The INEEL (INL) Nuclear Energy Mission

- Importance of Nuclear Energy to Energy Security, Prosperity, and Environmental Quality
- Historical Context for the INEEL Nuclear Energy Mission
- Summary of the Major Components of the New INEEL Nuclear Energy Mission

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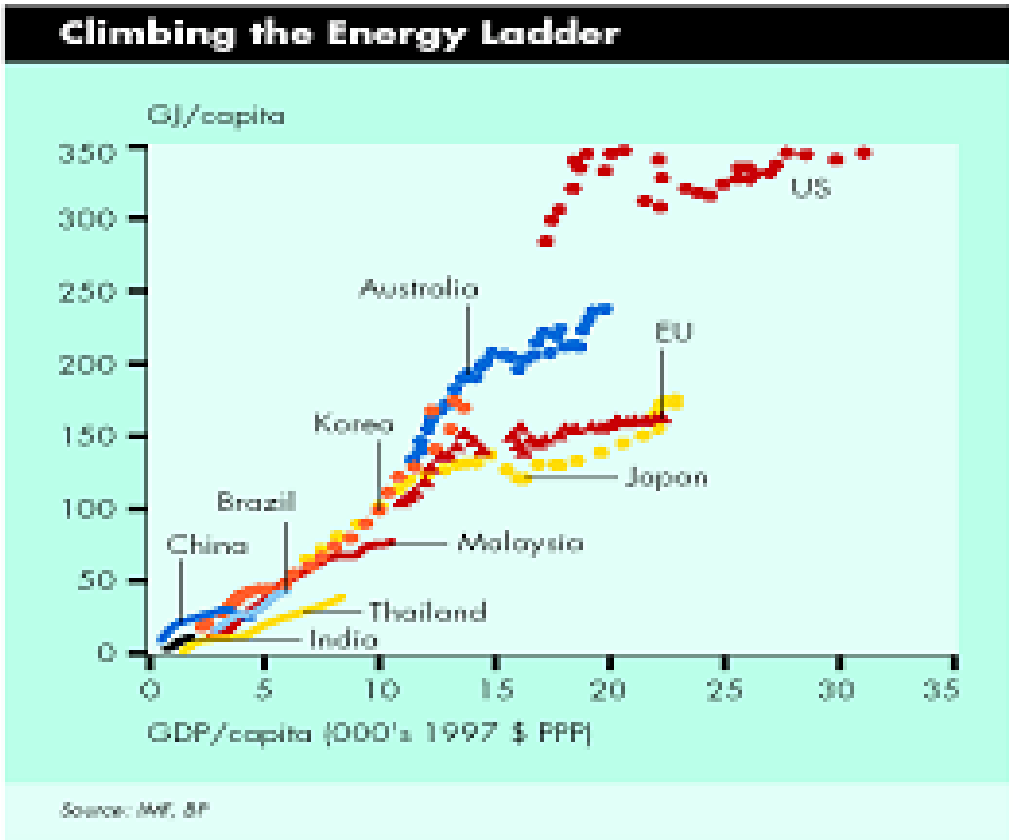
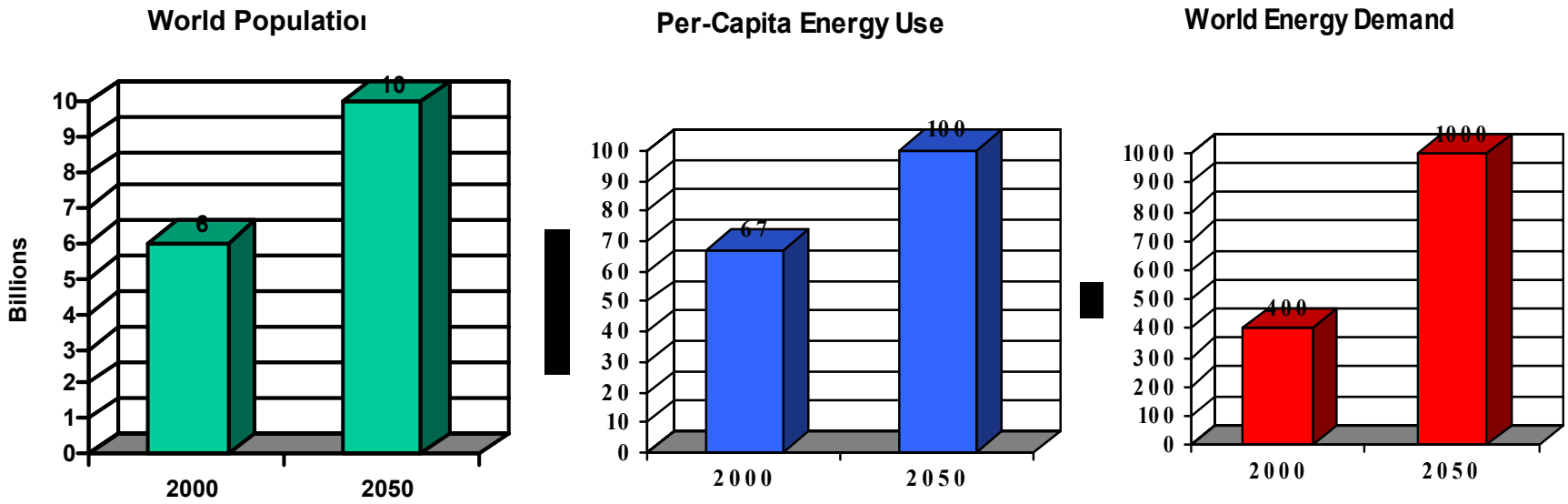
Energy is the Fuel of National Prosperity



Source: Royal Dutch Shell, "Exploring the Future –Energy Needs, Choices and Possibilities

World Energy Demand is Forecast to Grow Substantially in the First Half of the 21st Century

