SAND2007-7323P

RADIOACTIVE AND HAZARDOUS MATERIALS COMMITTEE
September 20-21, 2007

The Global Nuclear Energy Partnership (GNEP)

David Kessel
Manager, Carlsbad Operations
Sandia National Laboratories

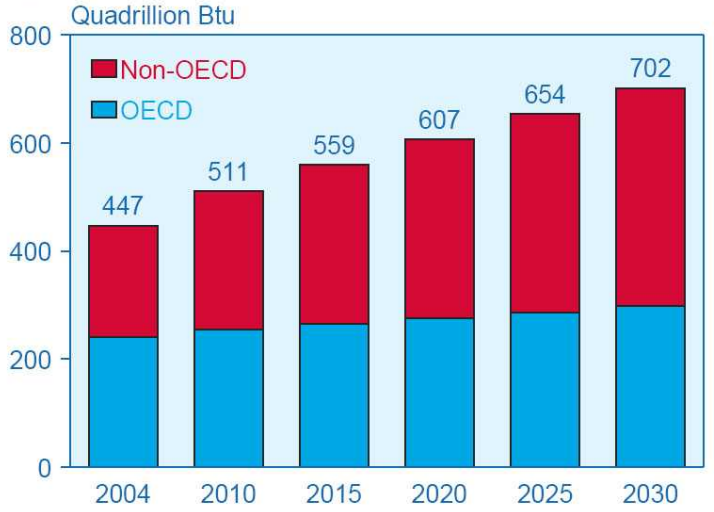
September 20, 2007

Sandia is a multi program laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

World energy demand is growing substantially

- **World energy consumption is predicted to increase by ~50% through 2030**
- **Total energy consumption in non-OECD countries will increase by 95% compared to 24% in OECD countries**
- **Volatility of oil and natural gas prices and supplies enhance attractiveness of nuclear power's stability**

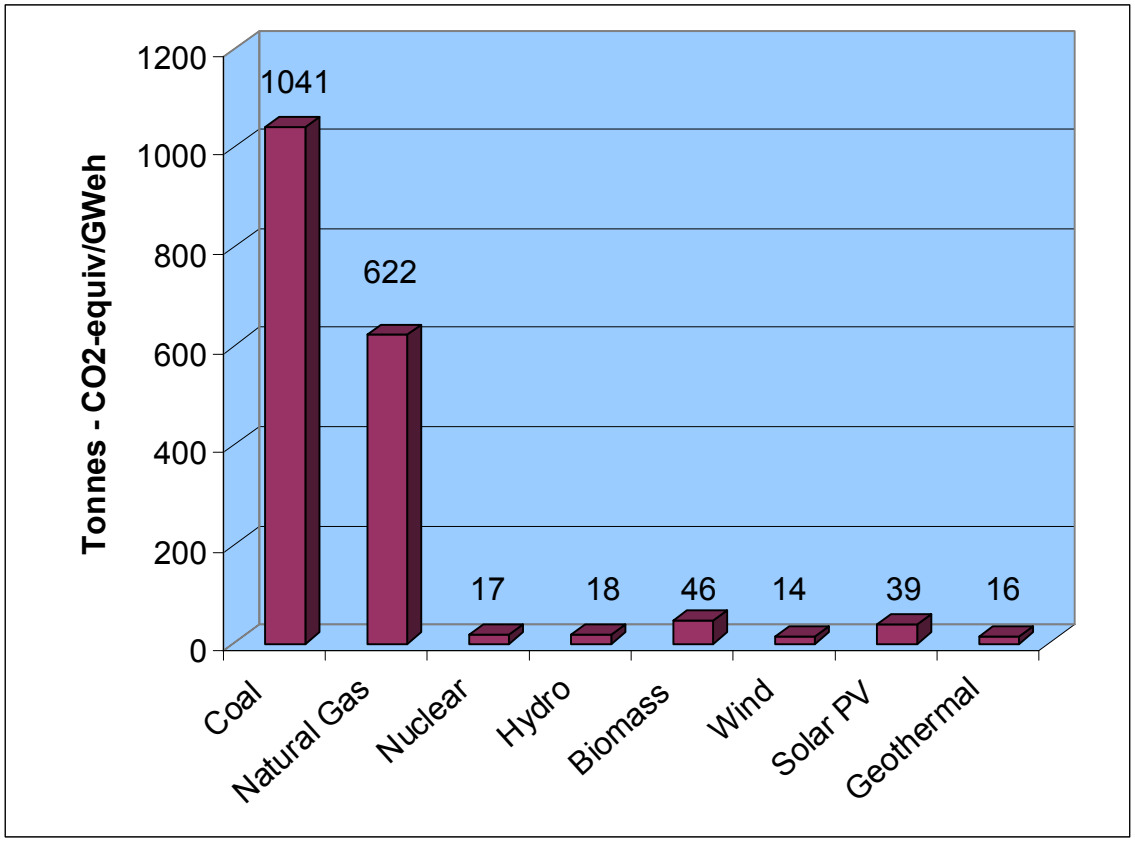
World Marketed Energy Consumption by Region, 2004-2030



