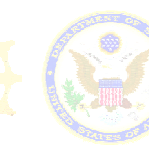
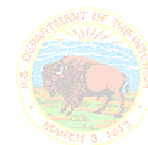
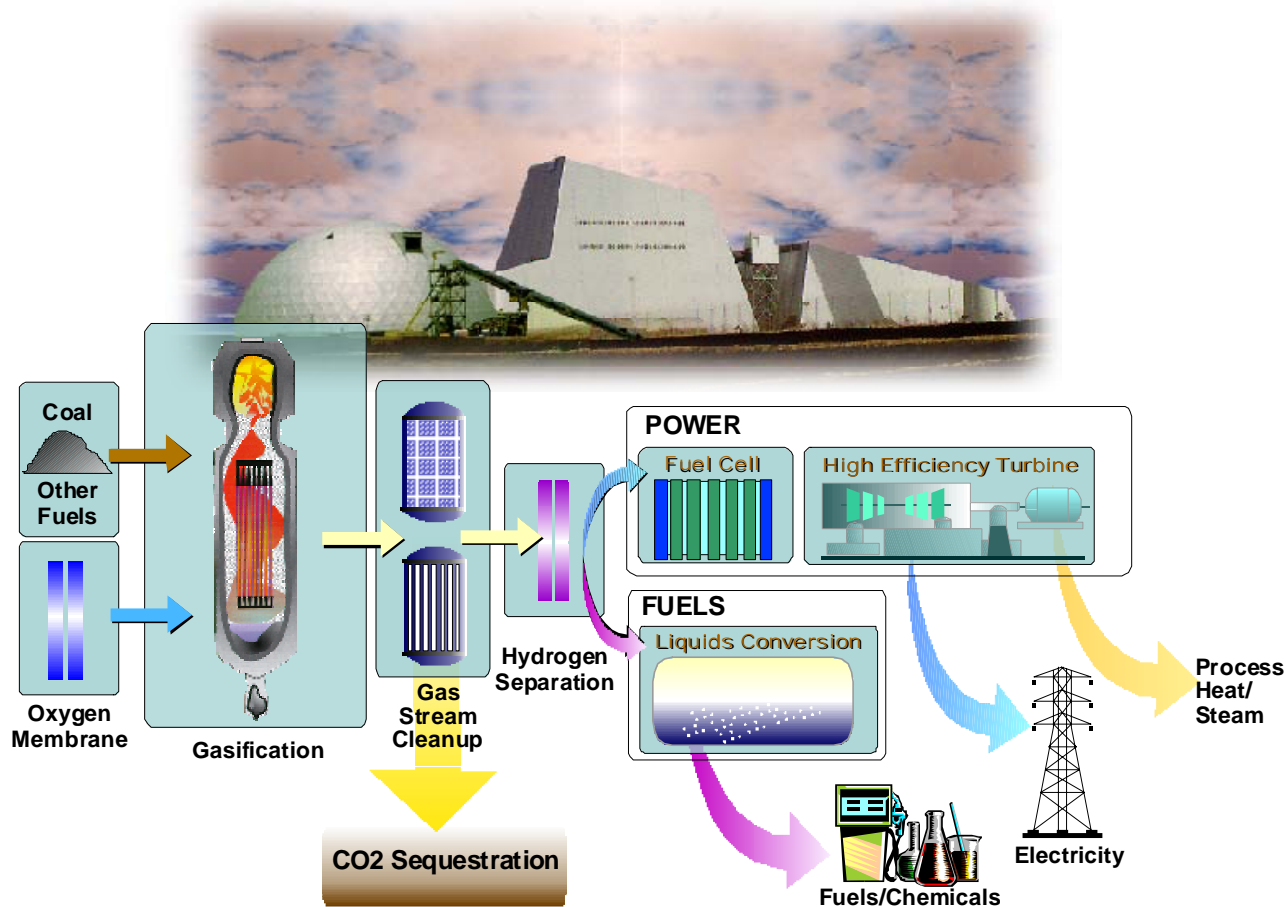