- *As population grows and developing countries attempt to increase their standard of living. . . . .*



- *. . . We will face increasing competition for limited energy resources*
- *The impact on energy supply stability may be great*

Notes: Present U.S. energy use - 300 GJ/person; developing world avg.. ~20 GJ/person

ENERGY SECURITY . . . . . is more important than ever

- *Our national security is closely tied to our energy security*
- *The U.S. spends an estimated $32 billion per year to defend oil supplies from the Middle East*
- *Energy Security is Achieved through Supply Diversity, Stability, and Sustainability*

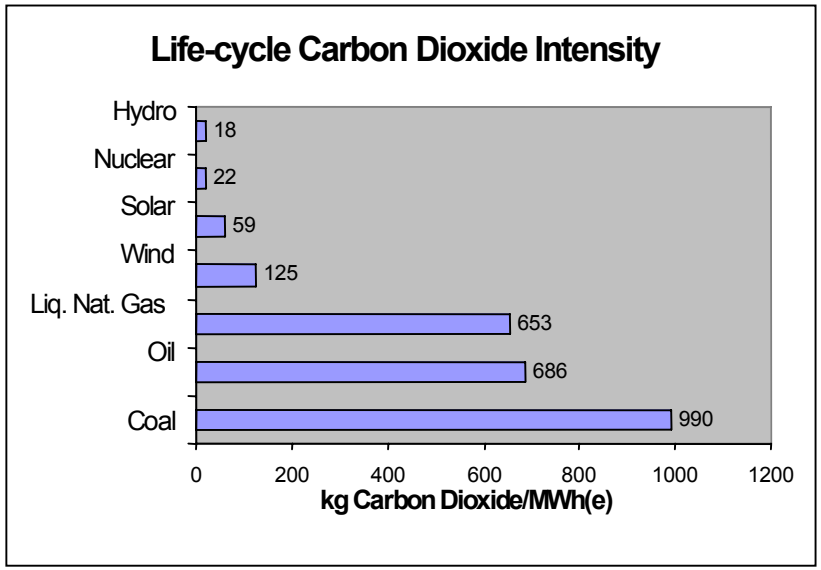
(Source - Transportation Energy Data Book: Edition 19-1999)

Desert Storm Photos of the USMC 4th Mar Div, 4th Landing Support Battalion "A" Co, Seattle

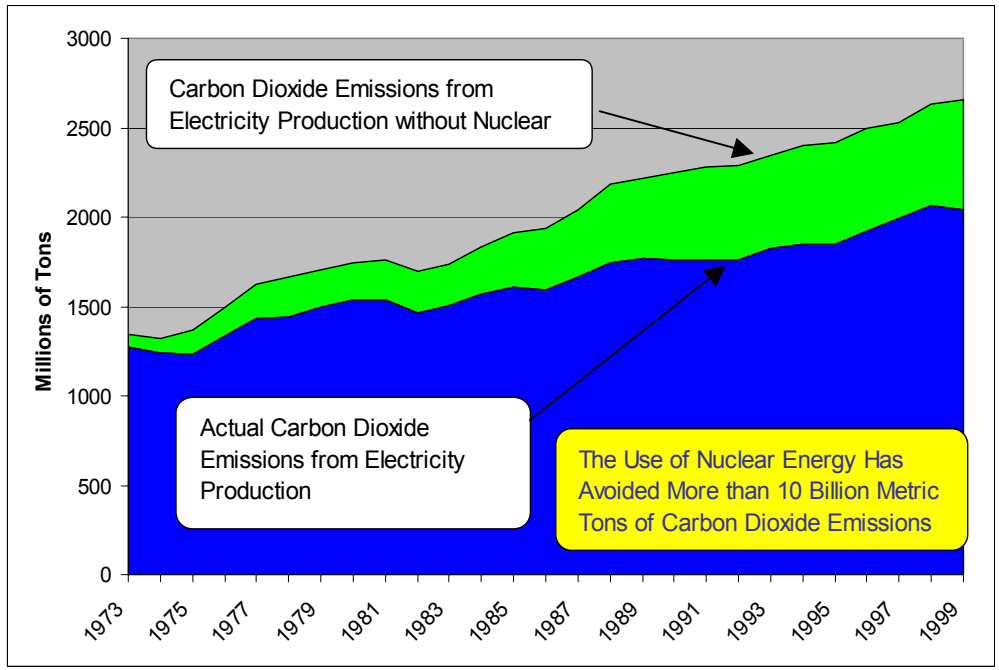
Energy Security and Environmental Quality are Strong Drivers for Increased Use of Nuclear Energy

- *Economic growth and prosperity are tied to abundant, affordable, and secure energy supplies*
- *Preservation of the environment and avoidance of adverse human health impacts increasingly demand clean energy supplies*
- *Depleting fossil fuel supplies and rising fossil energy prices motivate nations toward energy supply diversity*
- *U.S. Must:*
  - *Reduce reliance on foreign oil supplier in the transportation sector*
  - *Avoid becoming too reliant on foreign gas and oil supplies in the heating sector*
  - *Maintain diversity of supply in the electricity sector*
- *The major world economies in the U.S., Europe, and Asia have a responsibility to lead in the development and deployment of sustainable, secure, and clean energy supplies (. . .Nuclear Energy)*

Clean Nuclear Energy is an Important Contributor to the U.S. Emissions - Reduction Strategy



