“U.S. Outlook and International Programs for Nuclear Power”

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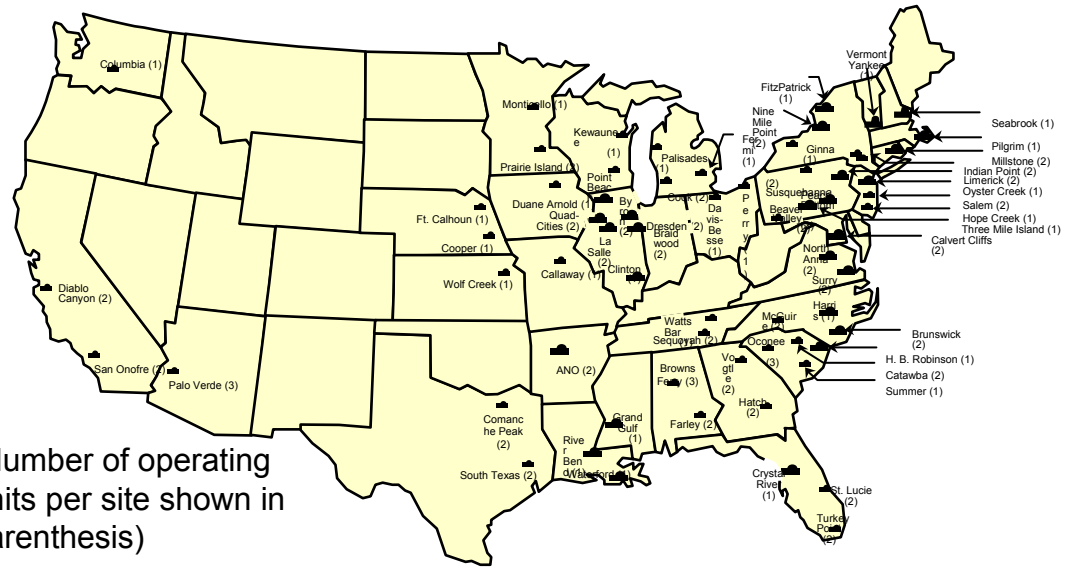
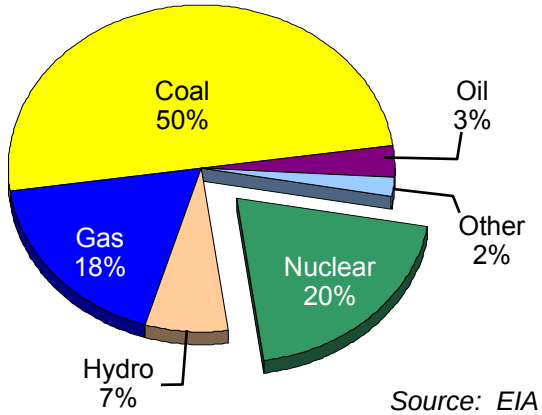
U.S. Department of Energy

Starting Point - U.S. Nuclear Plants Today



(Number of operating units per site shown in parenthesis)

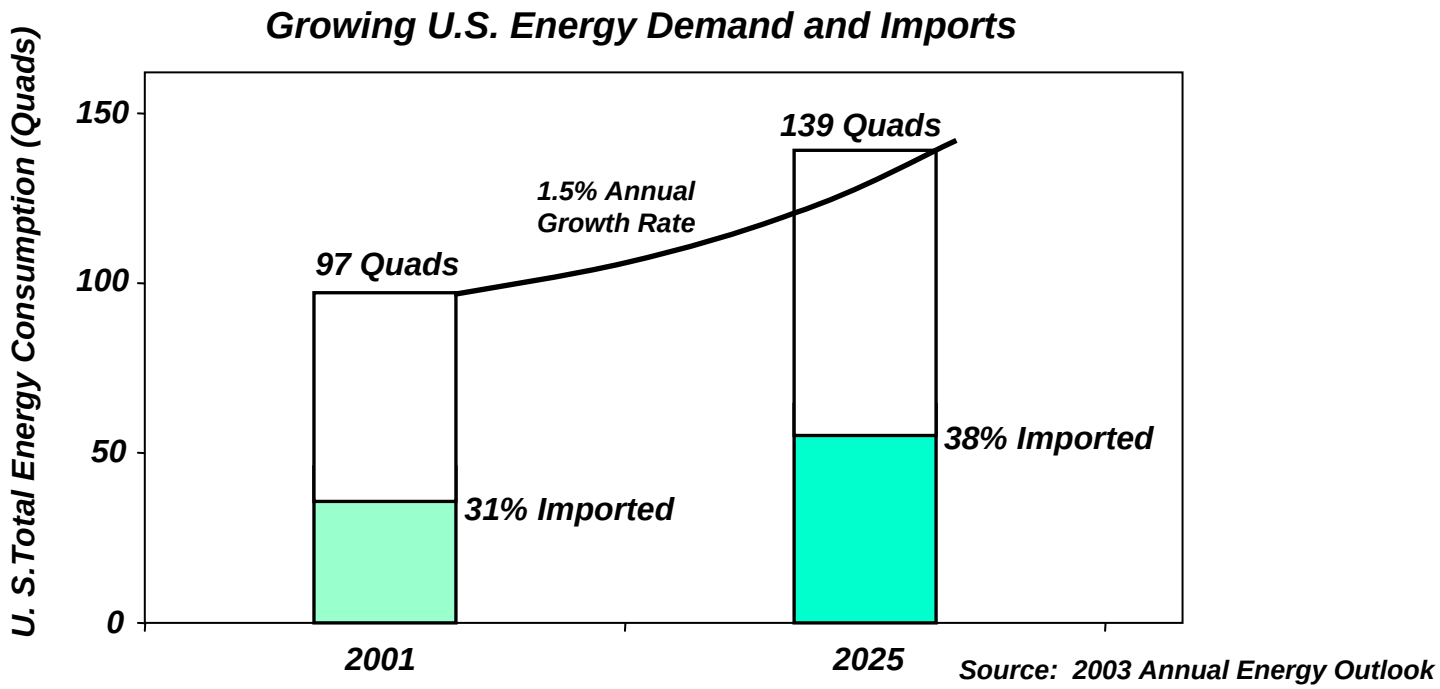


Source: EIA

Electricity Generation

- 103 commercial nuclear plants (97 GWe) produce electricity in U.S.
  (World's largest supplier of commercial nuclear power)
  - Located at 64 sites in 31 states; on average, each plant 19 years old
  - Licensed to operate for 40 years with option to renew for additional 20 years
  - 16 per cent increase in nuclear generation since 1995
  - If no new nuclear generation, share falls to 14% by 2025, towards zero by mid-century