Climate Friendly Technologies



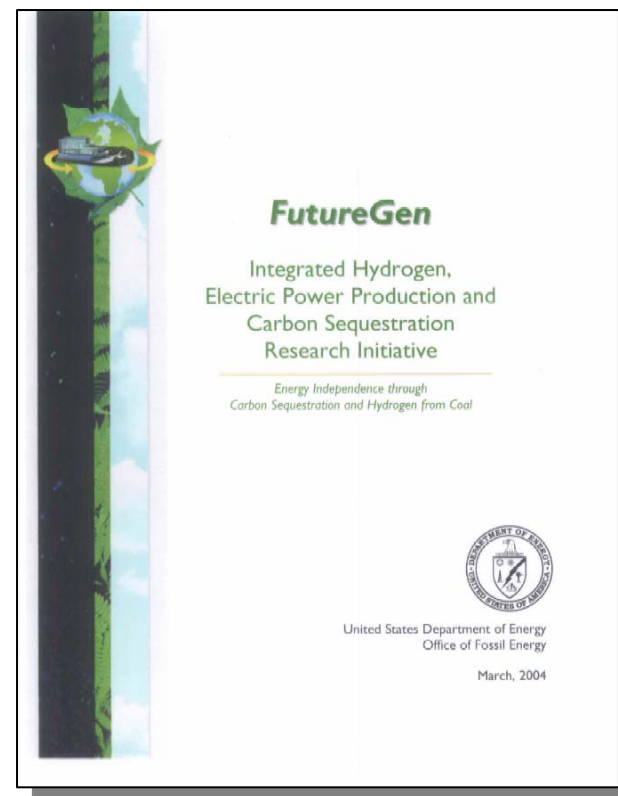
FutureGen

- Multiple products
 - Electricity
 - Fuels/Chemicals
 - H2 for transportation
 - Process Heat
- Multiple benefits
 - Higher efficiency
 - Near Zero Emissions
 - Enhanced Energy Security

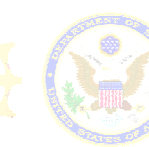
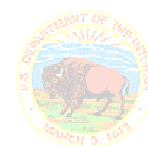


FutureGen Report to Congress

- **FutureGen:**
 - **\$1Billion Cost-shared, Coal-Based, Zero-Emission Electricity and Hydrogen Production Power Plant, 275 MW Nominal Capacity**
- **Objectives:**
 - **Establish Technical Feasibility and Economic Viability of Producing Electricity & Hydrogen from Coal with Near-Zero Emissions**
 - **Verify Sustained Operation with Carbon Sequestration**
 - **Verify Effectiveness, Safety and Performance of Carbon Sequestration**
 - **Establish Standardized Technologies for MMV**
 - **Gain Acceptance by Stakeholders for the Concept**



http://www.fossil.energy.gov/programs/powersystems/futuregen/futuregen_report_march_04.pdf 3



Clean Coal Awards

- **10-year, \$2 Billion Clean Coal Power Initiative.**
 - **Pegasus Project: Advanced Multi-pollutant Controls**
 - \$6.1 Million From DOE to Support the Proposed \$12.2 Million Project.
 - **Mesaba Project: Next Generation of IGCC Power Plants**
 - Construct and Operate the 531-MW Mesaba Energy Project
 - \$36 Million in DOE Funds for Support of a \$1.18 Billion Project
 - **Florida Clean Coal Plant: Air-blown IGCC Power Plant**
 - Construct a 285-MW Coal-based
 - DOE Will Contribute \$235 Million to the \$557 Million Demonstration Project
 - **Peabody Mustang Clean Coal Project**
 - Demonstration of the Advanced Scrubber and Fertilizer Production Systems
 - DOE Will Provide \$19.7 Million for the \$79 Million Project
- **FY 2005 Budget Request includes \$328 Million for Clean Coal Research including FutureGen**



Sequestration

Capture and Storage of CO₂

Advanced



Conversion to minerals, bioconversion, etc.