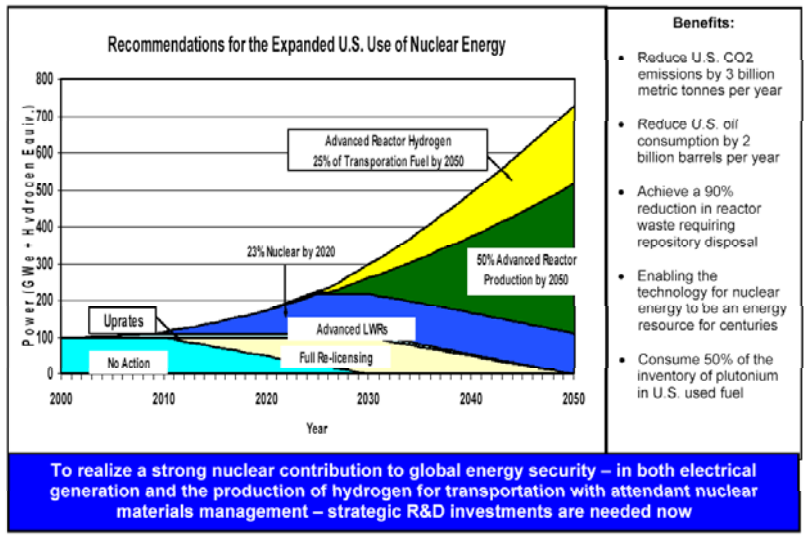
Reference: Uchiyama (CRIEPI, Japan)



Reference: Nuclear Energy Institute

6 DOE Laboratory Directors endorse a comprehensive and integrated plan to further the development and deployment of nuclear energy and the management of nuclear materials

- *50% of U.S. electricity produced by nuclear power by 2050*
- *25% of U.S. transportation fuel produced by nuclear energy (nuclear-produced hydrogen) by 2050*
- *Demonstrate a closed fuel cycle system by 2020*
- *Demonstrate a global nuclear energy system consisting of intrinsic and extrinsic safeguards that reduces proliferation risk.*