Sources: **2004:** Energy Information Administration (EIA), *International Energy Annual 2004* (May-July 2006), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets (2007).

The world is turning increasingly to nuclear energy for electricity generation

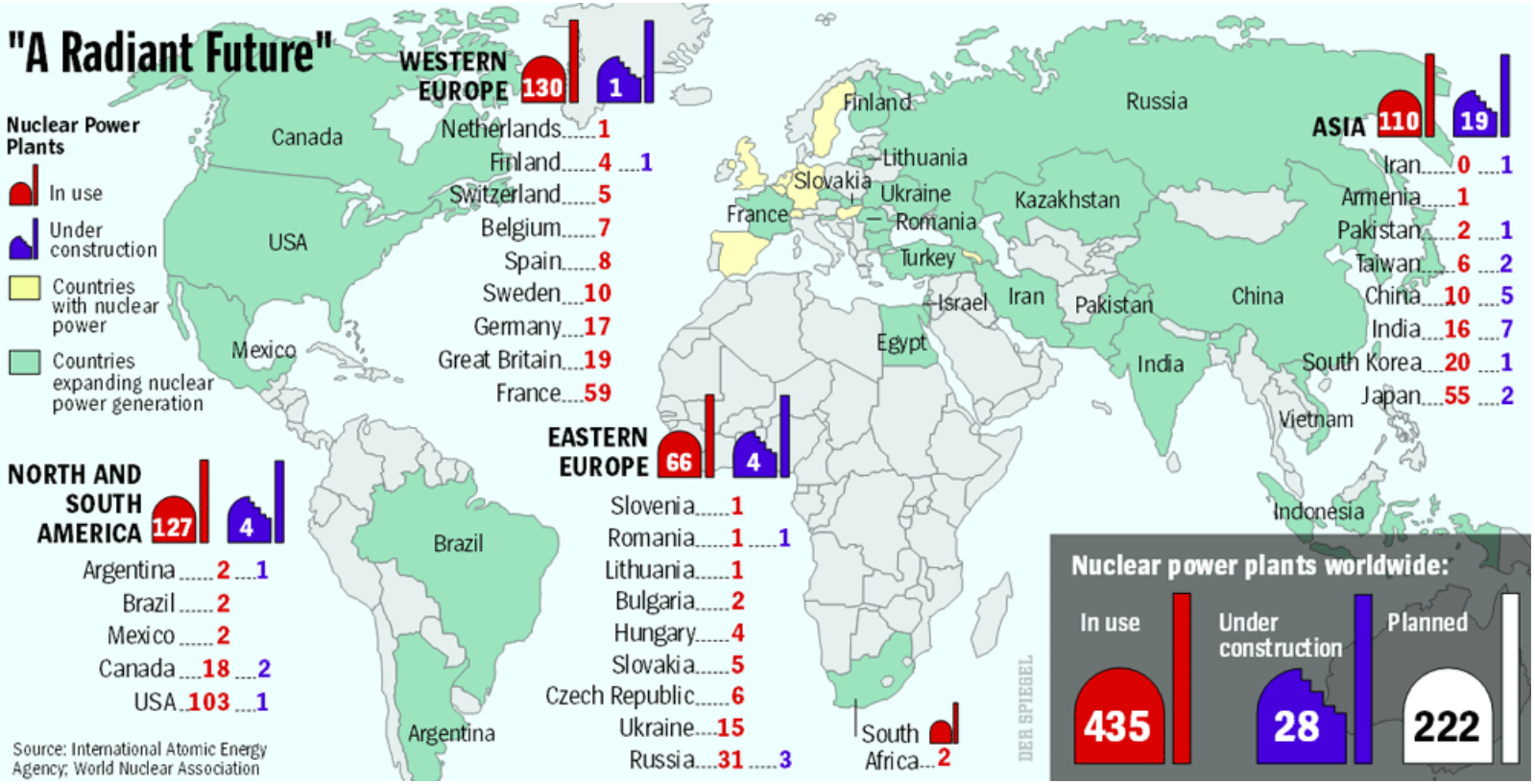
Nuclear energy is among the lowest greenhouse gas sources of electricity