Geologic



Injection into oil reservoirs, unusable aquifers, coal seams

Ocean



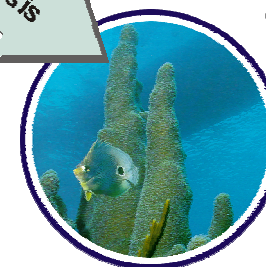
Deepwater injection

Enhancing Natural CO₂ Sinks

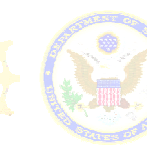
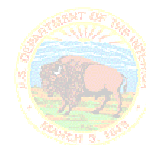
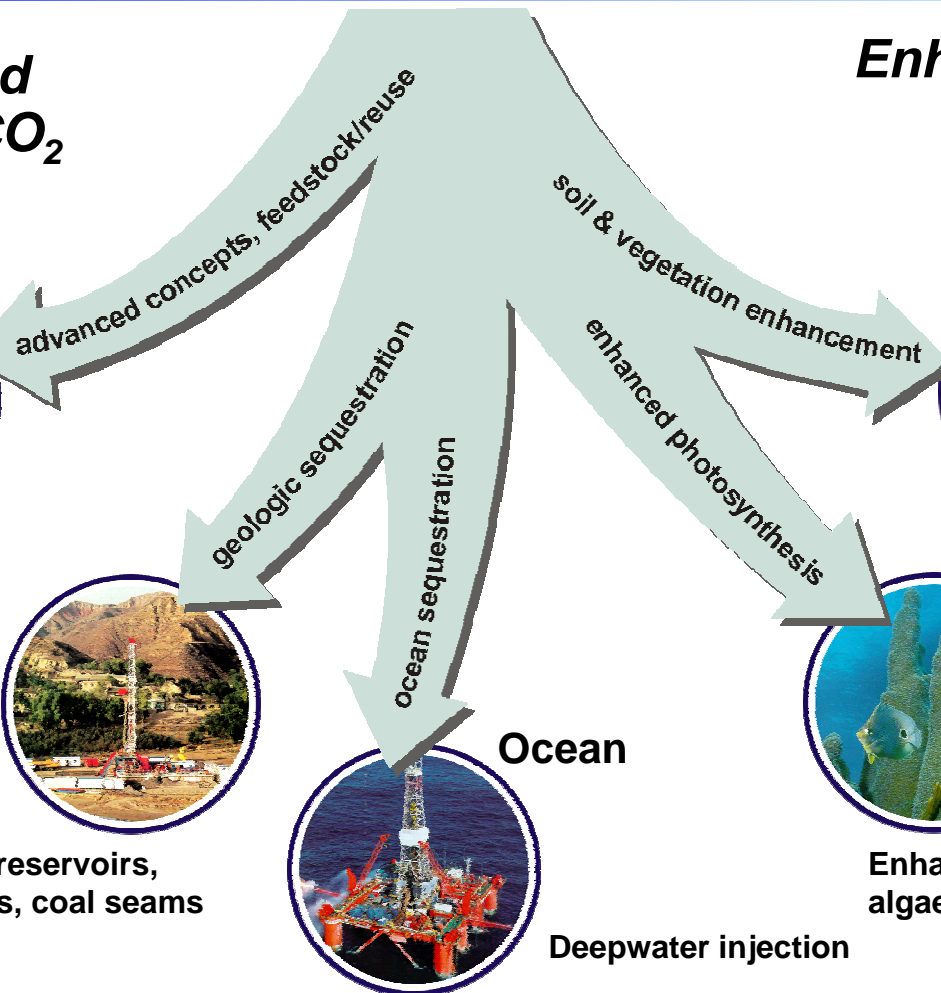
Improved nutrients, better agricultural practices