Forecast Growth in U.S. Demand
43 Percent Increase By 2025



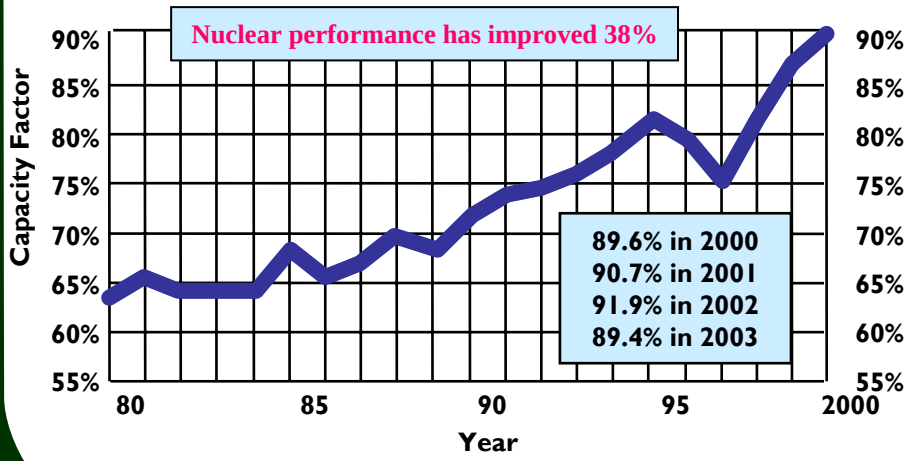
- Annual outlook is 1.5 percent growth in U.S. energy to 2025
- Most growth is in natural gas and coal
- Imports will increase by 75 percent by 2025

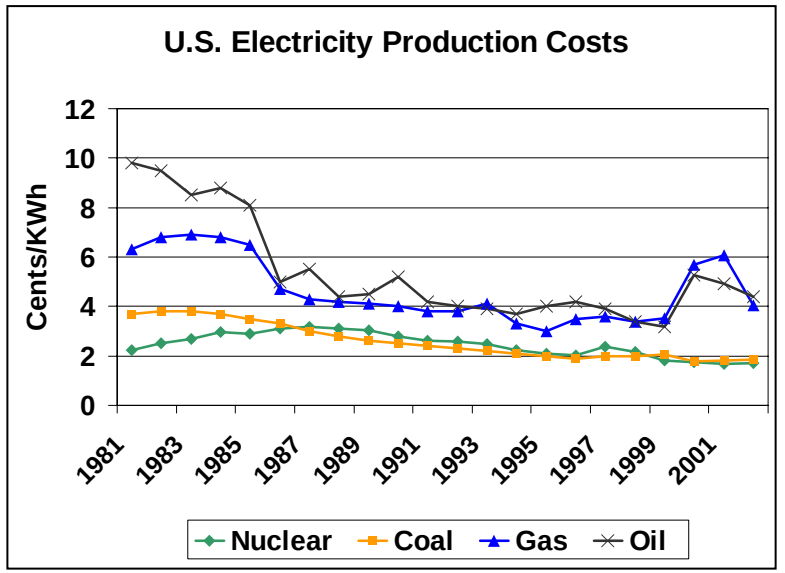
Nuclear Energy is Working for Our Economy Today

Plant safety, performance, and economics have steadily improved over the past 20 years

- Excellent plant management and operational experience
- Well-developed safety culture and effective regulation
- Low production costs compared to fossil fuels
- Provides greatest share of clean energy sources (over 70%) and avoids 175 MMTC each year

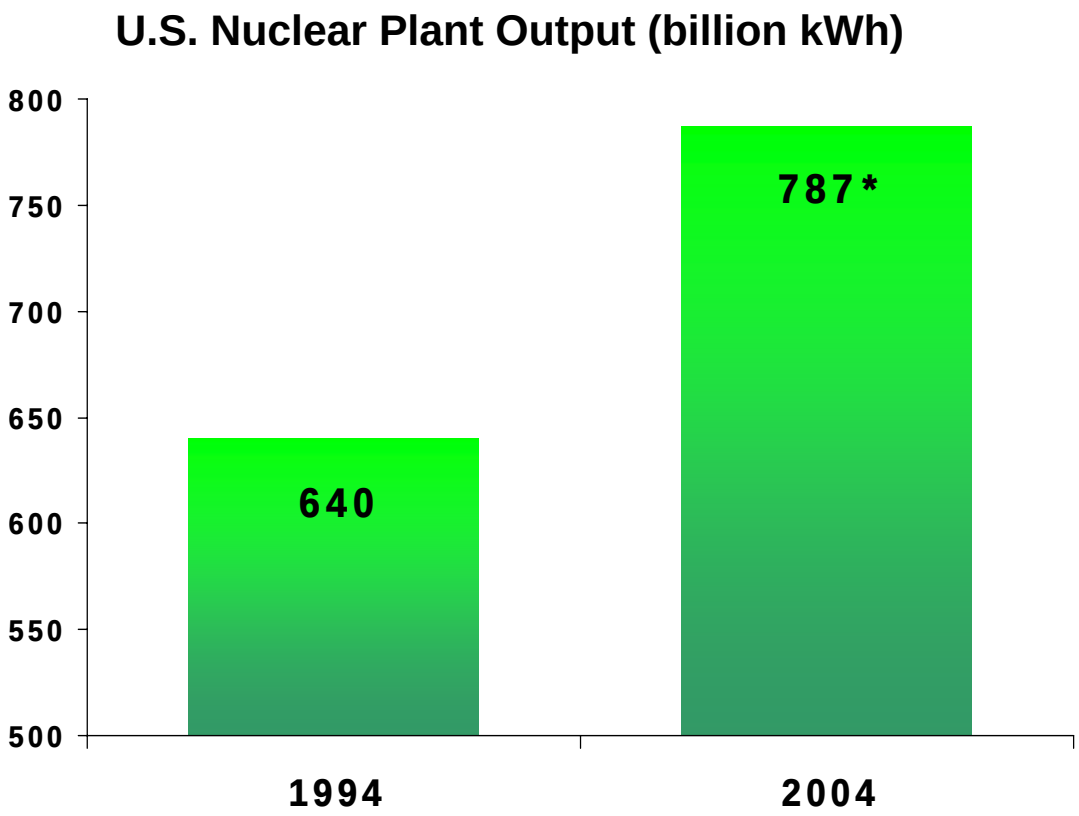
Nuclear Capacity Factor's Have Improved Dramatically