ARGONNE NATIONAL LABORATORY

INEEL
Idaho National Engineering and Environmental Laboratory

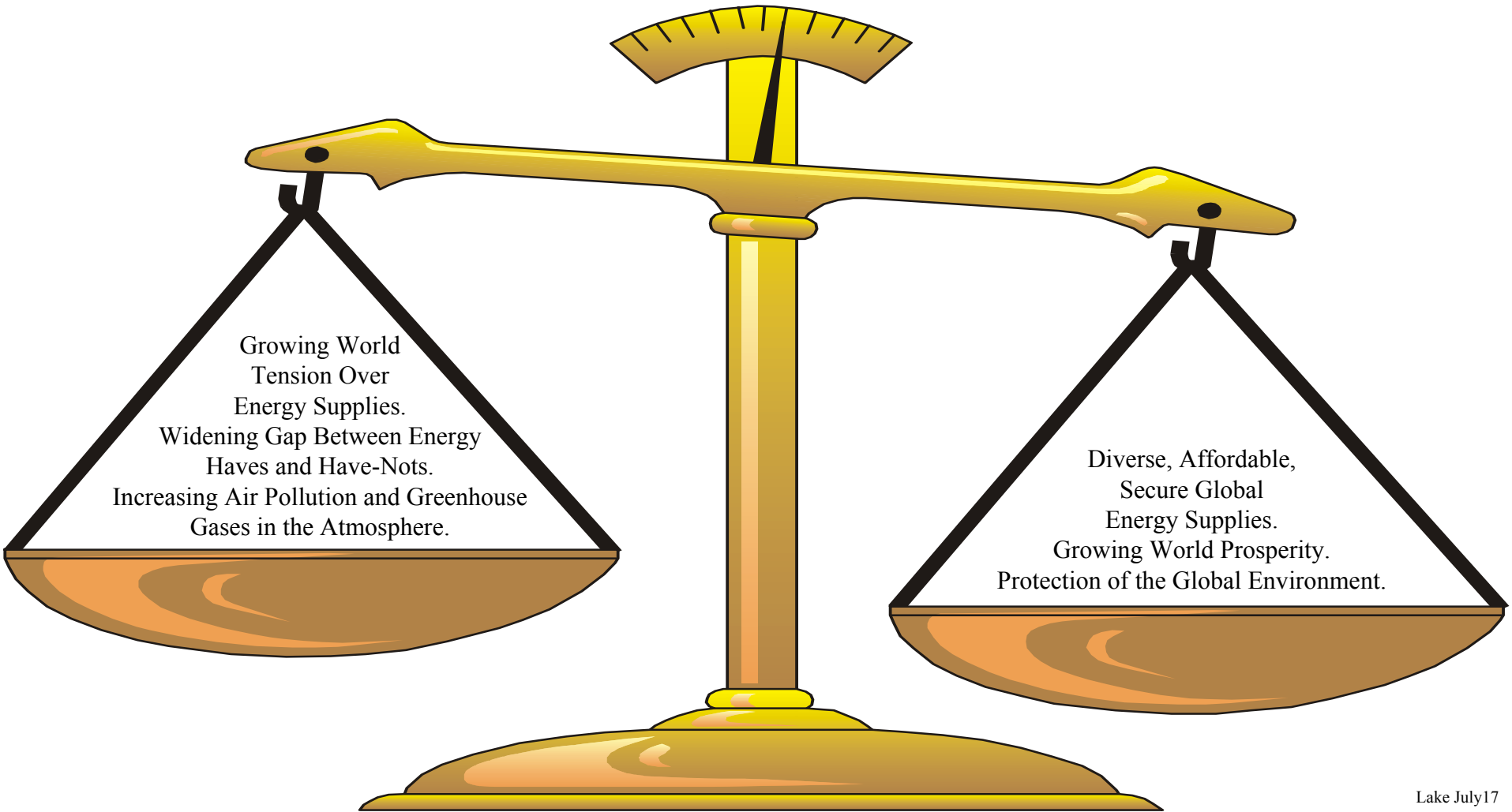
ornl

Lawrence Livermore National Laboratory

Los Alamos
NATIONAL LABORATORY

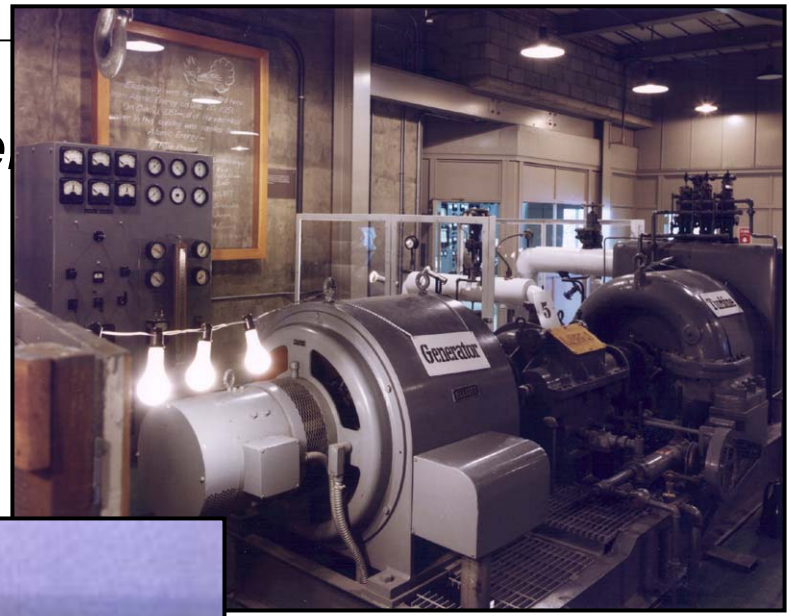
Sandia National Laboratories

What will be the Legacy of United States Energy Leadership?



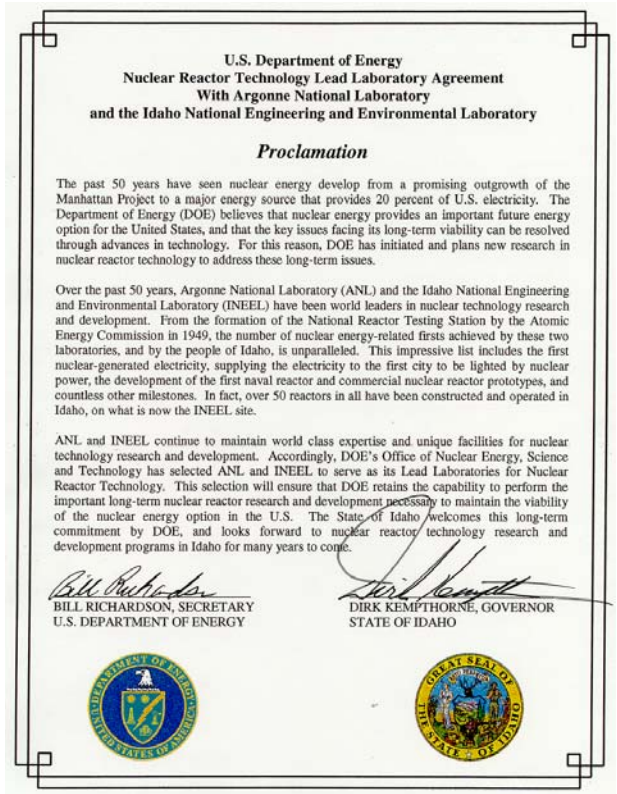
A Proud Heritage of Nuclear Excellence

- *World's first generation of electricity from nuclear powe*
- *First breeder reactor*
- *Design and construction of 52 mostly first-of-their-kind nuclear reactors*



In 1999, Energy Secretary Richardson created Lead Laboratories for Nuclear Reactor Technology at Argonne National Laboratory and Idaho National Engineering and Environmental Laboratory.

- *Preserve technical infrastructure, key facilities and nuclear energy data.*
- *Conduct leading-edge R&D/design-develop-demonstrate the next generation of nuclear energy technology.*
- *Maintain international collaborations.*
- *Support technology-needs planning (roadmapping)*
- *Facilitate the necessary dialog between decision makers and stakeholders to advance the technology.*



U.S. Department of Energy
Nuclear Reactor Technology Lead Laboratory Agreement
With Argonne National Laboratory
and the Idaho National Engineering and Environmental Laboratory

Proclamation

The past 50 years have seen nuclear energy develop from a promising outgrowth of the Manhattan Project to a major energy source that provides 20 percent of U.S. electricity. The Department of Energy (DOE) believes that nuclear energy provides an important future energy option for the United States, and that the key issues facing its long-term viability can be resolved through advances in technology. For this reason, DOE has initiated and plans new research in nuclear reactor technology to address these long-term issues.

Over the past 50 years, Argonne National Laboratory (ANL) and the Idaho National Engineering and Environmental Laboratory (INEEL) have been world leaders in nuclear technology research and development. From the formation of the National Reactor Testing Station by the Atomic Energy Commission in 1949, the number of nuclear energy-related firsts achieved by these two laboratories, and by the people of Idaho, is unparalleled. This impressive list includes the first nuclear-generated electricity, supplying the electricity to the first city to be lighted by nuclear power, the development of the first naval reactor and commercial nuclear reactor prototypes, and countless other milestones. In fact, over 50 reactors in all have been constructed and operated in Idaho, on what is now the INEEL site.

ANL and INEEL continue to maintain world class expertise and unique facilities for nuclear technology research and development. Accordingly, DOE's Office of Nuclear Energy, Science and Technology has selected ANL and INEEL to serve as its Lead Laboratories for Nuclear Reactor Technology. This selection will ensure that DOE retains the capability to perform the important long-term nuclear reactor research and development necessary to maintain the viability of the nuclear energy option in the U.S. The State of Idaho welcomes this long-term commitment by DOE, and looks forward to nuclear reactor technology research and development programs in Idaho for many years to come.