Terrestrial

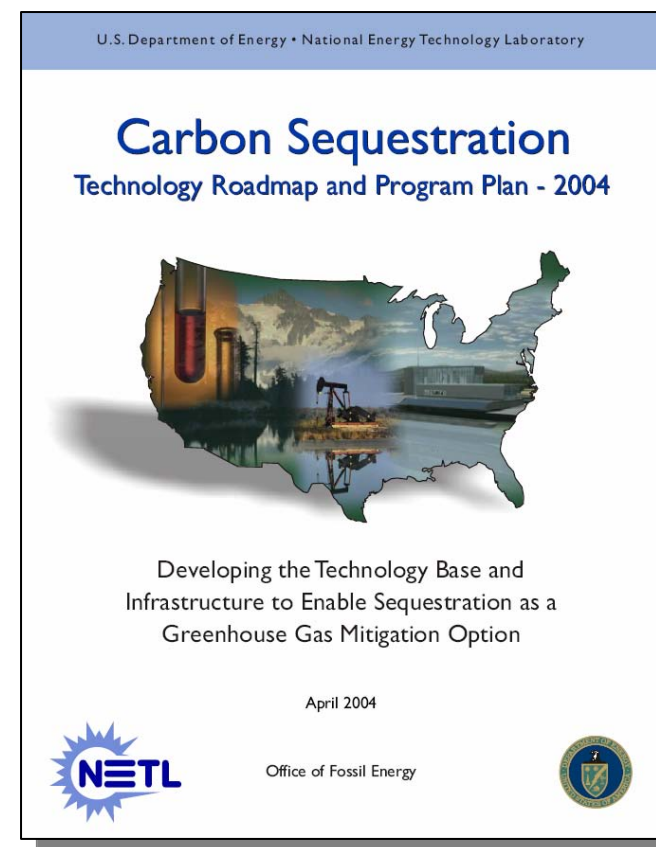


Enhanced photosynthesis in algae ponds, greenhouses



Carbon Sequestration Roadmap

- **Sequestration Program Encompasses All Areas of Carbon Sequestration**
 - CO₂ Capture
 - Sequestration/ Storage
 - Monitoring, Mitigation, & Verification
 - Breakthrough Concepts
 - Non-CO₂ GHGs
 - Infrastructure Development
- **Carbon Sequestration Planned to Play a Major Role in Future GHG Emissions Reduction Needs**

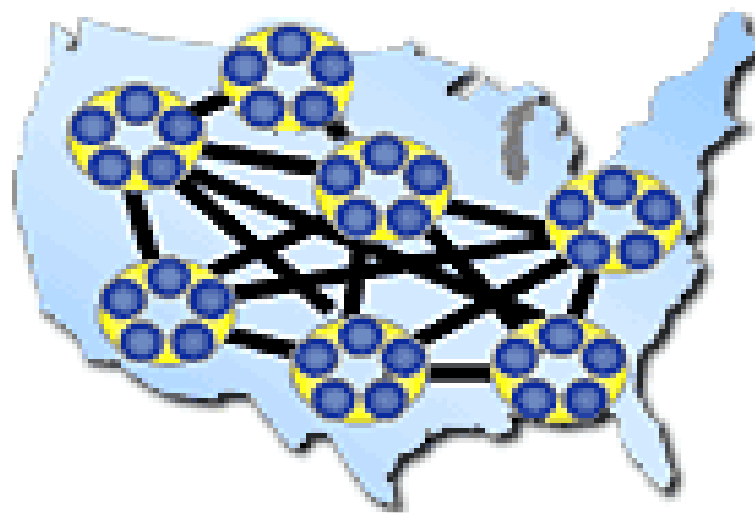


<http://www.fe.doe.gov/programs/sequestration/publications/programplans/2004/SequestrationRoadmap4-29-04.pdf>



Regional Carbon Sequestration Partnerships and the CSLF

- 7 Regional Partnerships
- Validating and Demonstrating Sequestration Technologies
- Studying Sequestration Approaches Best Suited for Specific U.S. Regions
- Studying Regulatory and Infrastructure Requirements
- 16 Int'l CSLF Partners + EU Will Share in Results