Source: Utility Data Institute

Performance Highlights
Significant Increase in Output During the 1990s



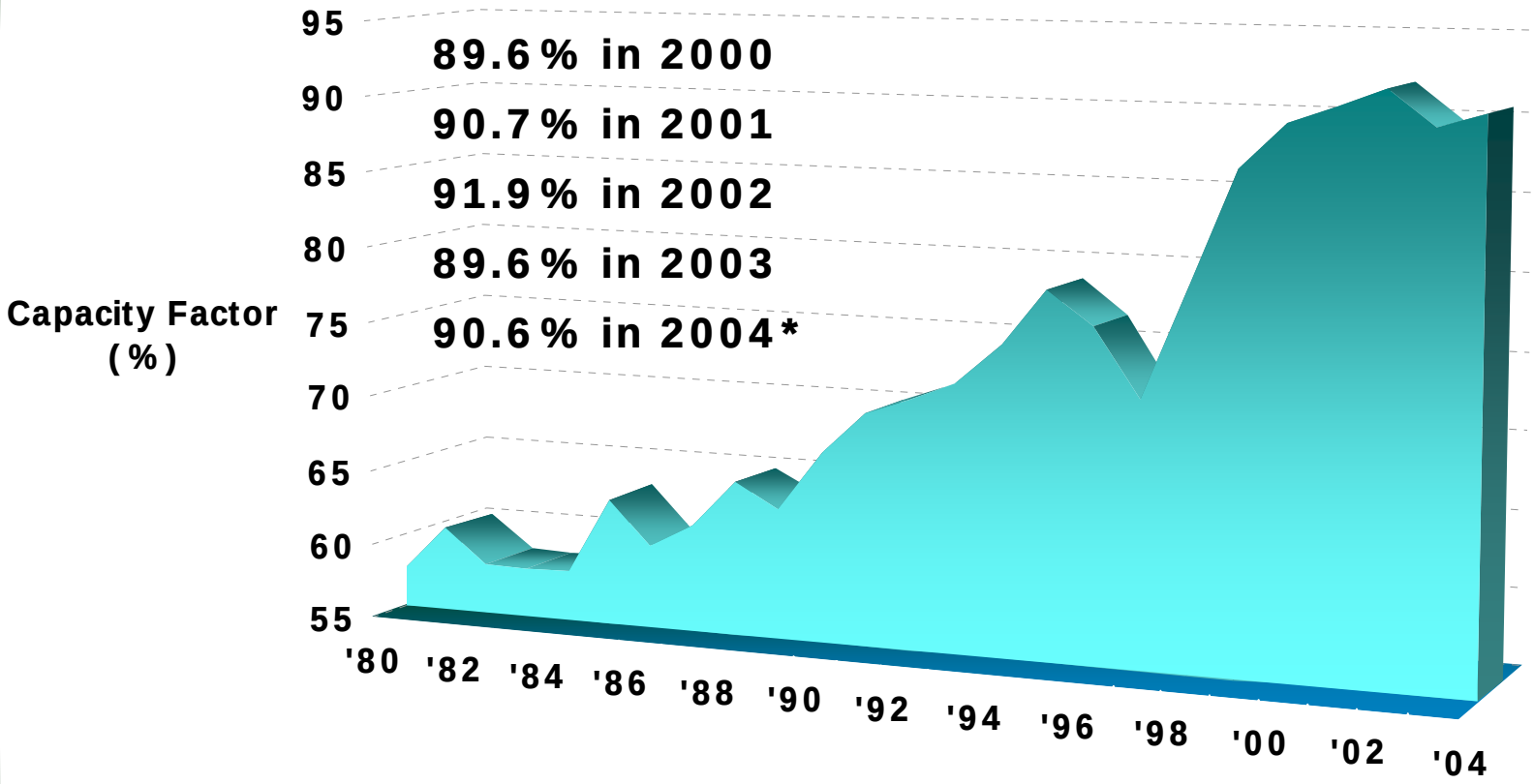
Increase in nuclear plant output 1994-2004:

- equivalent to output from 18 1,000-MW plants operating at 90%
- satisfied 20% of growth in U.S. electricity demand