- **Mitigating global climate change requires lowering CO2 emissions**
- **Nuclear power is the only viable alternative today to generate substantial electricity without a significant contribution to CO2 emissions**

Source: "Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis," Paul J. Meier, University of Wisconsin-Madison, August, 2002.

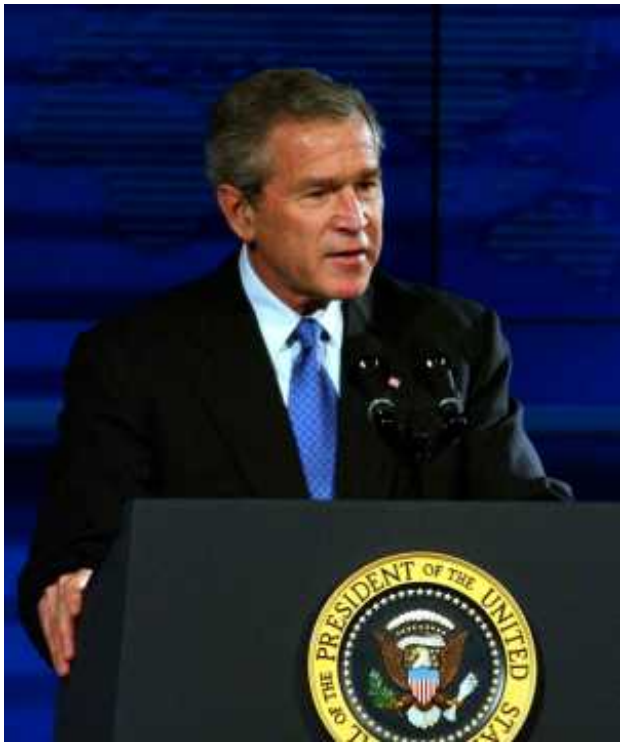
Nuclear power is expanding internationally to help meet the growing demand



http://www.spiegel.de/international/spiegel/0,1518,460011,00.html

GNEP was launched in February 2006 as part of the President's Advanced Energy Initiative

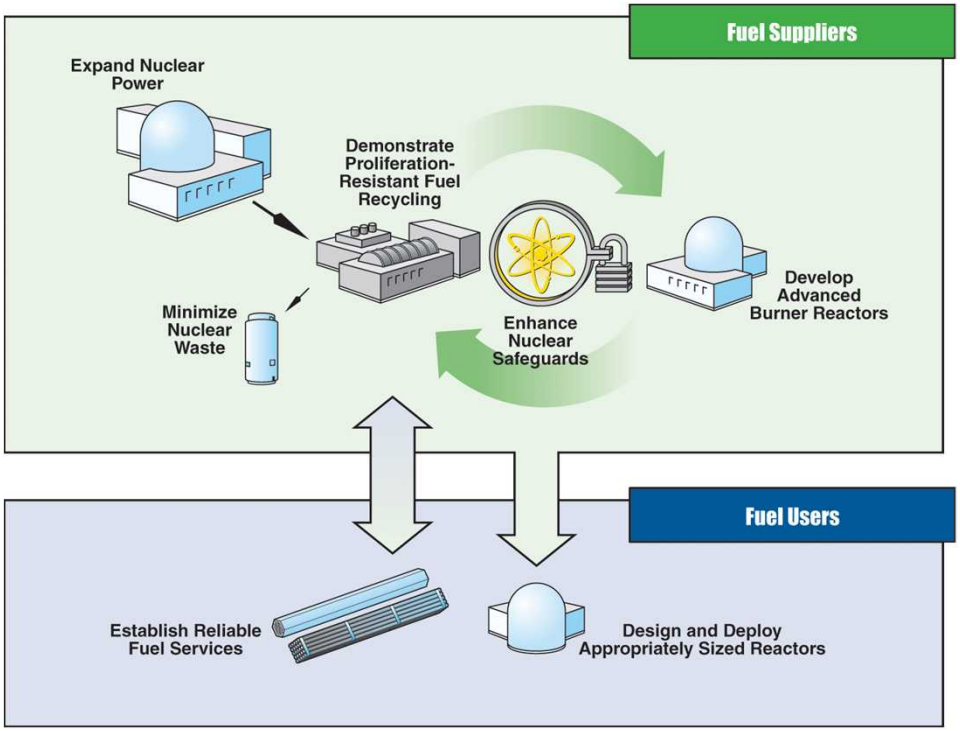
- **FY 2006 GNEP established as a program and funded at $80M**
- **FY 2007 funding of $167.5M**
- **FY 2008 proposed budget $405M**
  - House Mark $120M
  - Senate Mark $242M