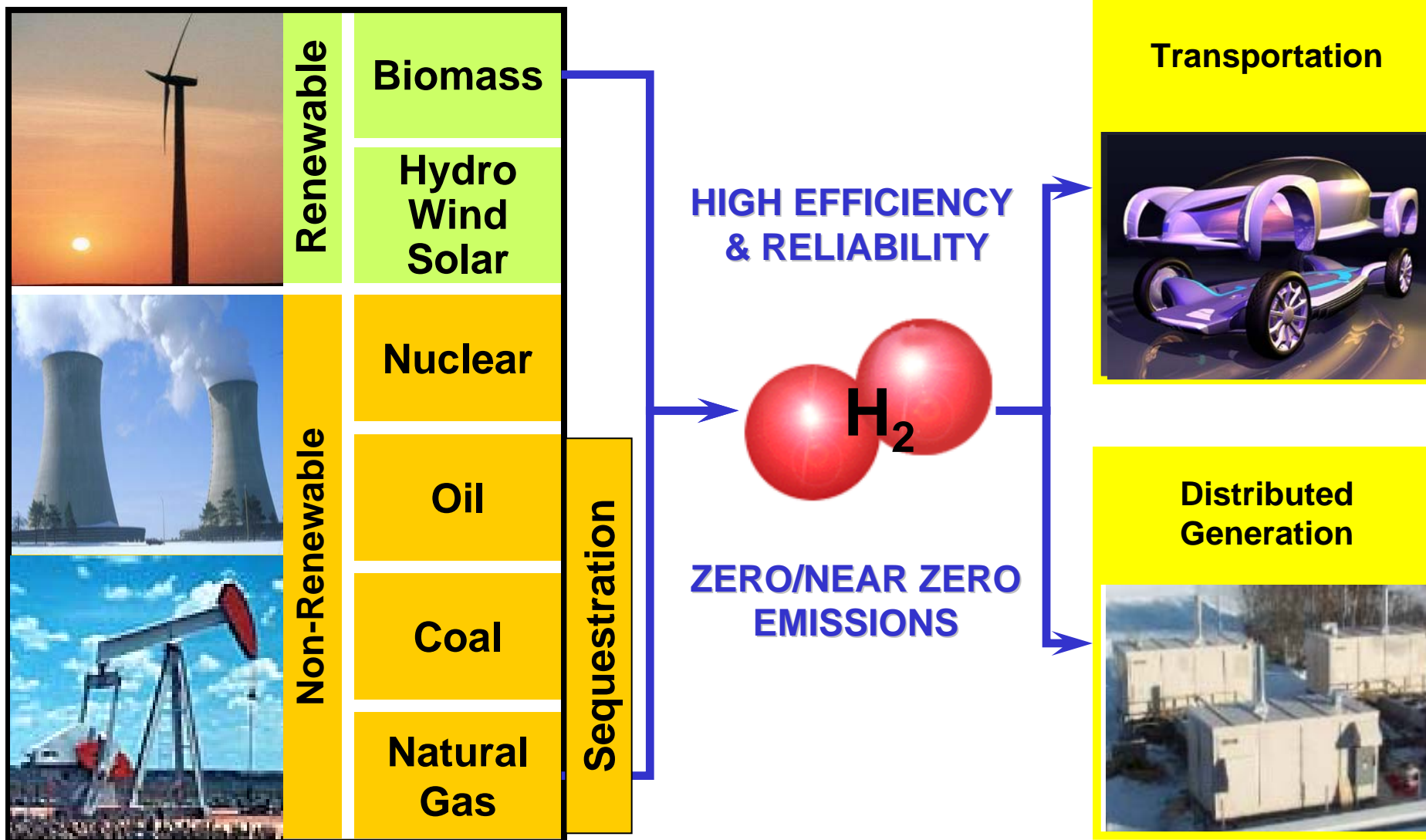


Carbon Sequestration Awards

- **DOE Selects Eight Innovative Projects to Capture and Store Carbon Dioxide from Power Plants**
 - **Projects Have a Total Cost of Nearly \$4.6 Million Over Three Years**
 - **Four Projects Will Focus on Advanced Separation Techniques to Capture Carbon Dioxide and Hydrogen From Fossil-Fueled Power Plants.**
 - **Three Will Focus on Advanced Separation Techniques, and Geochemical Methods for Sequestering Carbon**
 - **One Will Investigate Novel Concepts Involving CO2 Recycling and Products**
- **FY 2005 Budget Request includes \$87 Million for Carbon Capture and Sequestration Research**

