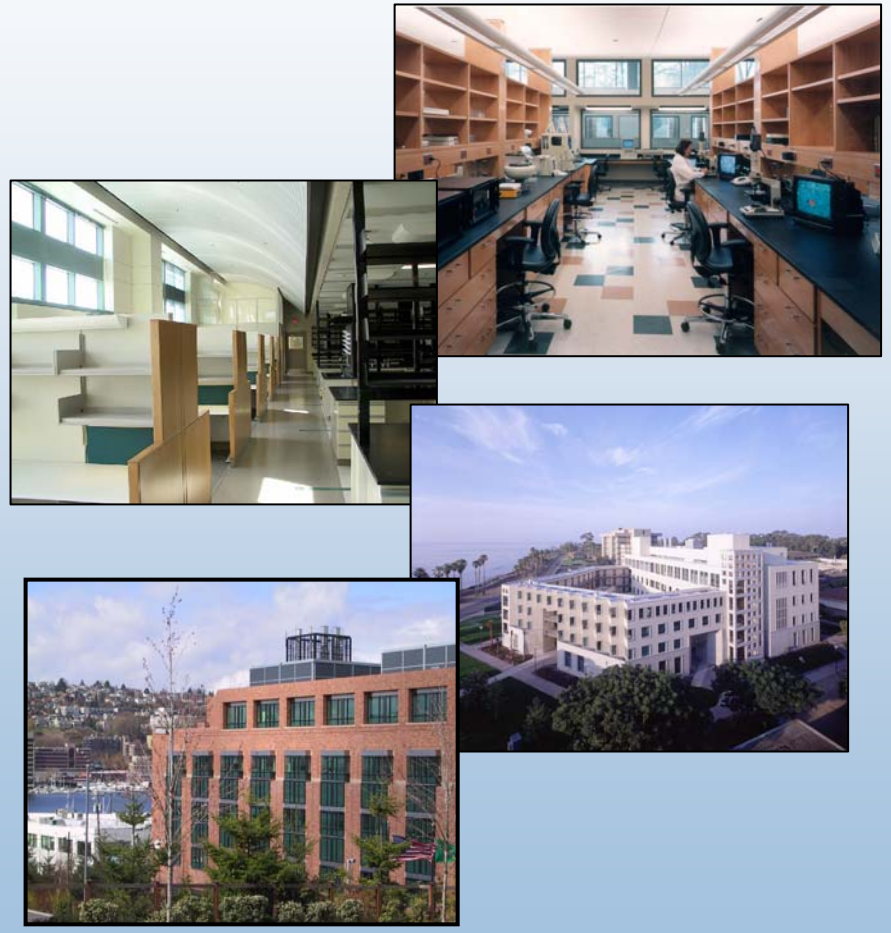
Centers of Innovation and Creativity:
A Magnet for Global Talent

…"What will the effects of such an altered talent landscape mean to the U.S. economy? While it is impossible to fully quantify the effects of lost brainpower, other evidence suggests the U.S. may be seriously losing out—in real dollars and cents–on the talents of a wide range of foreign scientists, engineers, inventors, and other professionals…"