BILL RICHARDSON, SECRETARY
U.S. DEPARTMENT OF ENERGY

DIRK KEMPTHORNE, GOVERNOR
STATE OF IDAHO

The National Energy Policy Endorses Nuclear Energy as a Major Component of Future U.S. Energy Supplies

Existing Nuclear Plants

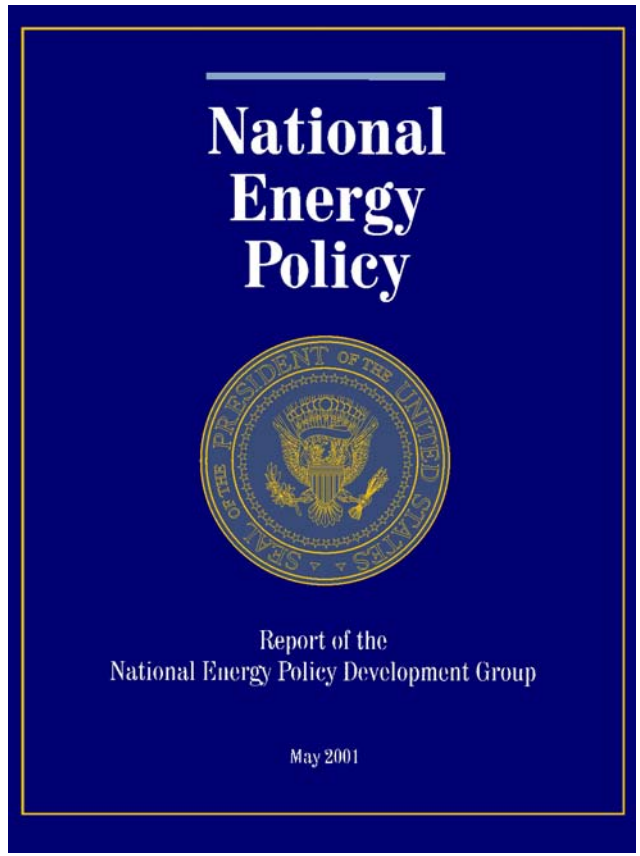
- *Expedited NRC licensing of Advanced Reactors*
- *Update and re-license nuclear plants*
- *Nuclear energy's role in improved air quality*
- *Geologic repository for nuclear waste*
- *Price-Anderson Act renewal*

New Nuclear Plants

- *Advanced fuel cycle/pyroprocessing*
- *Next-generation advanced reactors*

Reprocessing

- *International collaboration*
- *Cleaner, more efficient, less waste, more proliferation-resistant*

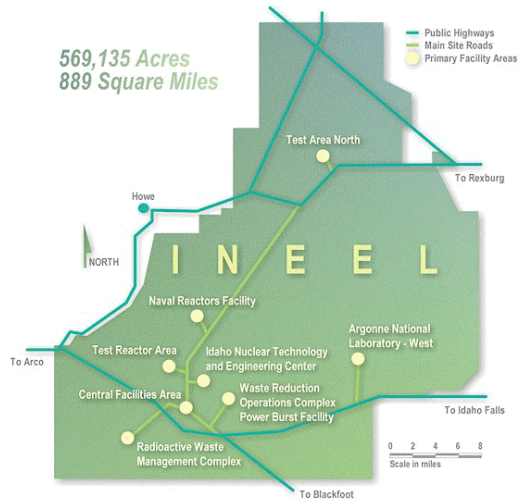


Designation of INEEL as a DOE NE LAB

"First, INEEL will be the central command center for the federal government's Generation IV nuclear systems research."

Second, an "Idaho Advanced Fuel Cycle Technology Initiative will be the focal point for developing and demonstrating separation technologies for treating and reducing spent nuclear fuel and high level waste."

– Spencer Abraham



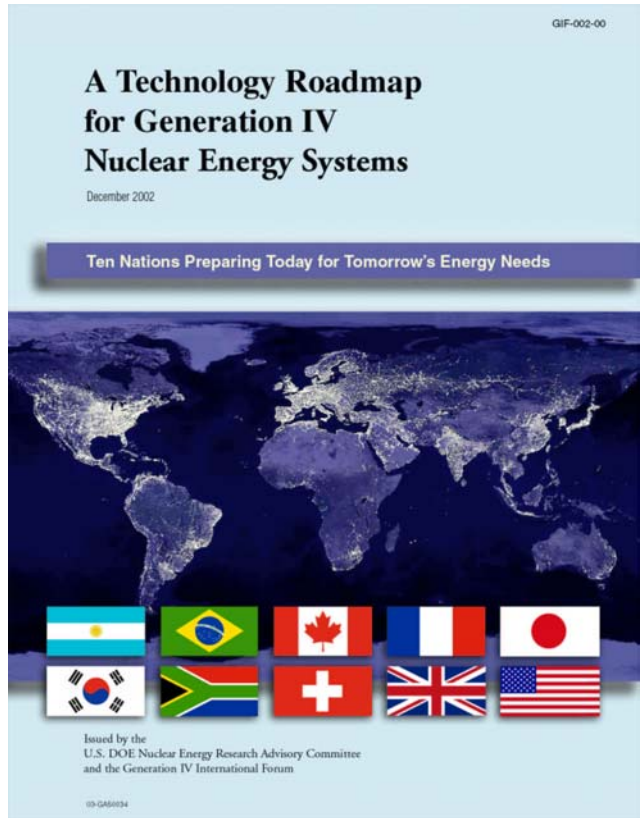
July 15, 2002

The INEEL Strategic Vision is to be the leading contributor to our Nation's Energy Security and Environmental Quality by developing advanced, sustainable, safe and economic nuclear energy and fuel cycle technologies

