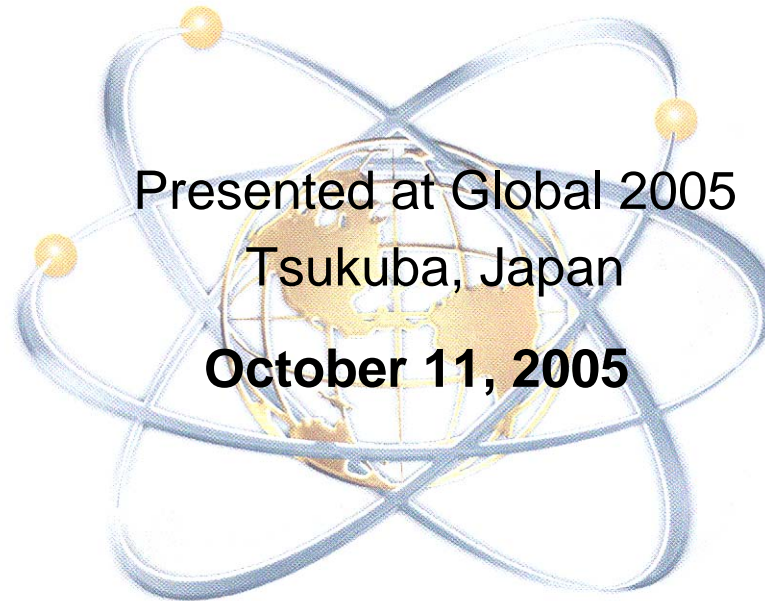




# **Power for Peace and Prosperity Building a Global Nuclear Future**

## **“Global Challenges – National Needs”**



Presented at Global 2005

Tsukuba, Japan

**October 11, 2005**

**Les E. Shephard, Vice President**

**Energy, Security & Defense Technologies**

**Sandia National Laboratories, USA**

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,  
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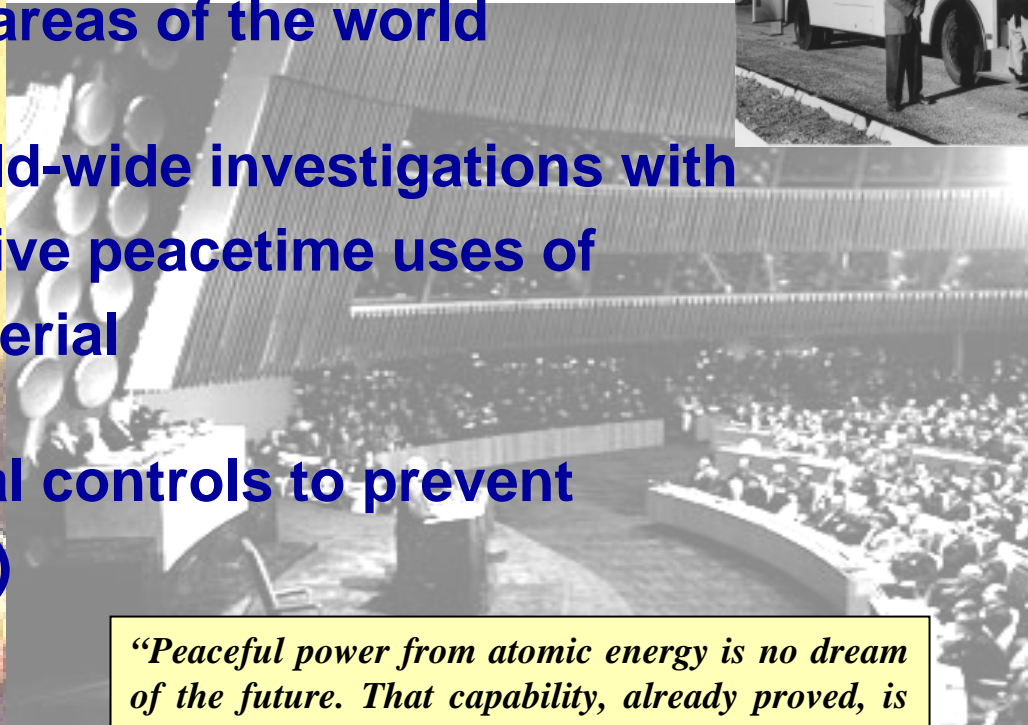


# President Dwight D. Eisenhower Atoms for Peace - 1953

Serve the peaceful pursuits of mankind . . .  
. . . provide abundant electrical energy in  
power starved areas of the world

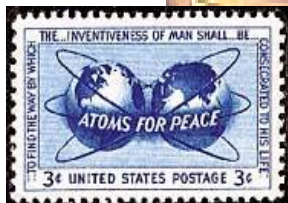
. . . encourage world-wide investigations with  
the most effective peacetime uses of  
fissionable material

Create international controls to prevent  
proliferation (IAEA)