"…my Administration has announced a bold new proposal called the Global Nuclear Energy Partnership…we will develop and deploy innovative, advanced reactors and new methods to recycle spent nuclear fuel."

Key international elements of GNEP

- **Fuel Suppliers:** Operate reactors and have complete fuel cycles, including uranium enrichment and spent fuel separations capabilities
- **Fuel Users:** Operate reactors, lease and return fuel
- **IAEA:** Provide safeguards and fuel assurances, backed up with a reserve of nuclear fuel for states that do not pursue enrichment and reprocessing



GNEP offers a solution for developing countries … by taking away their will, but not their right, to pursue enrichment and reprocessing.

International engagement pathways

- **Policy**
  - Establish bilateral and/or multilateral partnerships based on GNEP principles
- **Fuel Assurance**
  - International fuel assurance framework development includes:
    - *Reliable fuel leasing mechanisms between fuel suppliers and users*
    - *Emergency fuel banks/reserves in the event of an interruption in supply*
    - *Used fuel management*
- **Technical Collaboration**
  - Advanced fuel cycle cooperation (only with established fuel cycle countries)
  - Grid-appropriate reactors (small and medium size, 10-350 Mwe)
  - Infrastructure development for countries interested in nuclear power

The global partnership is taking shape

- France, Japan, China, and Russia, with UK and IAEA observers held a Ministerial meeting with the U.S. Secretary of Energy on May 21, 2007 in Washington, DC
- In a joint statement the partnership pledged to broaden participation to other nations