- *Leadership of the Generation IV Advanced Reactor Systems R&D*
  - *Systems Analysis and Integration*
  - *Very High Temperature Reactor*
  - *Gas-Cooled Fast Reactor*
  - *Supercritical Water-Cooled Reactor*
- *Leadership of the Advanced Fuel Cycle Engineering Demonstration*
- *Advanced Fuel Development and Irradiation Testing in the Advanced Test Reactor*
- ***Leadership and host site for the Advanced Reactor Hydrogen Co-Generation Demonstration***
- *System Ground Test for the Nuclear Space Initiative*
- *Fast Neutron Research Reactor*

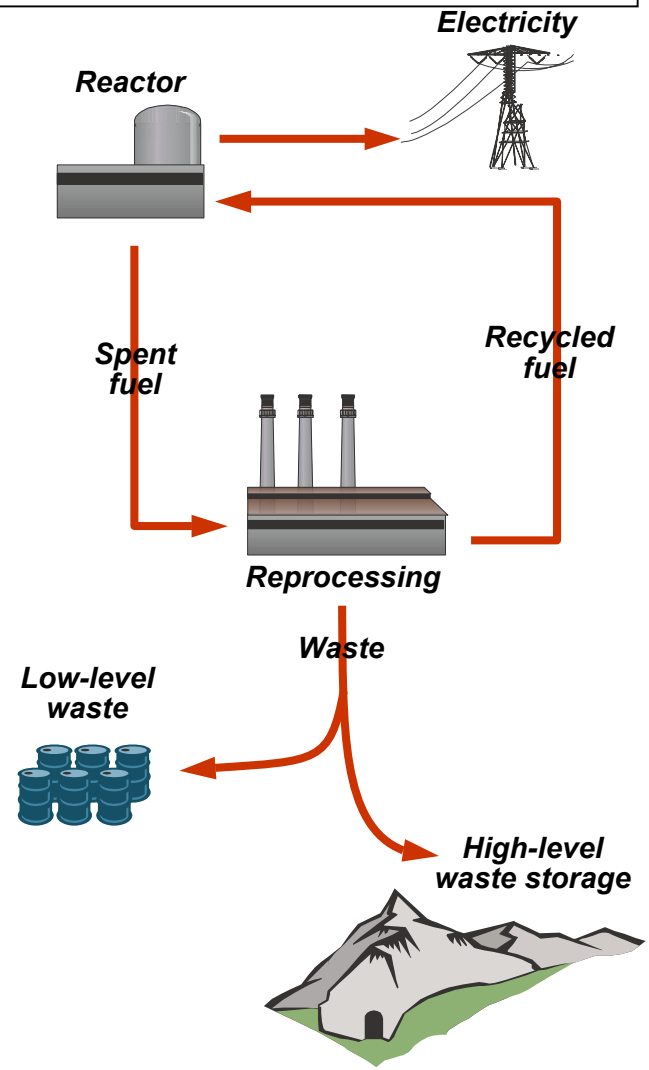
INEEL exercised strong leadership through the development of the Generation IV Roadmap

- *Effective facilitation of the 10-Country Generation IV International Forum*
- *Leadership of the 2-year roadmap study involving 100 international experts*
  - *Established global requirements*
  - *Developed evaluation methodology*
  - *Screened candidate systems*
  - *Identified strengths and weaknesses/R&D needs*
  - *6 GEN IV system concepts selected by GIF*
- *Generation IV Technology Roadmap completed Sept 2002*
- *International Cooperative R&D under development*

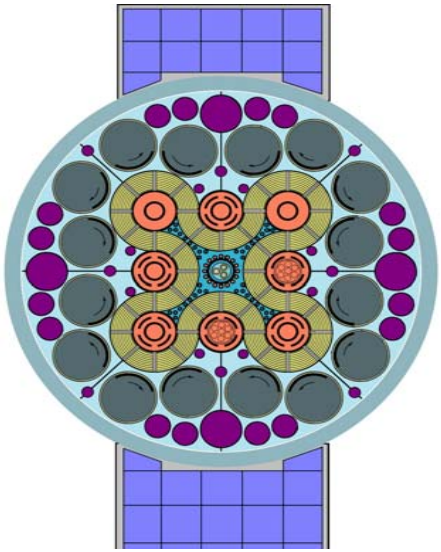


The Sustainable Fuel Cycle of the Future

- *Current U.S. "once-through" fuel cycle requires spent-fuel storage and management for thousands of years*
- *Lack of social/political acceptability of long-term waste storage may require a reexamination of U.S. waste management strategy*
- *Recycling of spent fuel reduces volume (96%) and lifetime (few hundred years) of disposable waste*
- *Advanced "fast" reactors can recycle multiple times*
  - *Burns plutonium and other long-lived materials*
  - *Extends fuel supplies 100X*
- *New recycle technology reduces nuclear materials proliferation-concern*



TRA Advanced Test Reactor (ATR)



Capabilities

- ***Fuels testing in various flux levels/spectra***
- ***Materials testing with large test volumes***
- ***Multiple temperature controlled testing in irradiation test vehicle***
- ***Transient testing with powered axial locator mechanism***
- ***Commercial radioisotope production***

Programs

- ***U. S. naval nuclear propulsion program***
- ***Weapons-grade MOX Fuel Testing (DOE)***
- ***Reduced enrichment research & test reactor fuel testing (DOE)***
- ***CANDU Materials Testing (Canada)***
- ***Graphite Oxidation and Aging (UK)***
- ***Reactor vessel material & weld material testing (Japan)***

Hydrogen is the key to energy security

- *President Bush's Freedom Fuel Initiative* *"with a new national commitment, our scientists and engineers, will overcome obstacles to taking these [fuel cell] cars from laboratory to showroom, so that the first car driven by a child born today could be powered by hydrogen and pollution-free"*