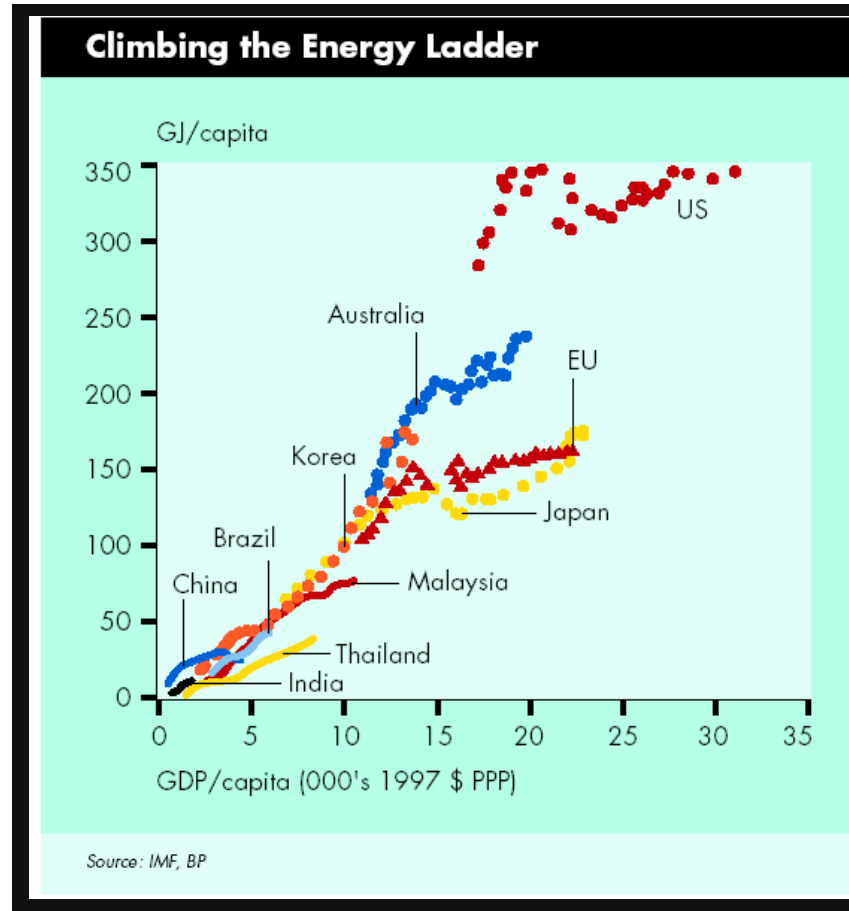
*“Peaceful power from atomic energy is no dream of the future. That capability, already proved, is here now - today.”*

*President Eisenhower,  
“Atoms for Peace,” - December 8, 1953*





# Economic Prosperity Requires Reliable and Affordable Energy

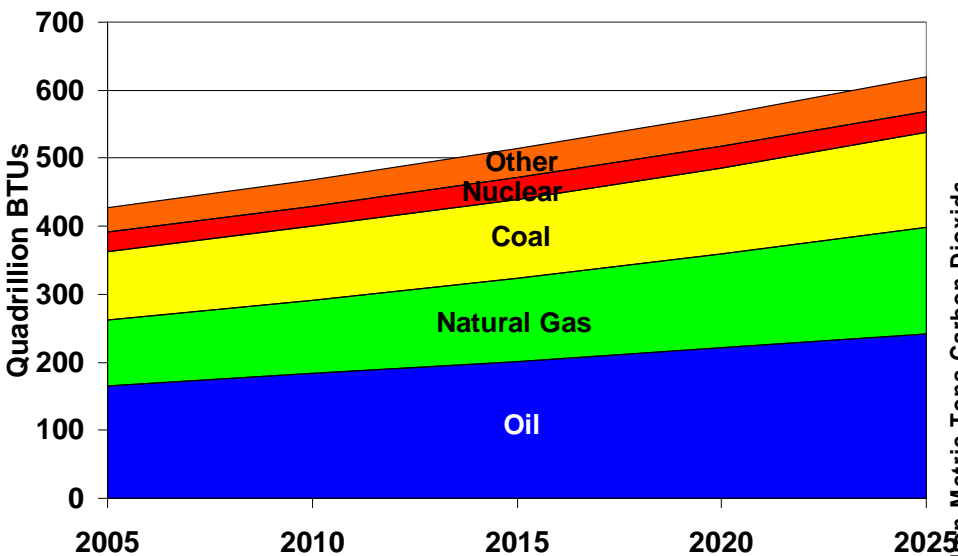


Source: Royal Dutch Shell, "Exploring the Future – Energy Needs, Choices and Possibilities"