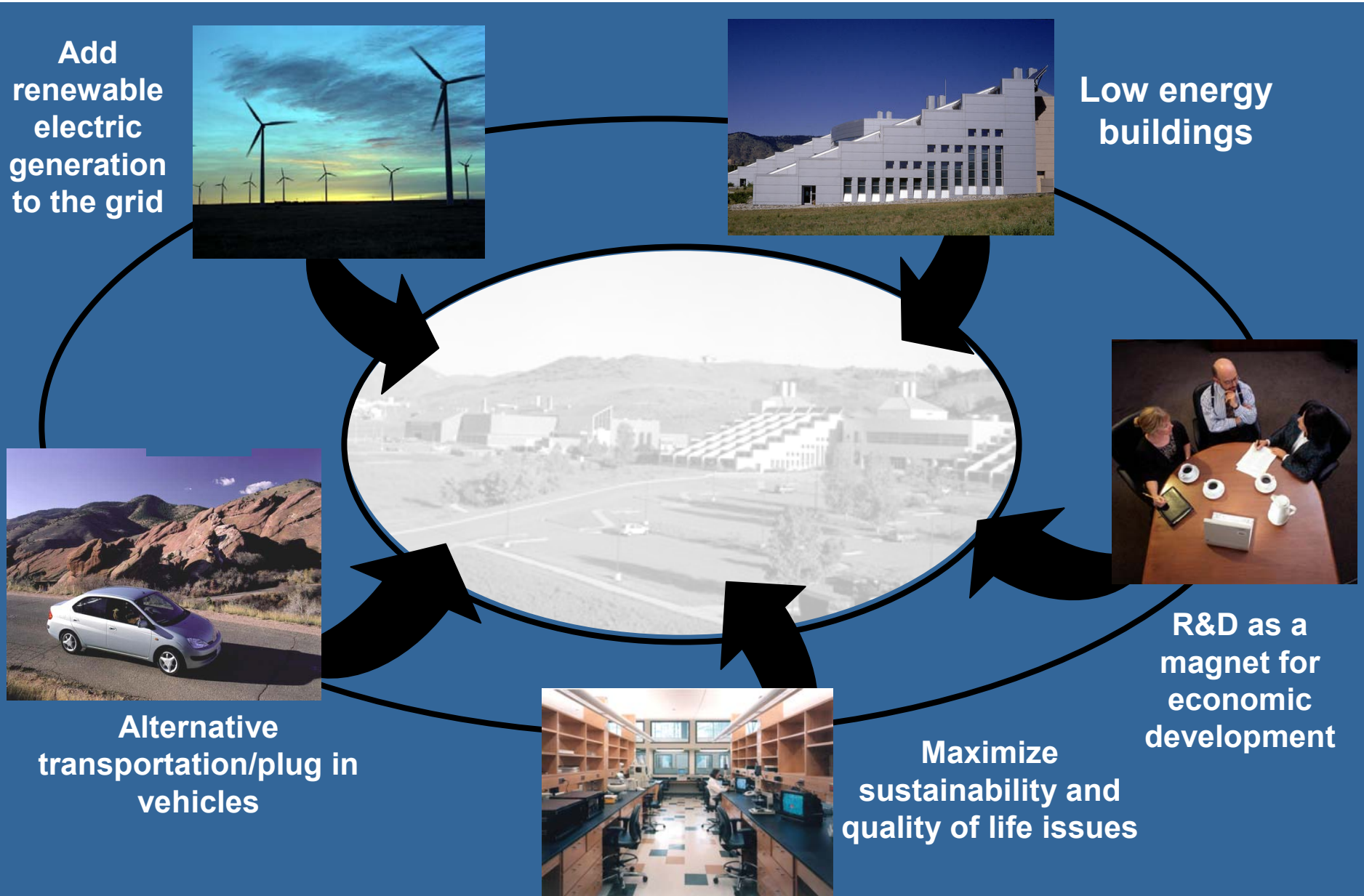
Adapted from Richard Florida's, "Flight of the Creative Class"

Laboratories as Assets for Innovation

- “Economic engine” in communities
- Large loads on local utility grids
- Highly visible
- Competing for world-class scientists

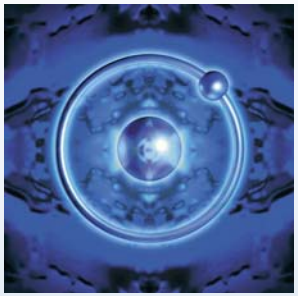


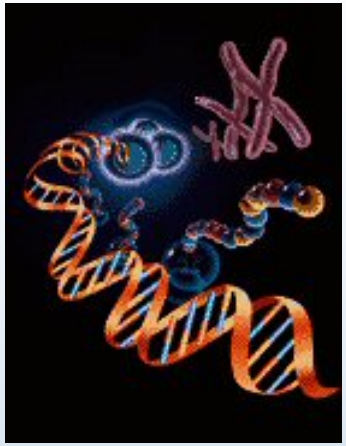
Research Campus of the Future:
A Systems Approach

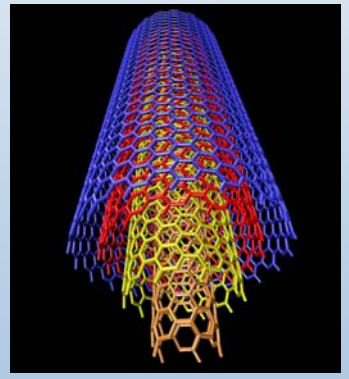


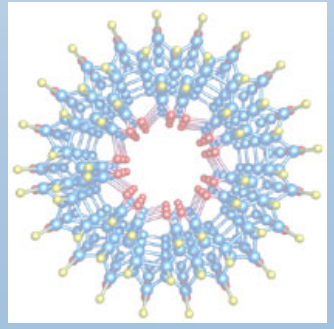
Directions in Energy Science and Technology: The Future Promise

- Supercomputers
- Genomics
- Nanoscience
- Fusion applications
- Cellulosic and biofuels applications
- Hydrogen









"Nano/Bio/Info"

The time is now to…….