** NEI estimate for 2004*

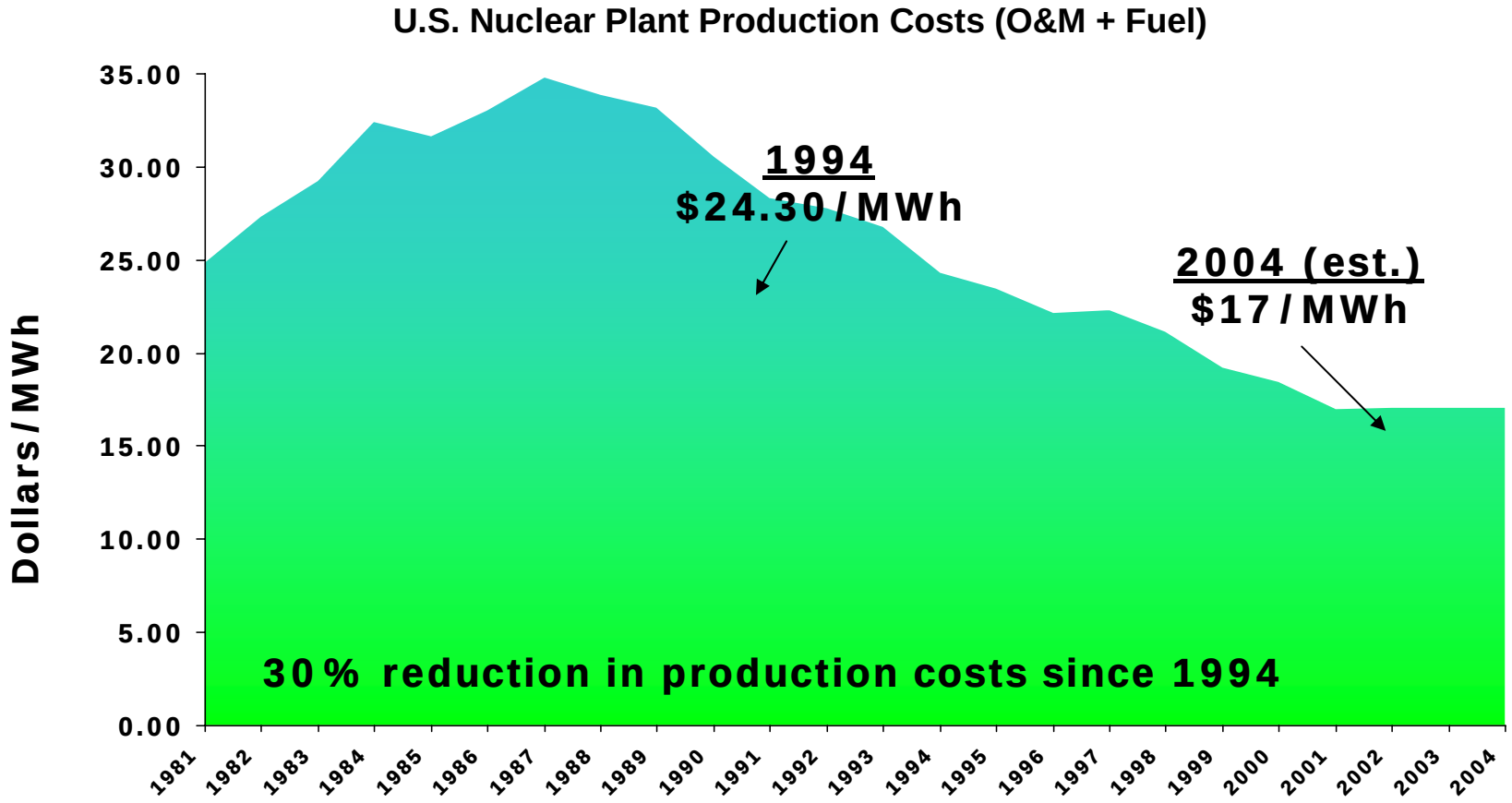
Source: Energy Information Administration

Performance Highlights
High Level of Industry Performance Continues



** Nuclear Energy Institute estimate*

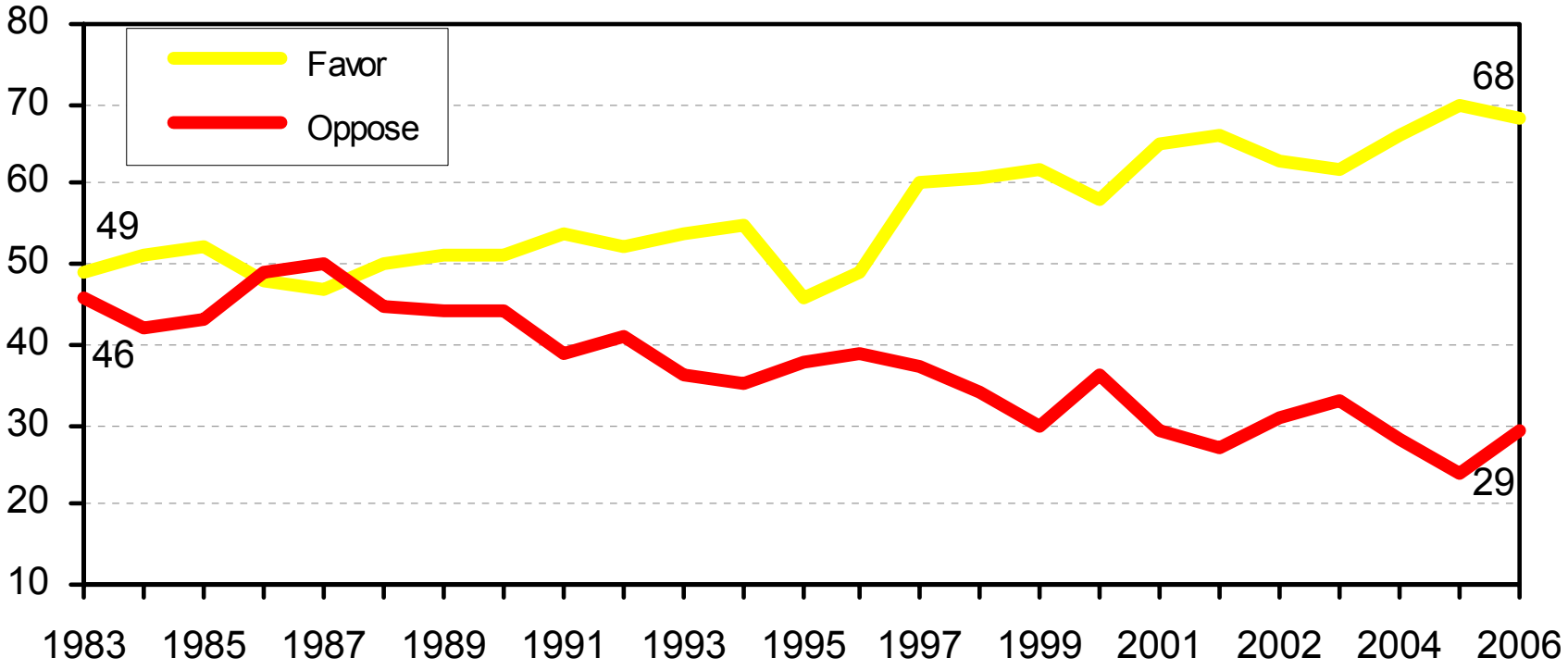
Performance Highlights
Steady Improvement In Economic Performance