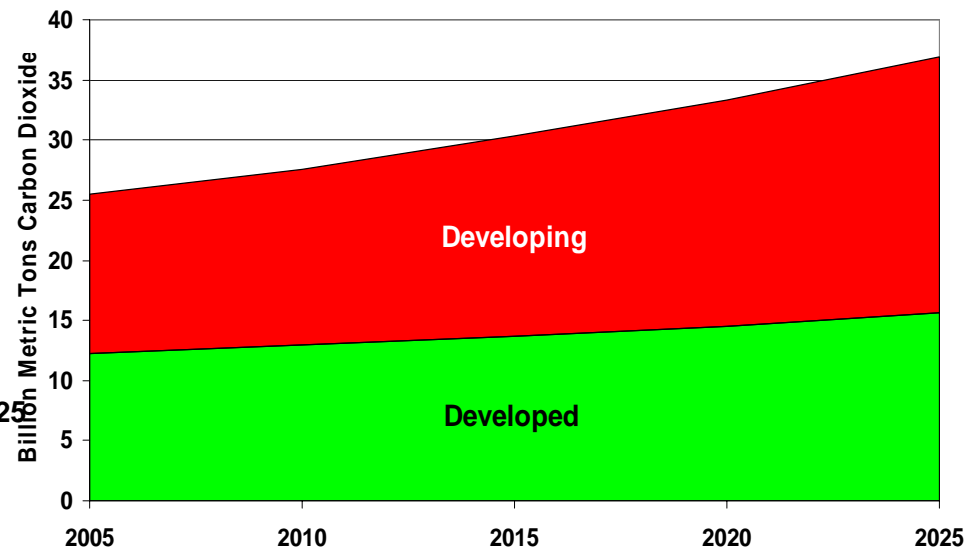


# Global Energy Demand and Carbon Emissions will Grow Over 40 Percent

## Energy Demand



## Carbon Dioxide Emissions



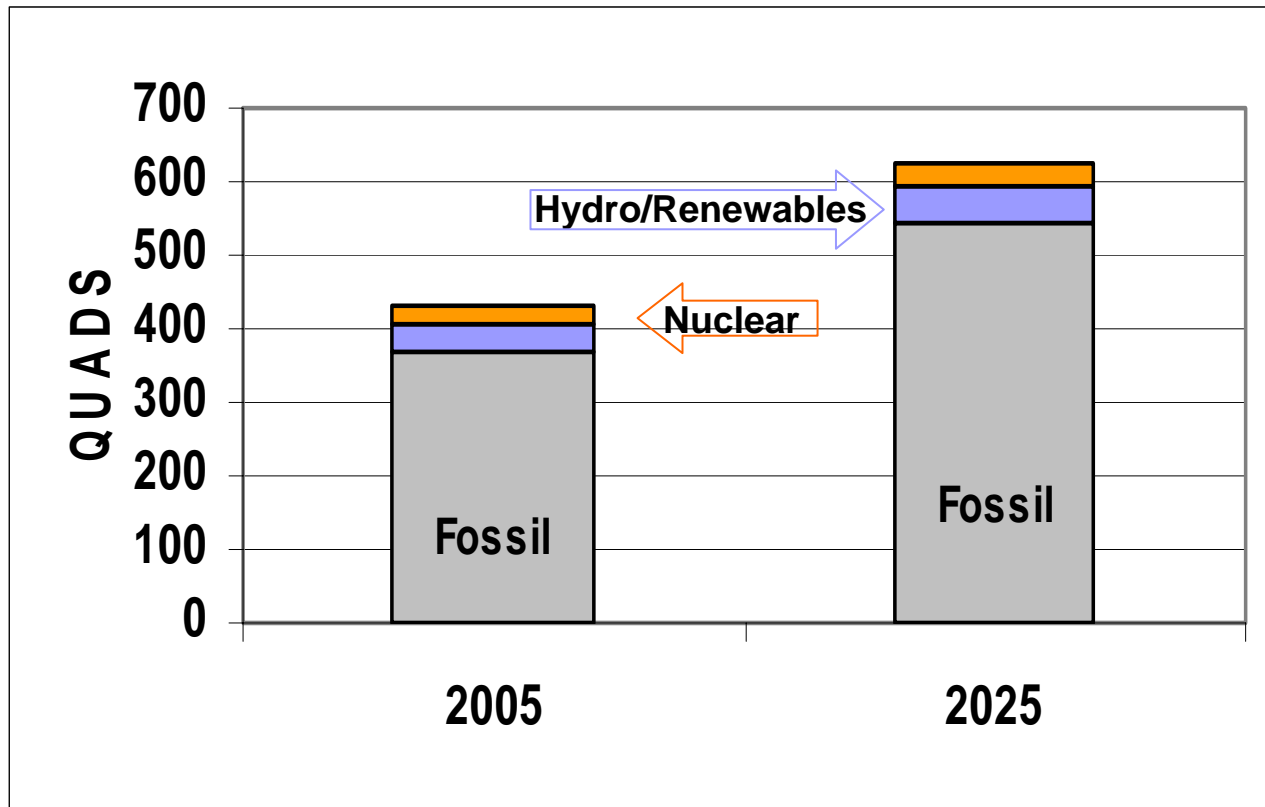
**AND Developing Countries will Account for 70% of the Increase**

Source: USDOE EIA IEO 2004 Reference Case





# ... for the Foreseeable Future, We Will be Highly Dependent on Fossil Energy



Source: USDOE EIA IEO 2004 Reference Case



# World-wide Growth in Energy Demand Will Require all Available Energy Technology Options



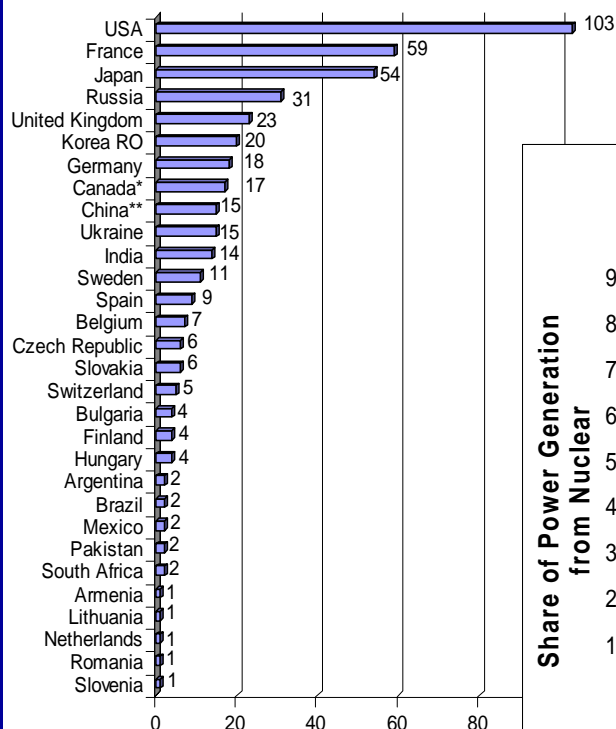
- A complete portfolio of supply options: renewables, fossil, nuclear
- Highly efficient and environmentally benign technologies
- Fault-tolerant, self-healing infrastructures
- Enhanced physical and cyber security and safety