Energy Ministers at May 21, 2007 GNEP Meeting in Washington DC

The domestic elements of GNEP and NP2010 advance nuclear energy

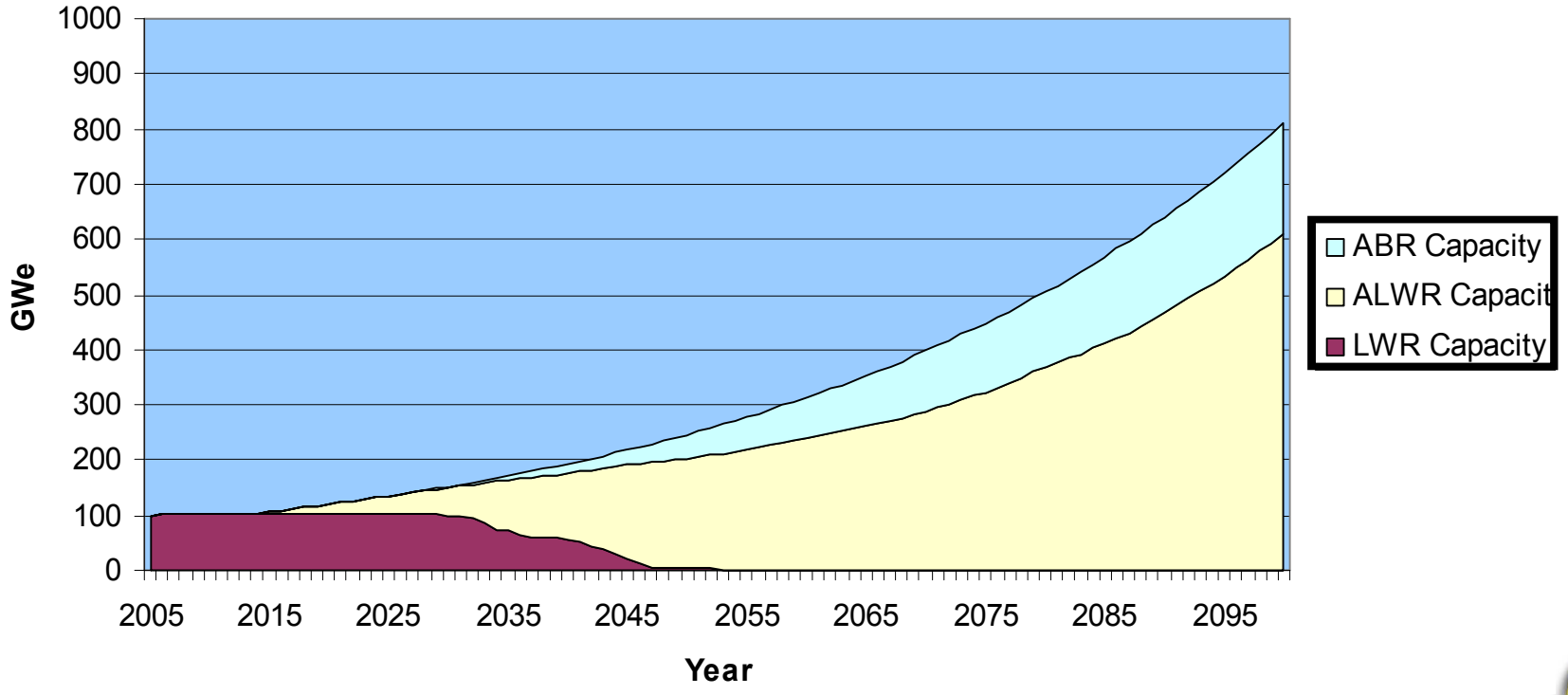
- **Expand nuclear power to help meet growing energy demand in an environmentally sustainable manner**

- **Develop, demonstrate, and deploy advanced technologies for recycling spent nuclear fuel that:**
  - *Do not separate plutonium*
  - *Simplify the disposition of nuclear waste*

- **Develop, demonstrate, and deploy fast reactors that:**
  - *Consume transuranic elements (TRU) from recycled spent fuel*
  - *Generate electricity*

At equilibrium in a GNEP fuel cycle many advanced recycling reactors support the light water reactor fleet

- GNEP has analyzed various deployment scenarios including single and multiple tier LWR U/Pu (MOX) with advanced recycling reactor systems
- In this example, nuclear energy grows by 2.4%/year, with ~ ¼ of the nuclear generating capacity in 2100 coming from Advanced Burner Reactors (ABR)



The GNEP Strategic Plan requires specific actions

- Obtain input from industries and governments on how best to bring the needed GNEP facilities into being, what technology and policy issues must be resolved, and what business obstacles must be overcome
- Develop a detailed GNEP technology roadmap for demonstrating solutions to the remaining technical issues
- Pursue industry engagement in the development of conceptual designs and other engineering studies that support both a nuclear fuel recycling center and an advanced recycling reactor
- Prepare a programmatic GNEP Environmental Impact Statement
- In 2008, prepare a decision package for the Secretary of Energy