George W. Bush, State of the Union Speech, January 2003

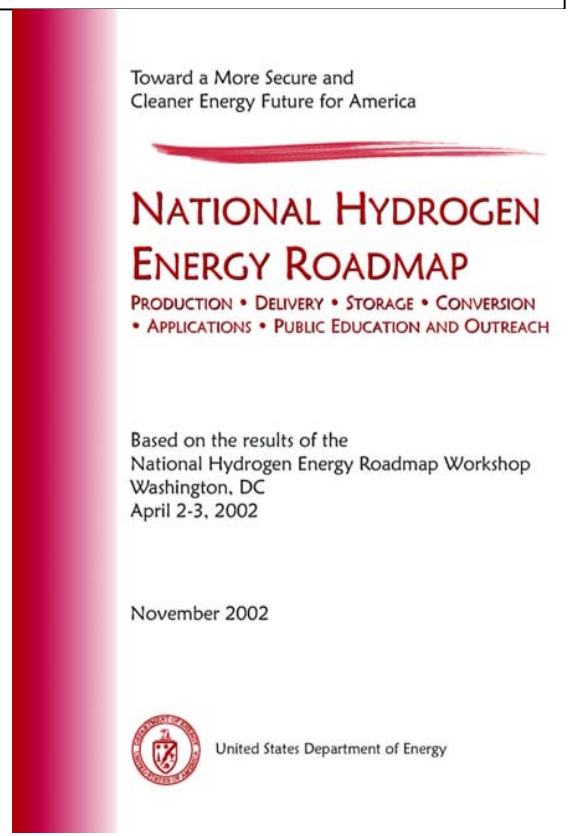
Displaces imported oil

Emissions-Free

National Hydrogen Energy Roadmap identifies major hydrogen production technologies

- Steam Reforming of Natural Gas (with Carbon Sequestration)
- Water "Cracking" using Nuclear Heat
  - Thermochemical
  - Thermoelectrical
- Coal Gasification (with Carbon Sequestration)
- Other Renewables and Bioproducts

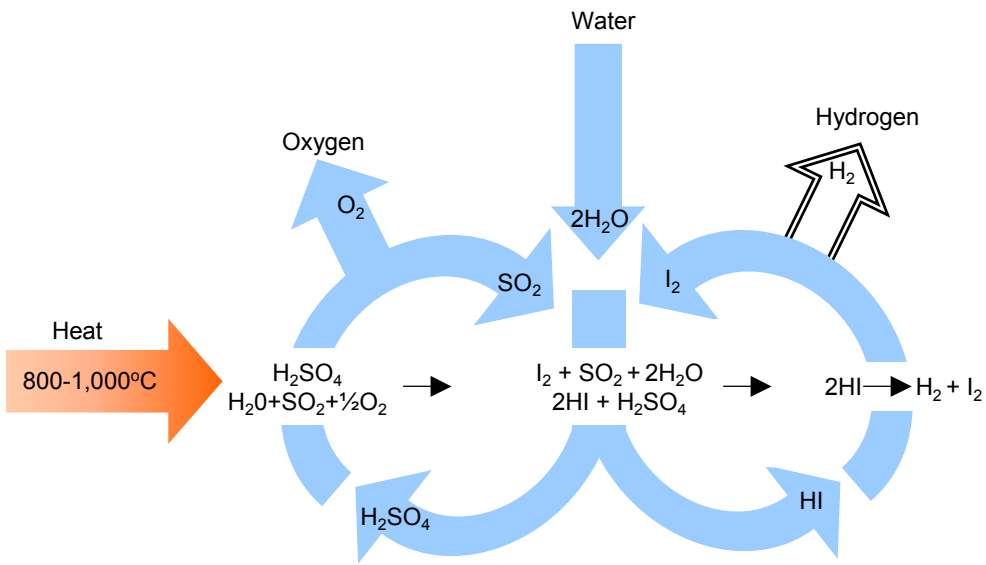
The Nuclear-Hydrogen Initiative is supported at the highest level of government



The Nuclear Hydrogen Initiative

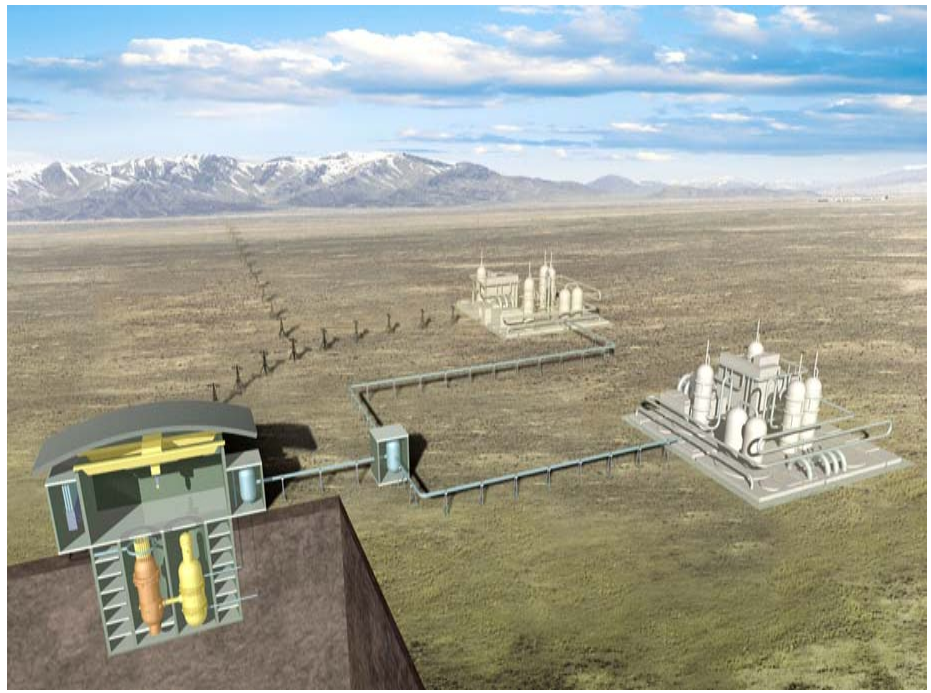
- 2005: Conduct laboratory testing of candidate hydrogen production processes
- 2006: Complete design and initiate construction of two hydrogen production pilot plants - (200 kW) high temperature electrolysis plant and (500 kW) thermochemical plant
- 2007: Begin operation of the initial pilot plants
- 2008: Begin system optimization and scaling of thermochemical pilot plant
- 2011: Complete process improvements and scaling of thermochemical pilot plant to MW class
- 2012: Complete designs and start construction of engineering scale hydrogen production systems
- 2015

Goal: Develop advanced hydrogen production technology as part of Next Generation Nuclear Plant (NGNP) to demonstrate economic, commercial-scale hydrogen production.