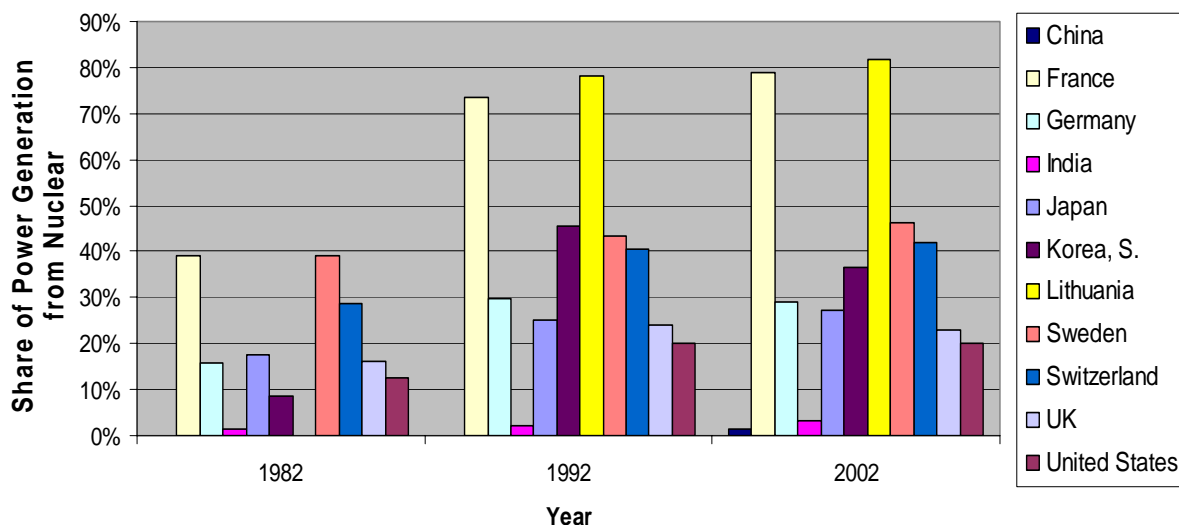


# Nuclear is an Important Contributor to Power Generation in Many Countries

## 440 Nuclear Power Plants Worldwide

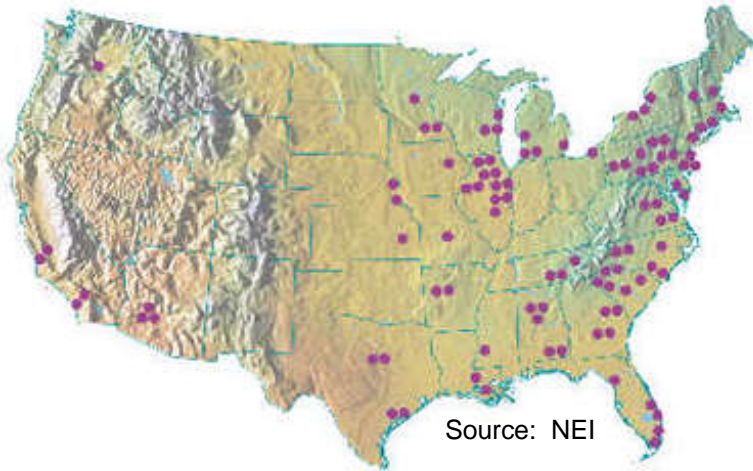


## Nuclear Share of Power Generation: 1982, 1992, 2002



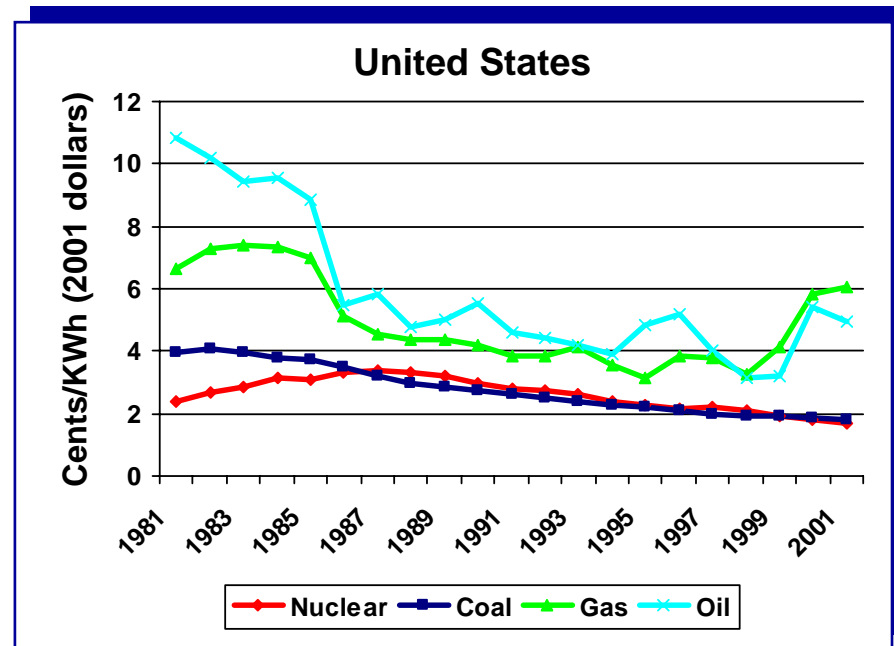


# Nuclear Energy in the US Has Performed Very Well



- They are, on average, 24 years old and licensed to operate for 40 years with an option to renew for an additional 20
- Over 2/3 of the United States' nuclear power plants have:
  - Renewed their licenses (**32 reactors**)
  - Filed for license renewal with the Nuclear Regulatory Commission (NRC) (**16 reactors**)
  - Officially informed NRC of expectations to apply for license renewal over the next six years (**22 reactors**)

- 103 commercial nuclear power plants producing electricity in the United States today
- Located at 64 sites in 31 states