Source: RDI

68 Percent Favor Use of Nuclear Energy

(Trend 1983-2006, Annual Averages)



Staying Ahead of the Issues
Groundswell of Support For New Nuclear Power Plants

- Broad-based political support from Bush administration, U.S. Congress
- Emerging consensus on nuclear energy's unique benefits and role in energy diversity/security
- Growing support from other industries

Staying Ahead of the Issues
What's Fueling the Interest In New Nuclear Power Plants?

- Emerging need for new baseload capacity
- Chronic volatility in natural gas prices, unsustainable pressure on gas supply from electric sector
- Environmental constraints on fossil-fueled generating capacity
- Fuel and technology diversity are essential to energy security

President Bush Speech
Columbus, Ohio March 9, 2005

" To ensure a diverse energy supply, we need to promote safe, clean nuclear power. Nuclear power can generate huge amounts of electricity without ever emitting air pollution or greenhouse gases…

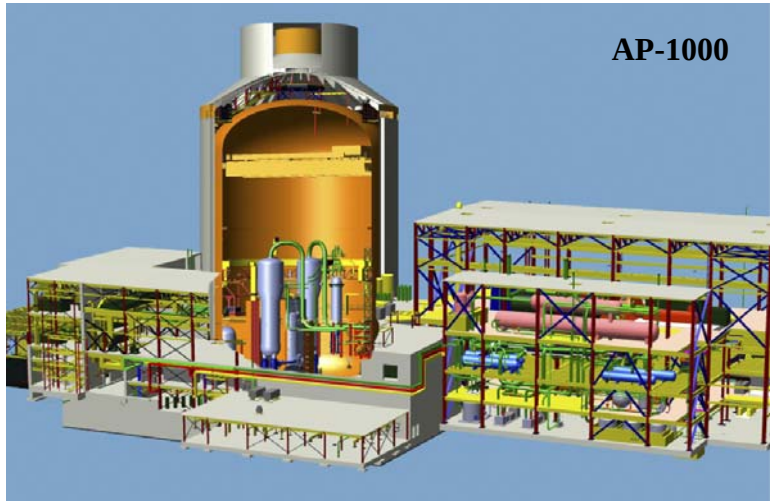
" ….We're taking early steps towards licensing the construction of nuclear power plants…

"….Another vital energy project is the hydrogen fuel initiative….We're investing $1.2 billion over 5 years to move hydrogen power from the research lab to the dealership lot…."

Major Challenges to Expanding Nuclear Power in the United States

- Permanent Nuclear Waste Disposition -- no new nuclear plants are likely to be ordered unless disposition path for spent nuclear fuel is clear.

- Regulatory Uncertainty -- power companies lack confidence that the untested “one-step” licensing process will not lead to excessive delays.



- Financial Uncertainty -- financial community and power companies lack confidence in how much new plants will cost and how long they will take to reach operation.

- Business Model -- Large light water reactors are better suited to regulated markets. To thrive in increasingly competitive markets, nuclear plants must become smaller, less expensive, and more flexible. This will require new technology.

What is DOE's Role?
Key Missions of the Office of Nuclear Energy, Science and Technology

- Development & Deployment of Advanced Technologies Required for a Viable Nuclear Future
  - Cooperate with the Private Sector to Deploy New Technologies
  - Cooperate with the International Community to Develop Next Generation Nuclear Technologies
- Support for U.S. Nuclear Technology Education
  - Prepare for Oncoming Retirements of Experienced Professionals
  - Our Energy Future Requires a New Generation of Nuclear Technologists
- Maintenance and Improvement of the Aging U.S. Infrastructure
  - Support for Advanced Research and Development
  - Enable the Private Sector to Support Current Nuclear Plants
  - Consolidate and Make Appropriate Capital Investments

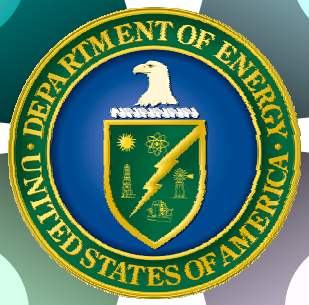
Program Overview:
Programs to Maintain a Viable Nuclear Energy Option

Nuclear Power 2010 Initiative

- Explore new sites
- Develop business case
- Develop Generation III+ technologies
- Demonstrate new NRC process

Advanced Fuel Cycle Initiative

- Recovery of energy value from SNF
- Reduce the inventory of civilian Pu
- Reduce the toxicity & heat of waste
- Effective use of geologic disposal
- Address issues of safeguards and proliferation resistance



Nuclear Hydrogen Initiative

Develop technologies for economic, commercial-scale generation of hydrogen.

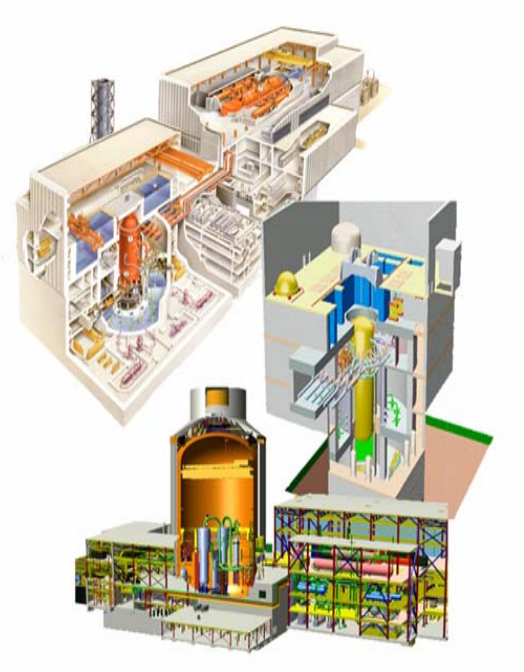
Generation IV

Better, safer, more economic nuclear power plant with improvements in

- safety & reliability
- proliferation resistance & physical protection
- economic competitiveness
- sustainability