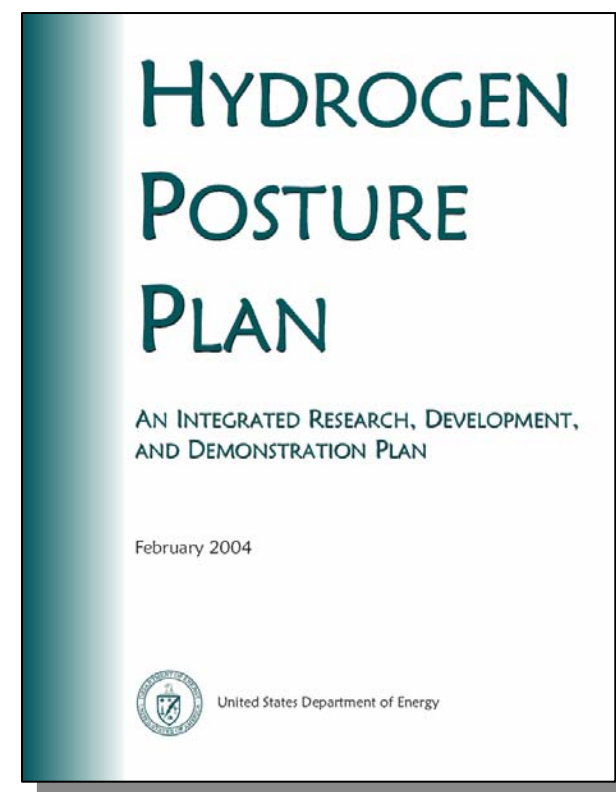


Hydrogen Fuel Initiative



Hydrogen Posture Plan

- **Hydrogen R&D Activities -- Focused Hydrogen Program**
 - **Will Integrate Technology for:**
 - **Hydrogen Production**
 - From Fossil, Nuclear, and Renewable Resources
 - **Infrastructure Development**
 - Including Delivery and Storage
 - **Fuel Cells for Stationary and Transportation Applications**
- **Technical Milestones on the Road to a Hydrogen Economy**



http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/hydrogen_posture_plan.pdf

10



Hydrogen Program Awards

- **Award of \$350 Million in Hydrogen Research Projects**
 - **Nearly One-Third of the President's \$1.2 Billion Commitment to Hydrogen and Fuel Cell Technology Research**
 - **Exploratory Research in Hydrogen Storage: Three "Centers of Excellence" \$ 150 Million**
 - **Vehicle and Infrastructure "Learning Demonstrations": DOE Share Is \$190 Million over 5 Years, Private Cost Share of Approximately \$190 Million.**
 - **Fuel Cell Research Projects: the DOE Share Is \$13 Million Dollars over 3 Years. Private Cost Share of Approximately \$10 Million.**
 - **Hydrogen Technology Education Projects to Broaden Awareness of Hydrogen's Benefits Among the General Public.**
- **FY 2005 Budget Request includes \$344 Million for Hydrogen and Fuel Cell Research including Deployment**



Energy Efficiency – Largest Investment Area

- **DOE RDD&D EE Investments:**
 - \$ 346 M RD&D *
 - \$ 453 M Deployment
- **Other Federal EE Investments:**
 - EPA \$ 110 M
 - NASA \$ 209 M
 - DOT \$ 2 M
 - USAID \$ 154 M
- **Investment Tax Incentives:**
 - \$ 384 M (Mostly Transportation)
- **Total = \$ 1,658 M**
- **Largest Category of CCTP Investments**



Zero Net Emission Buildings

Compact Fluorescent Light Bulbs



Hybrid Vehicles

* \$77.5M Fuel Cell RD&D Not Included – Included in Hydrogen Area



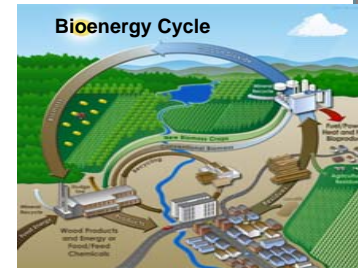
Energy Efficiency Awards

- **DOE and States to Spend \$17 Million on Joint Energy-Efficient Projects**
 - **13 Projects:**
 - **Managed by National Association of State Energy Officials**
 - **Under DOE's Innovative State Technologies Advancement Collaborative (STAC)**
 - **Effort Involves Participants From 31 States**
 - **Example Projects:**
 - **Development of a Strategy for Increasing Efficiency in HVAC Systems in the Northeast;**
 - **Development of a Total Energy Assessment Audit Protocol for the Chemical Industry; And**
 - **Demonstration of Truck Stop Electrification for Reducing Idling From Heavy-duty Vehicles**