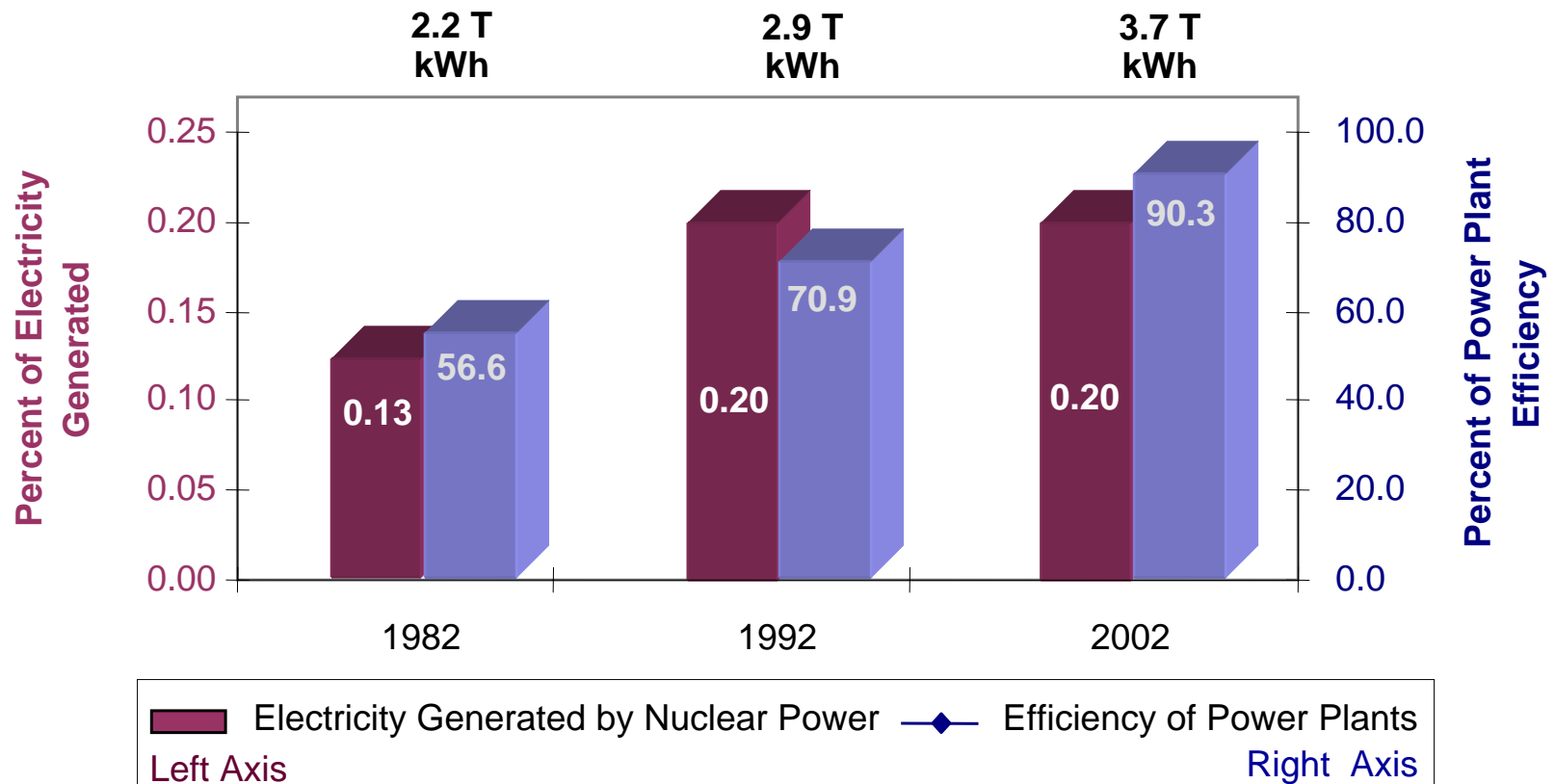






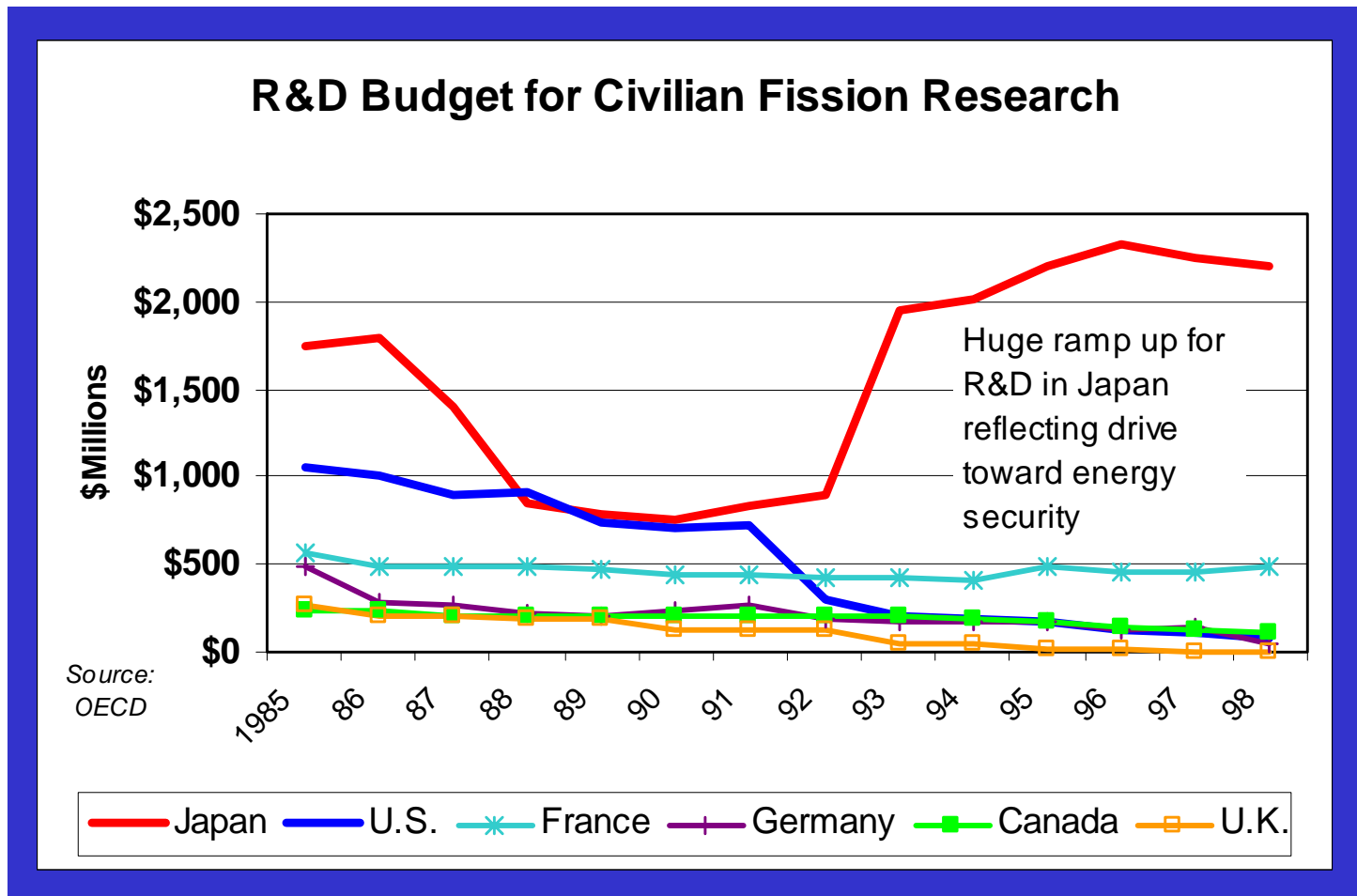
# U.S. Nuclear Electricity and Operating Efficiency