Nuclear Power 2010
An Initiative to Expand Nuclear Power

- **Program initiated in February 2002**
- **Based on NERAC *Near-term Deployment Roadmap***
- **Focused on addressing technical, regulatory and institutional barriers to new U.S. plants**
- **Government/industry cooperative effort**
  - ♦ Cost-shared projects
  - ♦ Market-driven approach



Program Goal	*Pave the way for an industry decision to build and operate at least one new advanced light water reactor plant in the United States early in the next decade.*

Development & Deployment of Advanced Technologies
Generation IV Nuclear Energy Systems

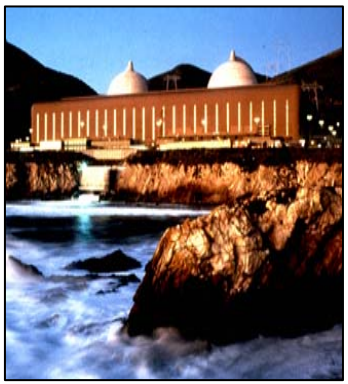
Generation I

Early Prototype Reactors

- Shippingport
- Dresden, Fermi I
- Magnox

Generation II

Commercial Power Reactors



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

Generation III

Advanced LWRs

- ABWR
- System 80+
- AP600
- EPR

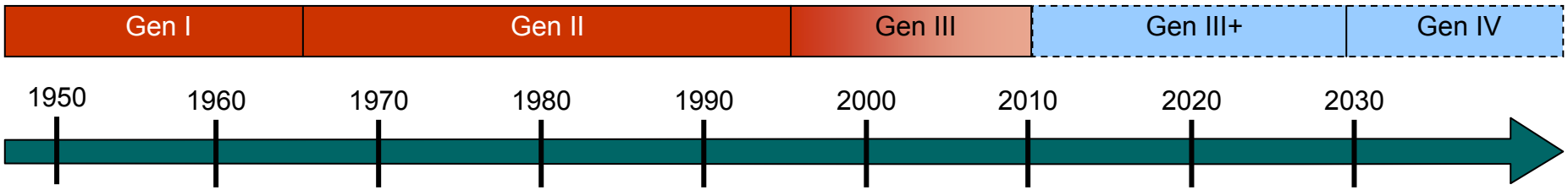
Generation III+

Generation III Evolutionary Designs Offering Improved Economics

- AP1000
- ESBWR
- ACR700
- IRIS

GEN IV Nuclear Energy Systems

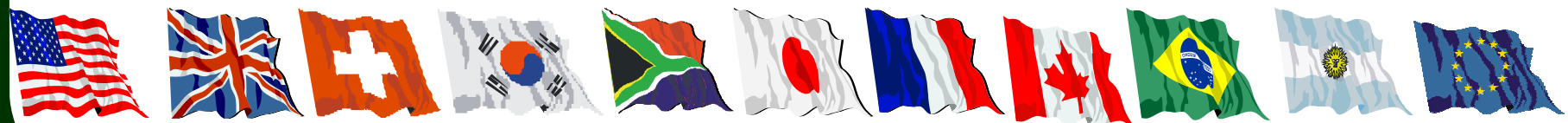
- Highly Economical
- Enhanced Safety
- Minimize Wastes
- Proliferation Resistant



Development & Deployment of Advanced Technologies Generation IV Nuclear Energy Systems

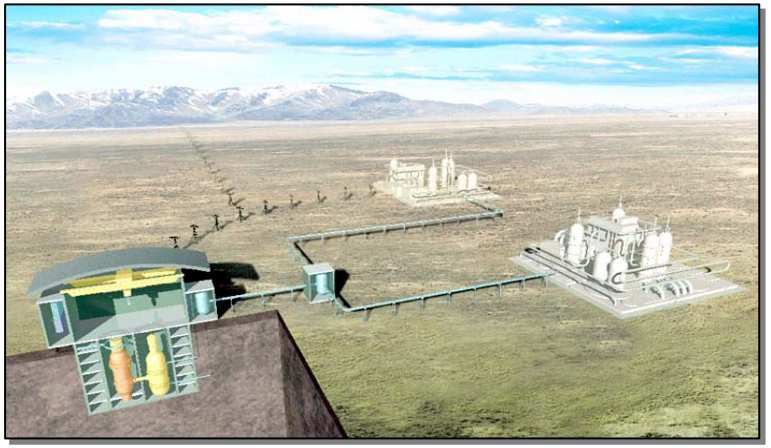
Generation IV is a world-wide initiative led by the United States

- This international collaboration began in January 2000
- Its purpose is to bring next-generation nuclear energy system technology to a state of maturity allowing for commercial deployment
- Generation IV reactors will offer improvements in:
  - Reactor safety and reliability
  - Proliferation resistance and physical protection
  - Economic competitiveness
  - Sustainability
- Multilateral Agreement signed February 28, 2005, in Washington, D.C.



Generation IV
Nuclear Energy Systems Initiative

FY 2006 Planned Accomplishments



- Initiate the irradiation of advanced coated particle fuel in the new Advanced Test Reactor multi-cell capsule test train at the Idaho National Laboratory.
- Develop models to predict the behavior of candidate very high-temperature reactor pressure boundary materials and very high-temperature component materials under expected operating conditions.
- Complete preliminary high-flux irradiations of high temperature metallic alloys at the Oak Ridge National Laboratory and initiate post-irradiation examinations
- Fabricate a high-temperature liquid-lead experiment at the Idaho National Laboratory for the investigation of lead and lead-bismuth fast reactor coolants.