The domestic GNEP Vision

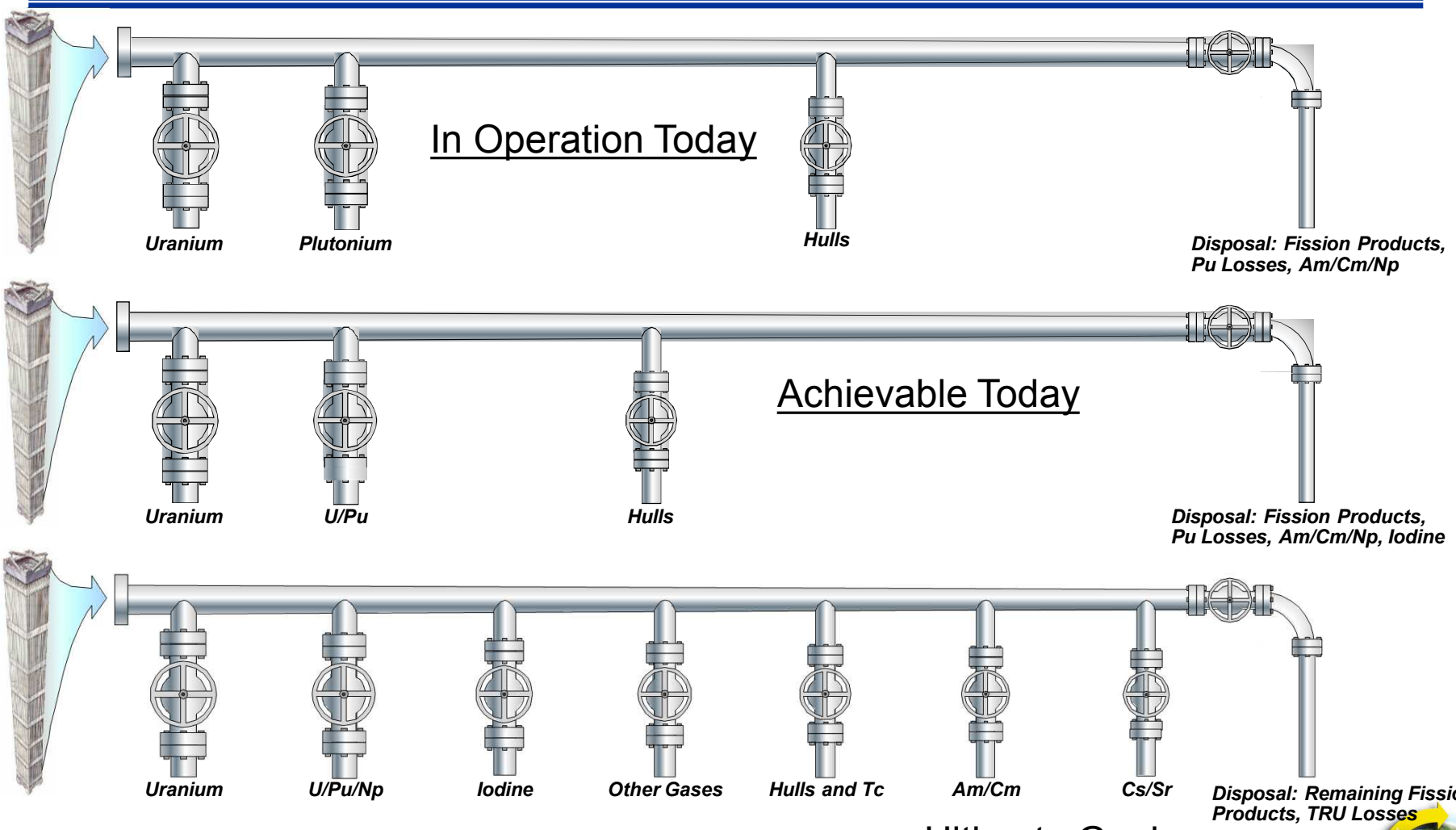
Converting used reactor fuel into reusable products and more manageable wastes

- Separate out reusable elements for electricity generation
- Separate out relatively short-lived wastes to reduce heat load in a geologic repository, enabling increased loading
- Significantly reduce amount of long-lived wastes requiring disposal which minimizes potential dose to public (10,000 years+)
- Reduce waste volume to reduce cost and increase effective repository capacity
- Generate electricity by deploying advanced recycling reactors (sodium-cooled, fast spectrum, recycling reactors) fueled by recycled uranium and transuranic elements
- Initial GNEP facilities will consist primarily of technologies that are operational at full-scale today, incorporating technology advances over time through modifications and expansions