Develop new, high performing, low energy laboratories

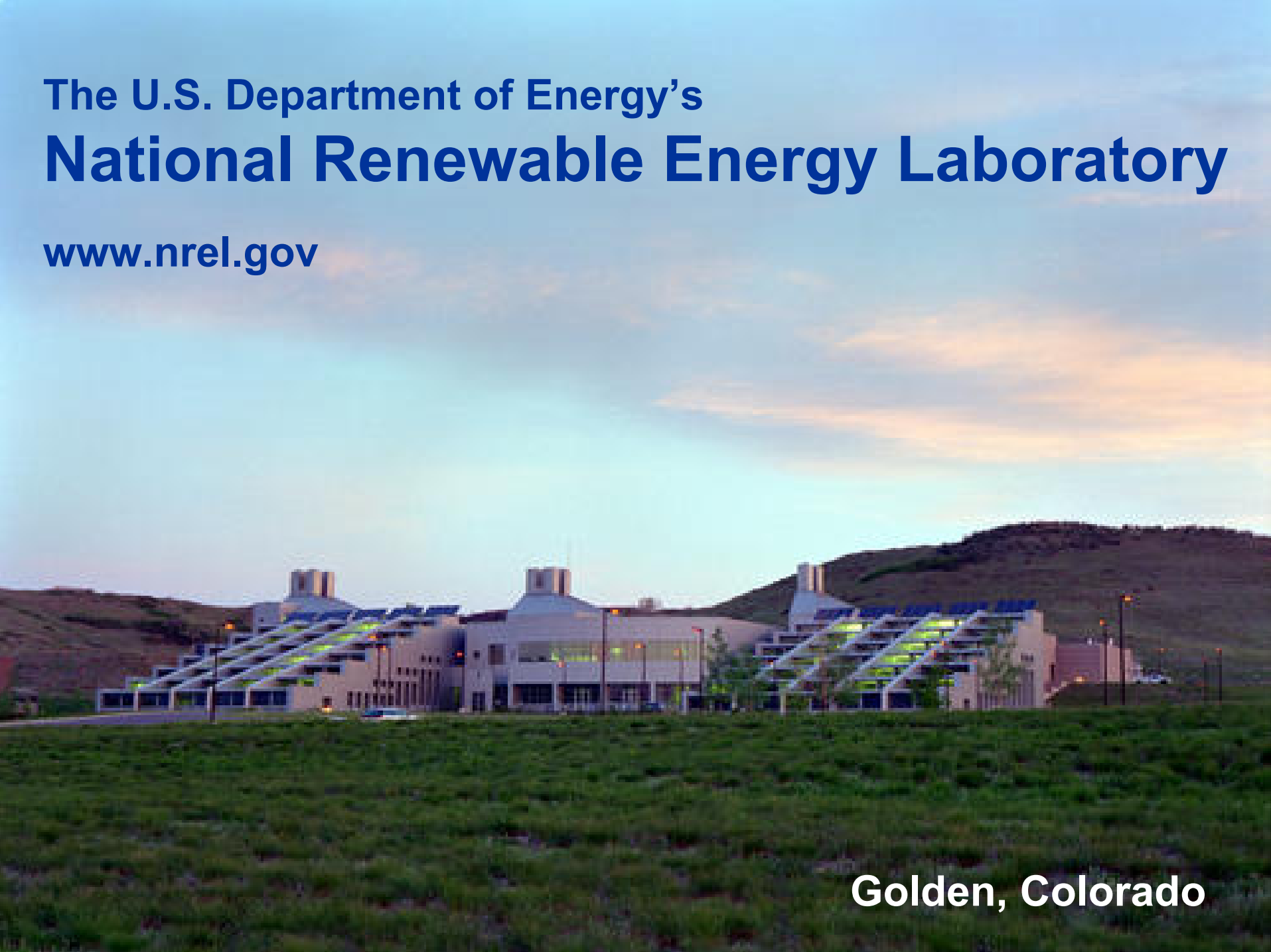
Create buildings that can be a part of how the nation thinks differently about its energy solutions

Design, build and retrofit lab buildings that contribute to a more diverse and secure national energy supply

The U.S. Department of Energy's

National Renewable Energy Laboratory

www.nrel.gov



Golden, Colorado