## United States





# Government Policy and Investment in Nuclear Energy Removed the US from the Market and Technical Leadership





# President Bush Sees New Nuclear Plants Essential to U.S. Energy Independence



"The first essential step toward greater energy independence is to apply technology to increase domestic production from existing energy resources. **And one of the most promising sources of energy is nuclear power. Today's technology has made nuclear power safer, cleaner, and more efficient than ever before. . .**"

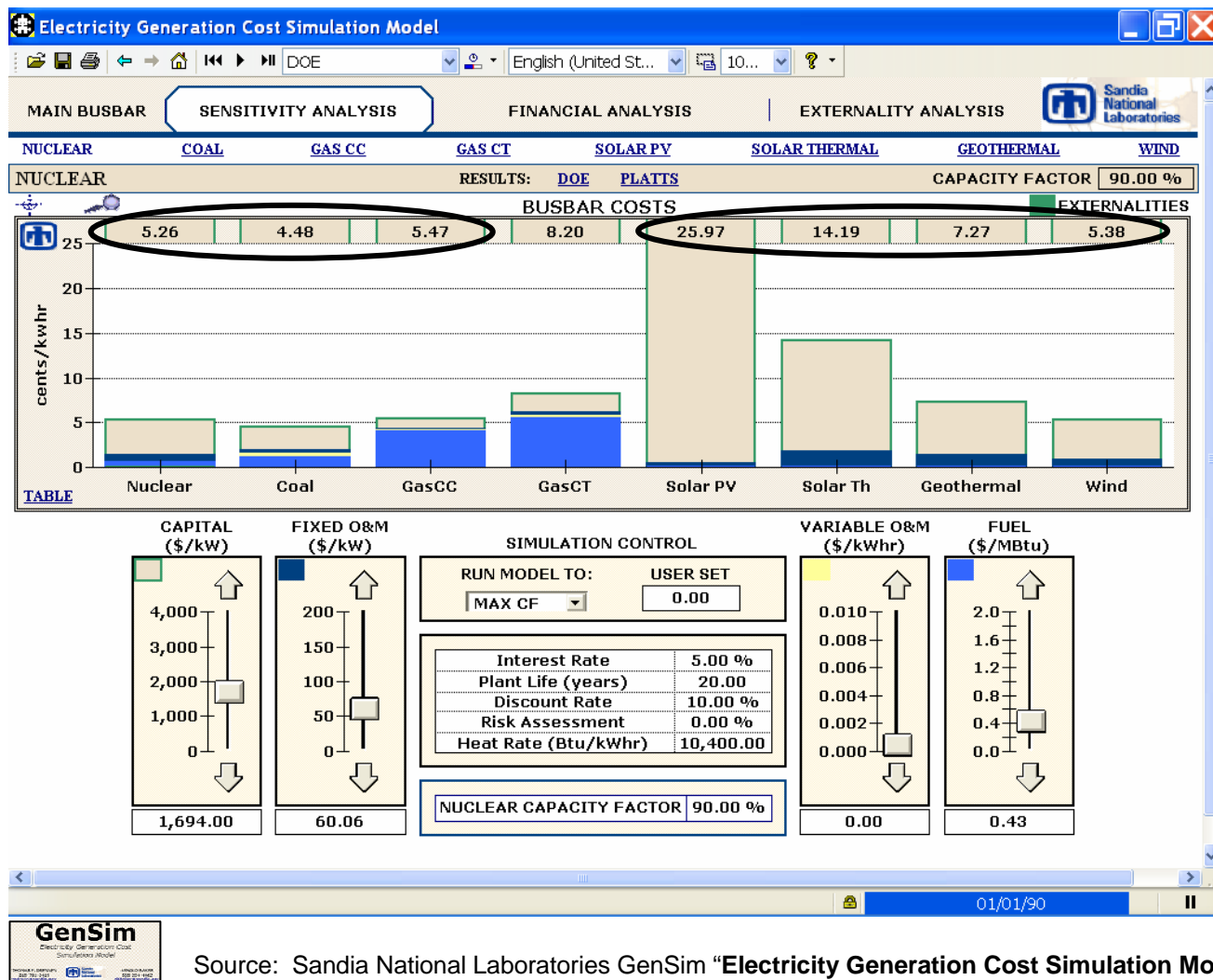
*George W. Bush  
April 27, 2005*

## Nuclear Power 2010 Initiative

- Seven-year, \$1.1B effort by Government and Industry to start building nuclear power plants by the end of this decade.



# A New Nuclear Plant is Roughly Cost Competitive with Coal and Natural Gas, Depending on Waste Management and Regulatory Stability

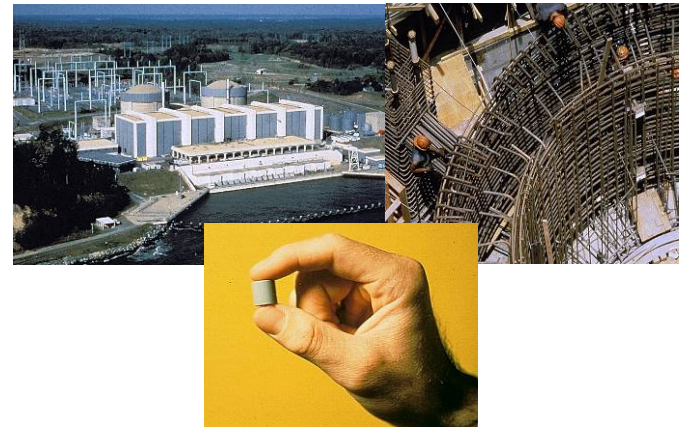


Source: Sandia National Laboratories GenSim "Electricity Generation Cost Simulation Model"



# The Peaceful Use of Nuclear Energy is Key to a Sustainable and Prosperous Future

- Nuclear plants are highly reliable and economic.
- Nuclear energy creates no airborne emissions.
- World nuclear fuel supplies can last a thousand years or more.