The domestic GNEP "reference" approach includes

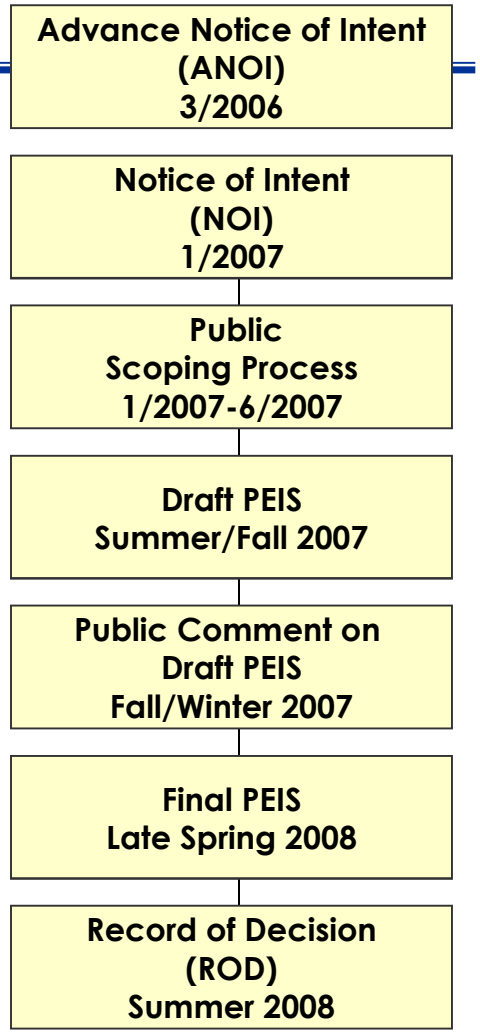
- Dual-path, industry-led separations process approaches: Aqueous and Electro-Metallurgical
- Advanced recycling reactor partially funded by industry and/or international sources
- Consolidate used reactor fuel for process storage at nuclear fuel recycling center site
- Short-lived waste management: decay storage followed by appropriate disposal
- Long-lived waste management: use existing process technologies (e.g. vitrification) to safely package wastes. Match waste hazards with best disposal options

Spent Fuel Separations Capability Today, Tomorrow and in the Future



National Environmental Policy Act (NEPA) analysis is underway for GNEP

- **GNEP Programmatic Environmental Impact Statement (PEIS)**
  - *Assess reasonable alternatives*
  - *Analyze potential environmental impacts*
  - *Assist DOE decision-making*
- **GNEP Siting Studies**
  - *Stakeholder interest in hosting facilities*
  - *Eleven grant applications funded*
  - *Both DOE and non-DOE sites proposed*



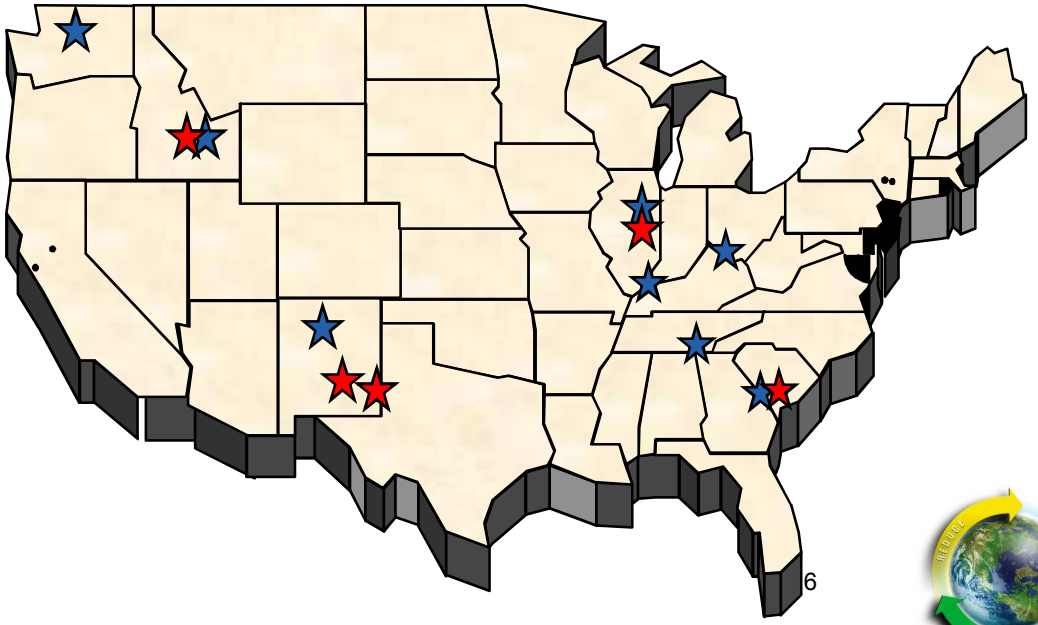
Thirteen site alternatives are under examination