Nuclear Hydrogen Initiative

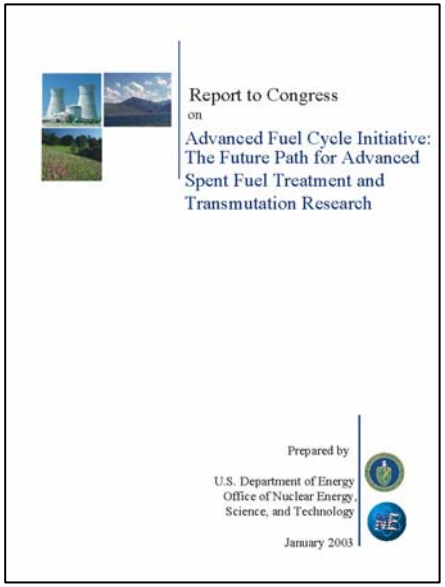
FY 2006 Planned Accomplishments

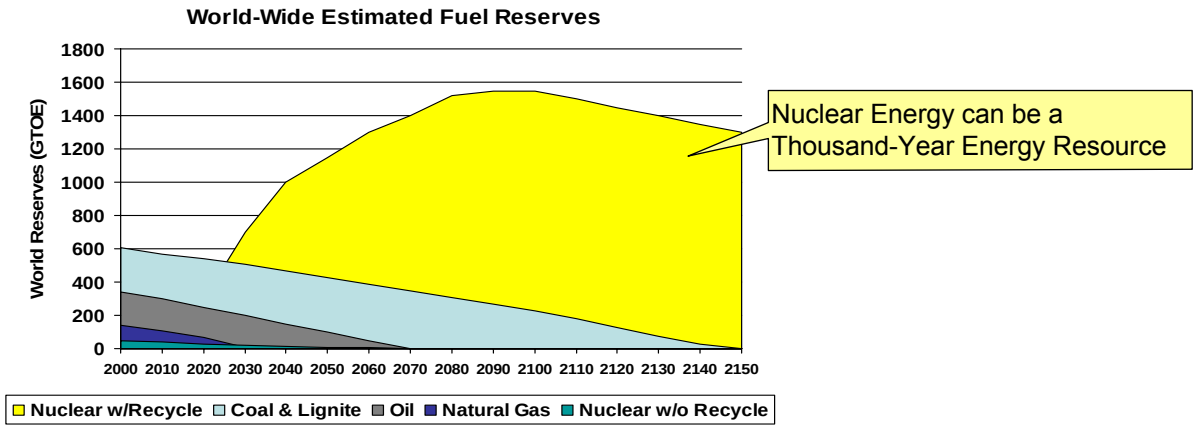
- Operate the S-I cycle chemical component reaction sections individually and initiate assembly in preparation for integrated laboratory-scale system operation in FY 2007.
- Complete long-duration and transient testing of HTE cell stacks that incorporate various cell materials and configuration options.
- Construct modular arrays of HTE cell stacks for integrated laboratory-scale operation in FY 2007.
- Complete flowsheets, economic analyses, and system designs for laboratory-scale experiments of high-potential alternative thermochemical cycles.
- Complete assessment of codes and standards applicable to a hydrogen production facility coupled to a nuclear reactor.

Development & Deployment of Advanced Technologies
Advanced Fuel Cycle Initiative

Major Goals

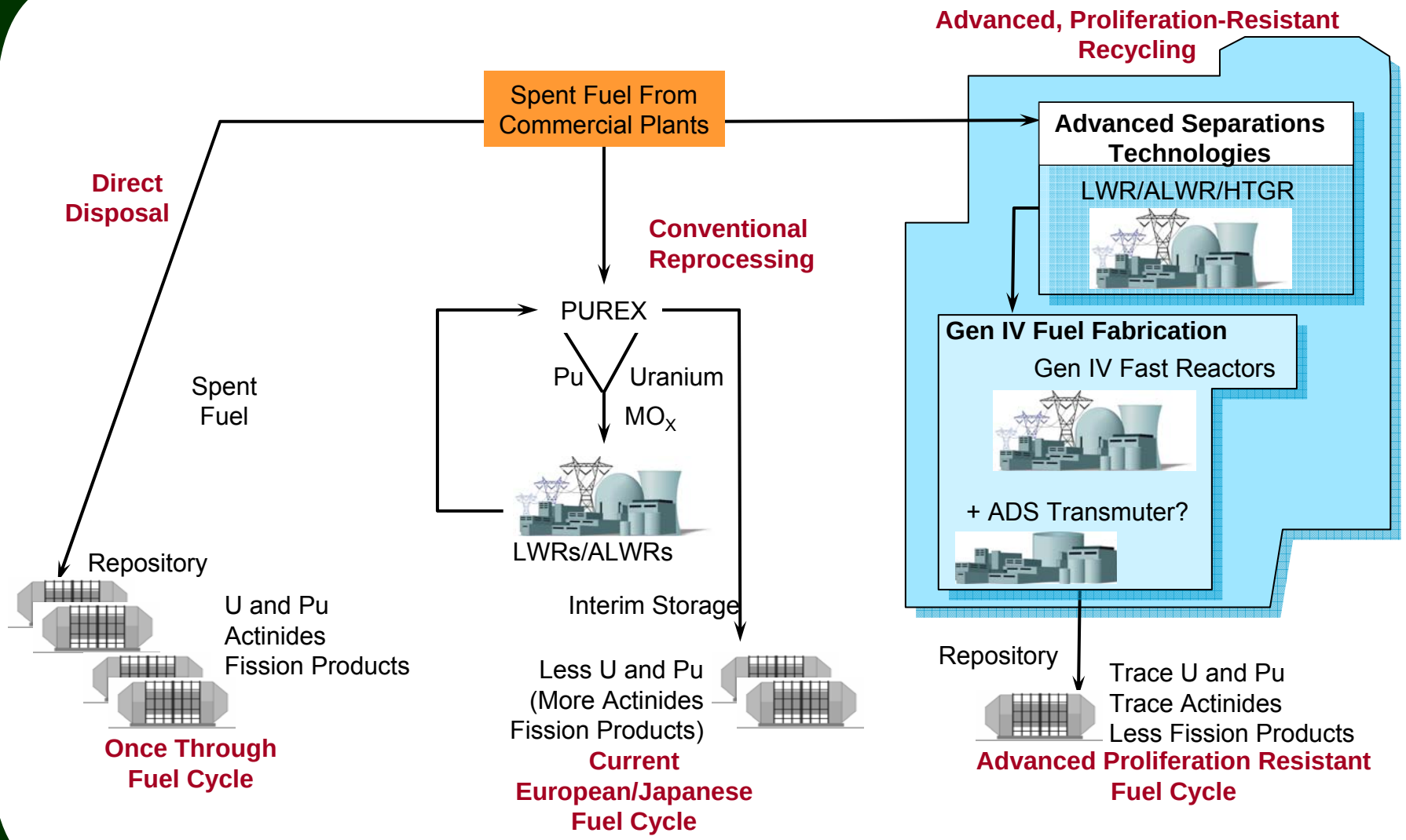
- **Develop fuel cycle technologies that:**
  - Enable recovery of the energy value from spent nuclear fuel (SNF)
  - Reduce the toxicity and heat generation of SNF bound for geologic disposal
  - Reduce the inventories of civilian plutonium in the U.S.
  - Support future Generation IV systems
  - Enable more effective use of the currently proposed geologic repository and reduce the cost of geologic disposal
- **Near-term R&D focused on separations and thermal recycle scenarios to inform Secretarial recommendation on need for second repository in 2007-2010**