Renew. Energy – 2nd Largest Investment Area

- **DOE RDD&D RE Investments:**
 - \$ 250 M RD&D
 - \$ 30 M Deployment
- **Other Federal RE Investments:**
 - USDA \$ 33 M
 - NSF \$ 4 M
- **Investment Tax Incentives:**
 - \$ 365 M (Mostly Wind)
- **Total = \$ 682 M**
- **Next Largest Category of CCTP Investments**



* \$90.8M Hydrogen RD&D Not Included – Included in Hydrogen Area

** \$4.5M Hydrogen Deployment Not Included – Included in Hydrogen Area



Renewable Energy Awards

- **DOE Announces Industry Partnerships to Expand Wind Energy Potential**
 - GE Energy Receives \$1.3 Billion in U.S. Wind Turbine Orders
- **DOE Supports Seven States in Effort to Install 1000 MW of Concentrating Solar Power Systems.**
- **DOE and USDA Award \$25 Million in Joint Biomass Research and Development Initiative to 22 Selected Projects**



Nuclear Energy

The Evolution of Nuclear Power

Generation I



Early Prototype Reactors

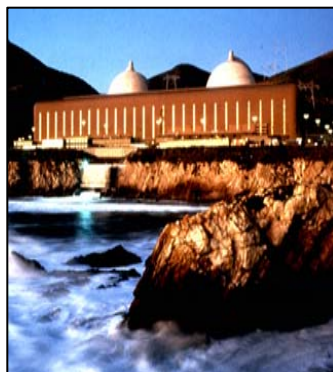


- Shippingport
- Dresden, Fermi
- Magnox

Generation II



Commercial Power Reactors



- LWR-PWR, BWR
- CANDU
- VVER/RBMK
- AGR

Generation III



Advanced LWRs



- ABWR
- System 80+
- AP600
- EPR

Generation III+



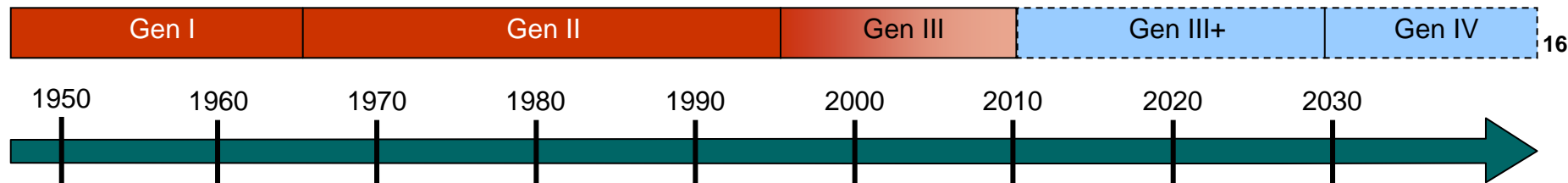
Generation III Evolutionary Designs Offering Improved Economics

Generation IV



- Highly Economical
- Enhanced Safety
- Minimize Wastes
- Proliferation Resistant