DOE Sites

- Argonne National Laboratory (IL)
- Hanford (WA)
- Idaho National Laboratory (ID)
- Los Alamos National Laboratory (NM)
- Oak Ridge Reservation (TN)
- Paducah (KY)
- Portsmouth (OH)
- Savannah River Site (SC)

Non-DOE Sites

- Atomic City, ID
- Barnwell, SC
- Eddy-Lea Counties, NM
- Roswell, NM
- Morris, IL

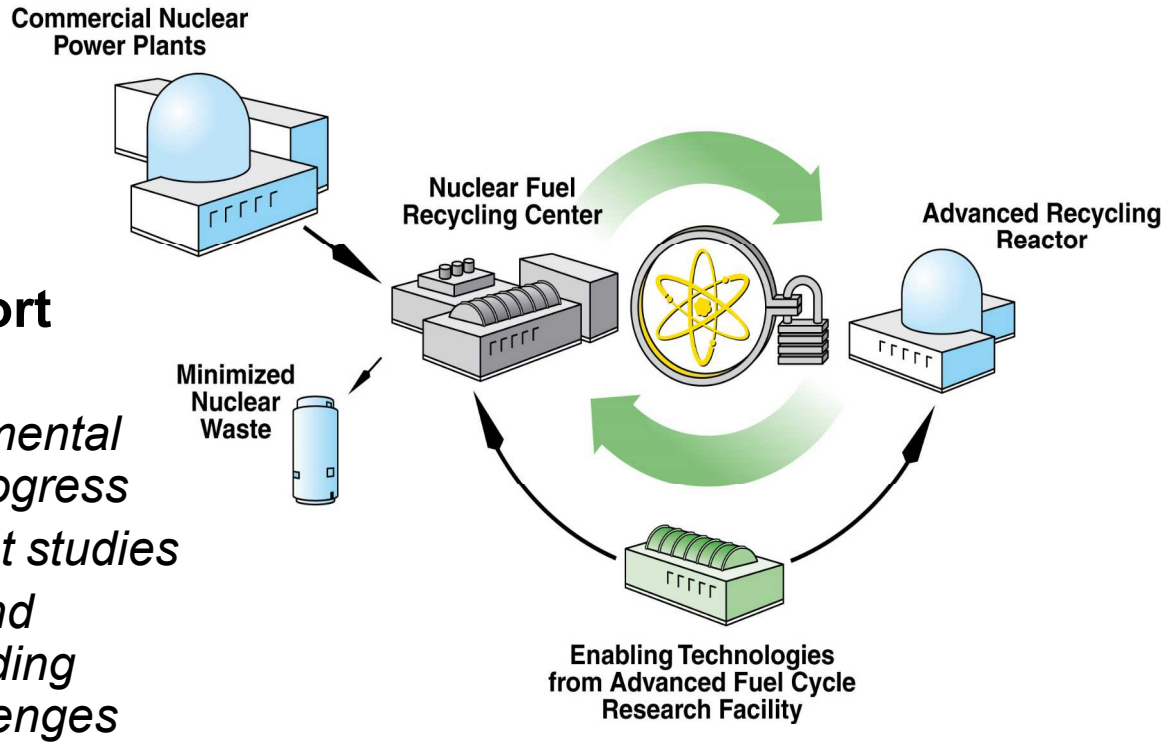


Industry engagement will inform GNEP planning

- **Scoping studies were completed last year as part of an Expression of Interest process**
- **Deployment studies will be funded through a Funding Opportunity Announcement to address:**
  - *Business plan*
  - *Technology development roadmap*
  - *Conceptual design studies*
  - *Communications plan*
- **Four applicants awarded $16 million September 2007**
  - *Initial reports to be completed by January 2008*

Summary

- **International support for GNEP is strong and moving forward**
- **There is significant effort underway**
  - *Programmatic Environmental Impact Statement in progress*
  - *Industry-led deployment studies*
  - *National laboratories and universities are responding to key technology challenges*



- **GNEP is addressing the challenges to ensure sustainability of the nuclear power renaissance**