## *But Challenges Remain*

- Highest levels of safety, efficiency, and operability must be achieved - everywhere.
- Nuclear materials and technology must be controlled to prevent weapons proliferation.
- A solution to the nuclear waste management issue must be achieved



# US National Lab Directors Recommended a Strong Nuclear Energy Program

## Nuclear Energy Action Plan (2002)

### *Nuclear Energy: Power for the 21<sup>st</sup> Century An Action Plan*

Energy is vital to human civilization. It underpins national security, economic prosperity, and global stability. As the world's most powerful and prosperous nation, the U.S. must lead the way in developing a diverse energy system that can meet rapidly growing world energy demand in a way that promotes peace, prosperity, and environmental quality. This diverse energy system must include a growing component of nuclear energy.

In July 2002, the Directors of six U.S. Department of Energy (DOE) National Laboratories wrote to the Secretary of Energy to urge DOE to "implement a comprehensive and integrated plan to further the development of nuclear energy and the management of nuclear materials." Such a plan can help achieve the Laboratory Directors' vision:

#### **Vision:**

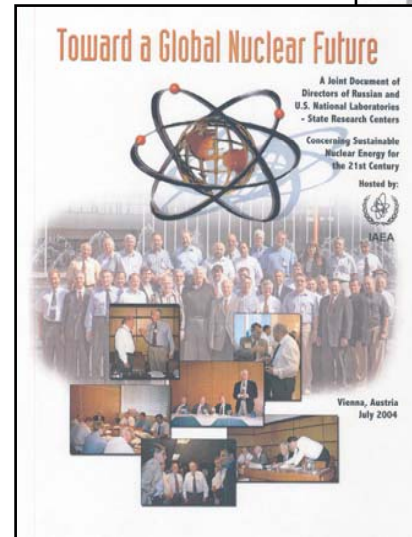
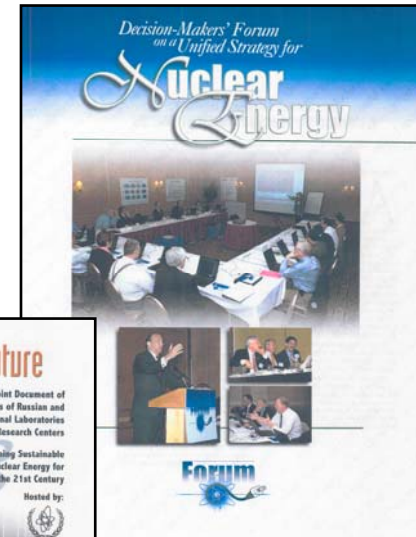
***Sustainable peace, prosperity, and environmental quality, enabled through immediate U.S. leadership in the global expansion of nuclear energy systems.***

**Goal #1:** Improve Air Quality – Reduce Carbon Emissions, and Increase Energy Security

**Goal #2:** Reduce Waste by 90%

**Goal #3:** Reduce Proliferation Risk

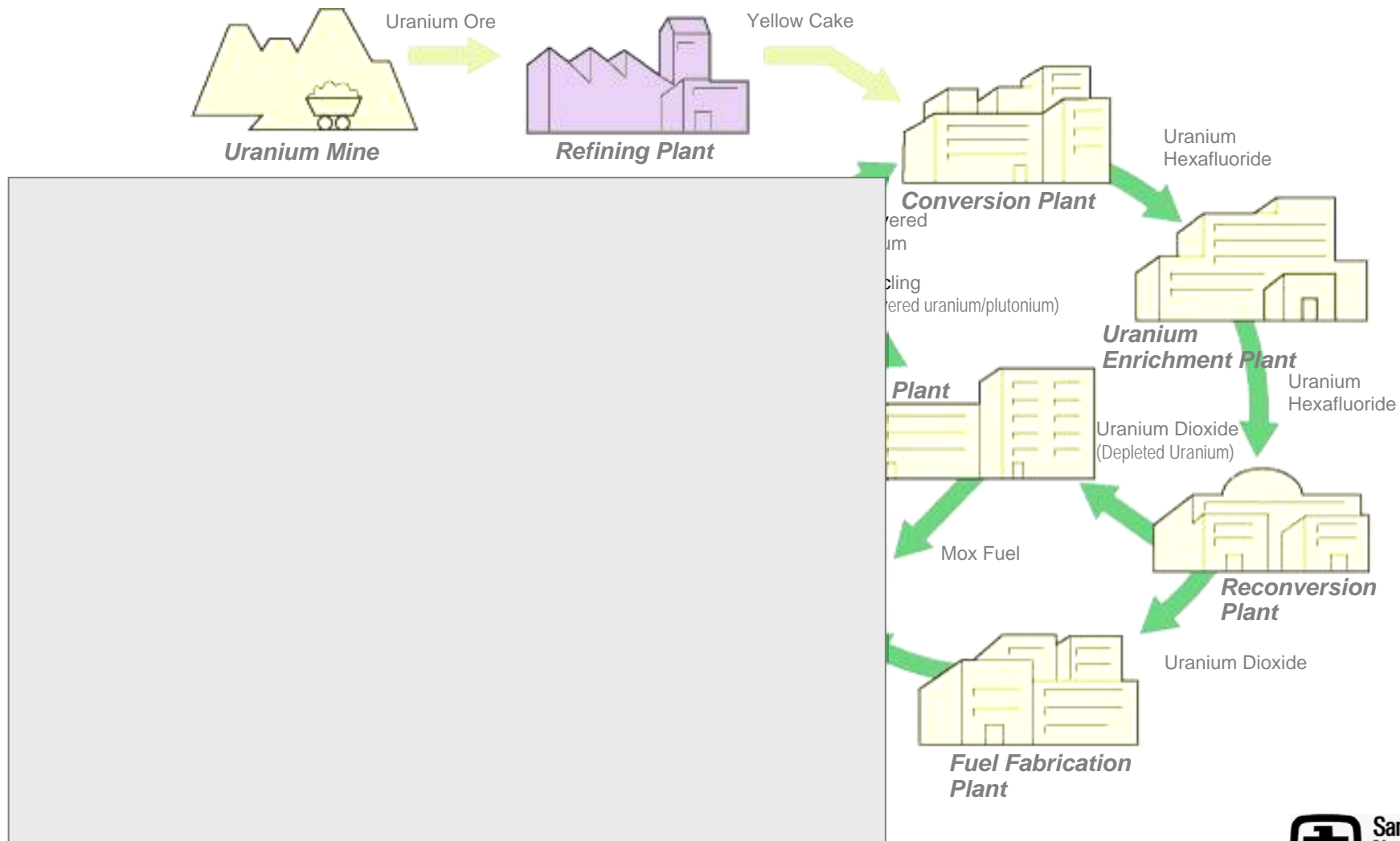
### Decision-Makers Forum in Washington, D.C. (2004)