<http://gen-iv.ne.doe.gov/>



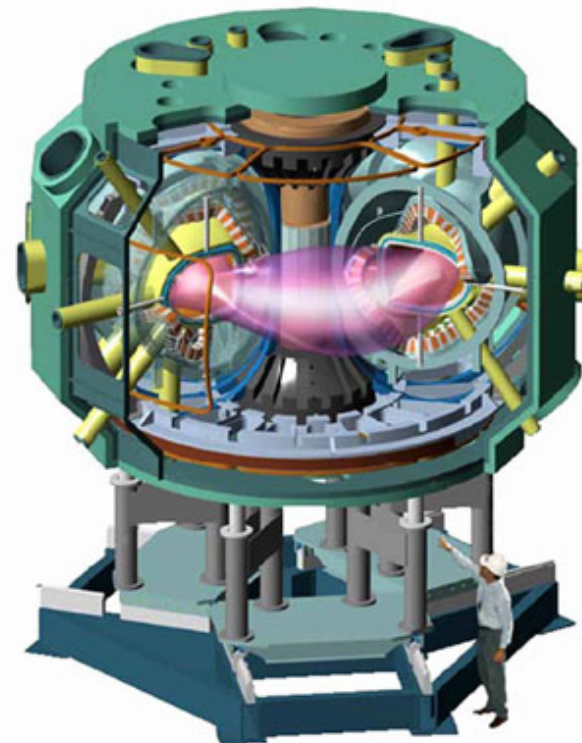
Nuclear Power Awards

- **Awards to Two Nuclear Utility-led Consortia Under the Nuclear Power 2010 Program**
 - DOE will begin the first phase of Nuclear Plant Licensing Demonstration projects with industry teams led by
 - Dominion (Virginia) - Advanced CANDU Reactor (ACR-700)
 - NuStart Energy (Pennsylvania) - Westinghouse Advanced Passive Pressurized Water Reactor (AP-1000)
 - Demonstrate the Nuclear Regulatory Commission (NRC) Process for Licensing the Construction and Operation of New Generation III+ Nuclear Power Plants
- **FY 2005 Budget Request includes \$313 Million for Nuclear Fission Energy Research including Deployment**

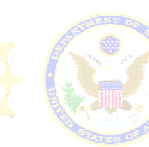
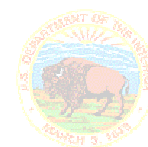


Fusion Energy

- **ITER**
 - **Negotiations On-Going Over Site**
 - Rokkasho or Cadareche
 - **US Rejoined ITER in January 2003**
 - ITER FY05 Request \$38M
 - **Goals**
 - 500 MW for 500-2,500 Seconds
 - Commercialization by 2050
- **Fusion Science**
 - **Demonstrate Burning Plasmas**
 - **Understand Plasma Behavior**
 - **Determine Approaches and Configurations**
 - **Develop New Materials**



Stellarator,
Princeton Plasma Physics Laboratory
<http://www.pppl.gov/>



Fusion Energy Awards

- **DOE Funds Fusion Science Centers at University of Maryland/UCLA, and at University of Rochester**
 - **Universities Will Establish Academic Centers of Excellence That Will Focus on Fundamental Issues in Fusion Plasma Science, Including:**
 - **Research in Areas of Such Wide Scope and Complexity Not Feasible for Individual or Small Groups of Researchers.**
 - **Strengthen the Connection Between the Fusion Research Community and the Broader Scientific Community.**
 - **Education and Training.**
 - **Total DOE Funding for the Two Centers over Their Five-year Duration Is Expected to be Nearly \$12 Million.**
- **DOE Also Funds Princeton, MIT, and Gen. Atomics**
- **FY 2005 Budget Request includes \$264 Million for Fusion Energy Research, including \$38 M for ITER**



UNFCCC Signatories Have A Unique S&T Opportunity ...

- Engage in Cooperative S&T Action, Guided by a Long-View
- The 20th Century Evidenced An Outstanding Historical Record of Technological Achievement, Often on a Grand Scale:
 - From Agricultural Production to the Industrial Revolution
 - From Exploration of Space to the Curing of Diseases
- Key Challenges for the 21st Century -- Water, Food, Health, Economic Development, *including* Climate Change -- Will Find Energy and Related S&T as Powerful & Enabling Means for Goal Achievement
- Sustained Leadership in S&T Can Enable the World To:
 - Bring on the Technologies Required to Meet These Challenges
 - Do So Within Reasonable Means, and at Lower Costs
 - Sustain Economic Growth and Human Development, and
 - Move Toward Near Net-Zero Emissions in the 21st Century
- U.S. is Investing Seriously, With a Deliberate Strategy, But Needs Help