Sources: World Energy Council Survey of Energy Resources, and DOE estimates

Enhancing Proliferation Resistance: AFCI Approach to Future Fuel Cycles



International Involvement: Collaborations on Proliferation-Resistant Fuel Cycles

- Working with international partners on fuel cycle options allows us to positively influence R&D direction
- Bilateral Collaborations:
  - France (CEA)- advanced aqueous and pyroprocessing technology development, advanced fuels research
  - Japan, South Korea – pyroprocessing only
  - Joint Japan-US-France transmutation fuel test in MONJU
- Generation IV International Forum
  - Multilateral collaboration on next-generation reactors with proliferation-resistant closed fuel cycles
  - PRPP Expert Group developing PRPP evaluation methodology framework and metrics for use by “designers” (DOE-NE) and “safeguarders” (NNSA)
- International Organizations
  - Working with IAEA and NEA on nuclear energy technology and policy matters; chair working groups, provide consultants, attend meetings

2005 U.S. Energy Policy Act Provides Investment Stimulus for New Plants

- Federal standby support
  - Provides $2 billion of risk coverage for first 6 plants
  - Covers delays resulting from licensing or litigation
- Federal loan guarantees
  - Covers up to 80% of project cost
  - Allows more highly leveraged capital structure
  - Reduces project cost
- Production tax credits fro first 6,000MW

The Global Nuclear Energy Partnership (GNEP)

The Global Nuclear Energy Partnership is a comprehensive strategy to:

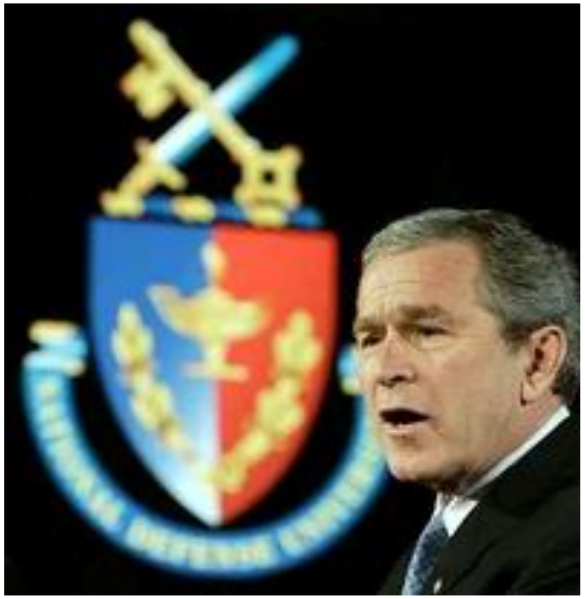
- Increase U.S. and global energy security
- Encourage clean development around the world and improve the environment
- Reduce the risk of nuclear proliferation

GNEP Benefits

- Reduce America's dependence on fossil fuels
- Provide abundant energy without generating carbon emissions or greenhouse gases
- Recycle used nuclear fuel to minimize waste and curtail proliferation concerns
- Safely and securely allow developing nations to deploy nuclear power to meet energy needs
- Assure maximum energy recovery from still-valuable used nuclear fuel
- Reduce the number of required U.S. geologic waste repositories to one for the remainder of this century

Key GNEP Program Elements

- Expand use of nuclear power
- Minimize nuclear waste
- Demonstrate recycle technology
- Demonstrate Advanced Burner Reactors
- Establish reliable fuel services
- Demonstrate small, exportable reactors
- Enhanced nuclear safeguards technology



"To build a secure energy future for America, we need to expand production of safe, clean nuclear power"

President Bush, 06/2004

GNEP Next Steps

- Expand nuclear energy in the U.S.
  - Administration and Congress have taken steps to encourage new nuclear power plants.
  - Address spent fuel issue and Yucca Mountain.
- Demonstrate advanced recycling
  - Work in GNEP consortium to prove technologies needed to close fuel cycle, minimize waste, and obtain more energy benefit.
- Build global consensus on GNEP vision
  - Enlist partners to limit the spread of sensitive nuclear technologies in a way that enables nuclear power to meet global challenges.

Summary

- Nuclear Energy is once again at the forefront of U.S. Energy Policy
- The Office of Nuclear Energy, Science and Technology has played a leading role and plans to continue its efforts in developing next-generation nuclear energy technology to serve the energy and environment
- Proliferation resistance and physical protection is an integral concept in our R&D programs
- DOE-NE and NNSA are collaborating, along with international partners and organizations (e.g., IAEA, NEA) on substantive technical and policy manners
- Appropriate collaboration with international partners leverages resources and expertise without increasing proliferation risks
- International collaboration and leadership also allows the U.S. to influence international fuel cycle policy, R&D, and technology deployment

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