### Met With Russian Counterparts to Discuss Principles in Common (2004)



# Nuclear Fuel Cycle – Growing Complexity Associated with Spent Fuel Management







# Overarching Recommendation

Concurrent with its Deployment of New Commercial Reactors, the United States Must Move Forward Rapidly With:



**Safeguards**

- **Advanced reactor technology for:**
  - Efficient production of electricity and hydrogen
  - Management and utilization of proliferable nuclear material
  - Global market penetration and dominance
  - Reactors for specific export markets

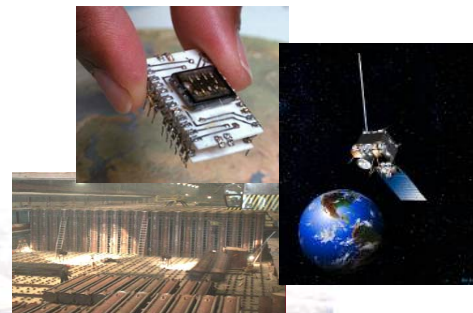
- **Advanced fuel separation and recycle technology for:**

- Nuclear material resource optimization and management for proliferation resistance
- Minimized burden on waste repository
- Global market engagement

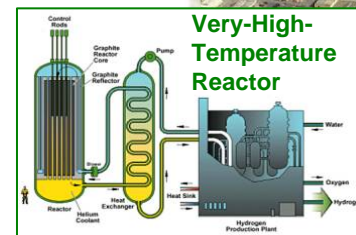
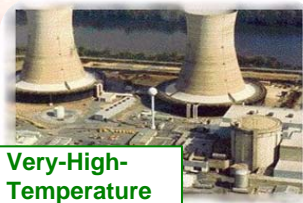
- **Advanced proliferation prevention technologies and approaches for:**

- Process transparency through smart process controls
- Real-time diversion prevention, detection and response
- Comprehensive fuel cycle information management and integration

## Advanced Proliferation Prevention



## Advanced Reactor Technology



**Advanced Fuel Separation**

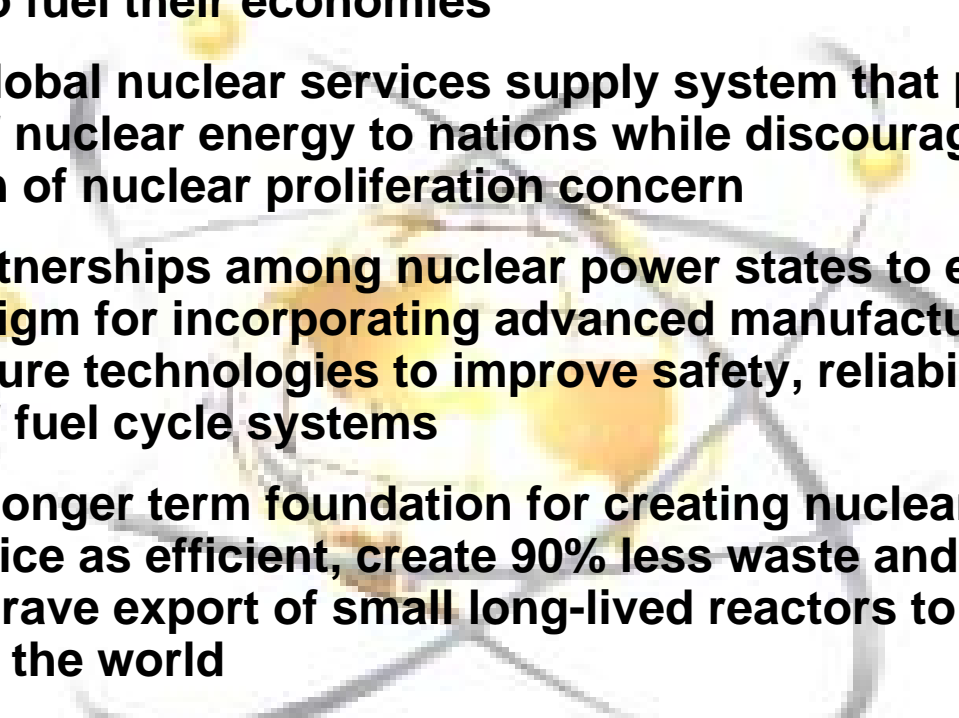




# **Building a Global Nuclear Future**

## **“Global Challenges – National Needs”**

### **Focus on the Future**

- 
- **Enable the emerging world to access clean, reliable energy supplies to fuel their economies**
  - **Create a global nuclear services supply system that provides the benefits of nuclear energy to nations while discouraging materials production of nuclear proliferation concern**
  - **Create partnerships among nuclear power states to establish a new paradigm for incorporating advanced manufacturing and infrastructure technologies to improve safety, reliability and security of fuel cycle systems**
  - **Provide a longer term foundation for creating nuclear systems that are twice as efficient, create 90% less waste and enable the cradle to grave export of small long-lived reactors to developing markets in the world**
  - **Pursue a multi-national repository that provides significant safety, security, economic and non-proliferation advantages.**





# Building a Global Nuclear Future

## “Conclusions”

- Energy is a key driver of world economic prosperity
  - Demand for energy and electricity will grow substantially over the coming years, especially in the developing world
- Nuclear power will be an important part of the global energy and electricity mix and a key asset in reducing global carbon emissions
- Science and technology supported by domestic and international policy cooperation, will enable nuclear power success