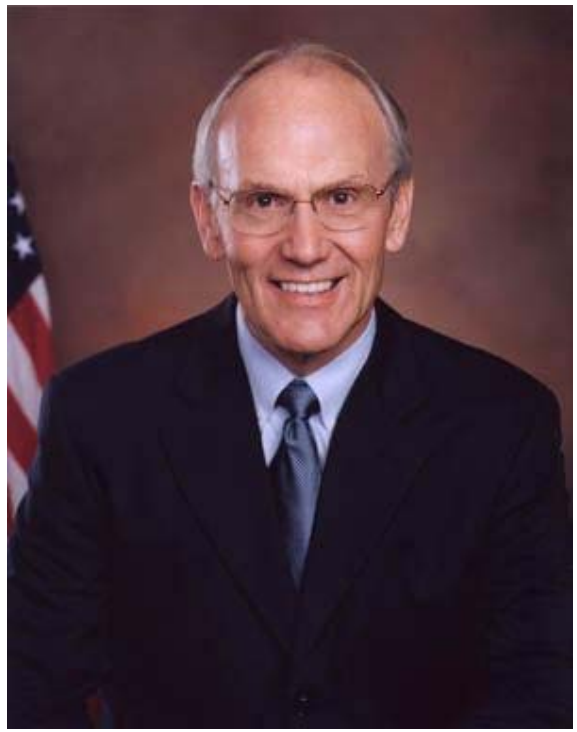
The Very High Temperature Reactor is the leading Generation IV technology for near-term demonstration

- *VHTR mission is high-efficiency electricity and hydrogen production*
  - *Improved economics*
    - *Reduced capital cost*
    - *Expanded product markets*
  - *Naturally safe/high temperature capability*
  - *Sustainable*
    - *Energy security and zero emissions*
    - *plutonium burnup capability*
    - *Deep-burn or closed fuel cycle*
  - *Secure and robust*



Senate Energy Authorization Bill

Authorizes the Secretary of Energy to establish an Advanced Reactor Hydrogen Co-Generation Project



- *Scope includes R&D, design, construction, operations and demonstration*
- ***INEEL named as Lead Laboratory for the project and the preferred site***
- *Requires U.S. industry, university, and laboratory participation and encourages international collaboration*
- *Authorizes:*

  $635 M (2004 - 2008) plus TBD (2009 and beyond) for design and development

  $500 M for construction

Nuclear Energy enables the NASA Jovian Icy Moons Orbiter and other deep space missions

- *Planet-Sized Jovian Moons (Callisto, Ganymede, Europa)*
- *Water, Energy, & Chemistry for Life*

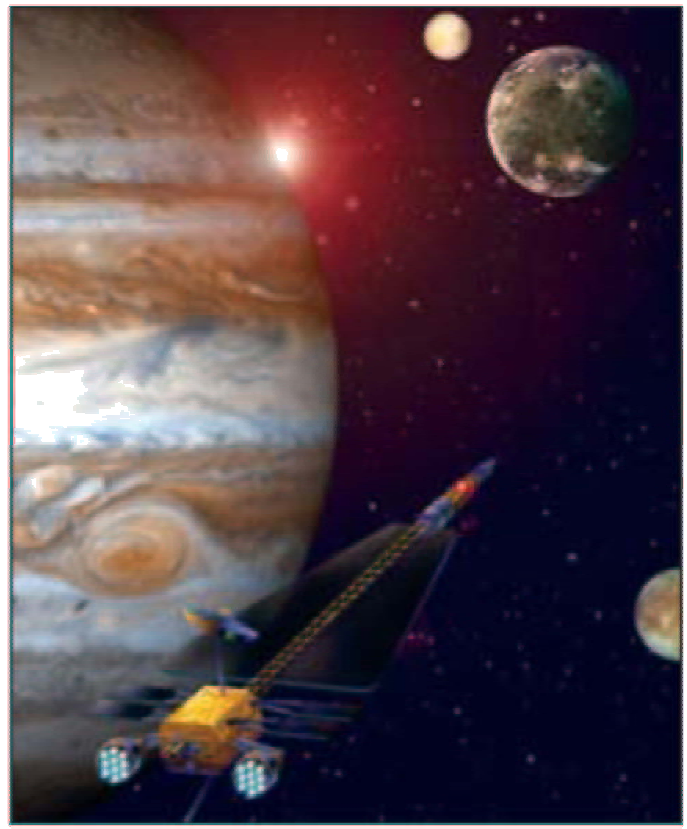
Power-Rich, Low Altitude Orbit greatly improves science mission value compared with Galileo Fly-By

Mission Profile

- Chemical launch to high Earth orbit
- Nuclear Electric Earth Departure Spiral (2 years)
- Interplanetary Cruise (6 years)
- Jupiter-Capture Spiral (1 year)
- 3-year Science Mission

NASA Jet Propulsion Laboratory Design/Tradeoff Study

- 3 Contractor Teams
- 3 Reactor Technologies
- 3 Power Conversion Technologies



INEEL has an opportunity to contribute to a more secure and prosperous tomorrow with affordable, safe, and emissions-free Nuclear Energy