The DOE Nuclear Integration Project
Implications for the future of the U.S. Nuclear Enterprise

A Strategic Planning Look at "All Things" Nuclear In DOE

- "Weapons to Watts to Waste"
- Transition to next administration & beyond

Thesis:

- Energy Security, Nuclear Weapons, Proliferation & Terrorism, Climate Change and Environment are Primary Interlocking Issues (Opportunities) for Next Administration.

- The Department of Energy is central to those opportunities.
  - Has world-class assets ~ (Labs +)
  - Has major accomplishments
  - Integration of these assets critical for success

March 2008

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2007 Carnegie International Nonproliferation Conference
PART 1: A Conversation with Deputy Secretary of Energy Clay Sell on GNEP and Nonproliferation Policy
June 26, 2007

http://www.carnegieendowment.org/files/sell.pdf

Some Briefing Recipients

- Larry Welch
- John Ahearne
- Frank Miller
- Lab Directors
  - Steve Chu
  - Mike Anastasio
  - George Miller
- Sid Drell
- Burt Richter
- Roy Schwitters
- John Holdren
- Matt Bunn
- Daryl Kimball
- Dan Poneman
- Andy Marshall
- Joe Braddock
- Susan Eisenhower
- Roald Sagdeev
- Rich Mies

- George Shultz
- Charlie Curtis
- Bill Schneider
- Pete Domenici
- Bill Martin
- Sam Nunn
- Ron Lehman
- John Hamre
- Bob Joseph
- Bill Perry
- Will Happer
- Graham Allison
- Ash Carter
- Brent Scowcroft
- Jim Schlesinger
- John Gordon
- John Deutch
- Ernie Moniz
- Alex Flint
- Jim Baker
- Tim Roemer
- Dick Meserve
- John Marburger*
- Arden Bement*

Groups

- Strategic Command
  - Nuclear Weapons Staff
- Exchange Mon. Decision Makers Forum
  - (Environmental Management)
- Center New American Security
- Naval Submarine League
- Princeton U. Physics Colloquium
- Vanderbilt U Civil Engineering
- DNFSB Staff

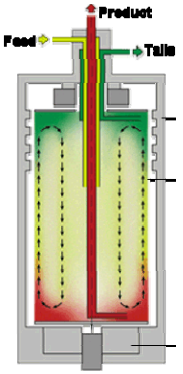
*Scheduled

Outline

Strategic Planning			
Vision	Assets	Strategies	Operating Principles

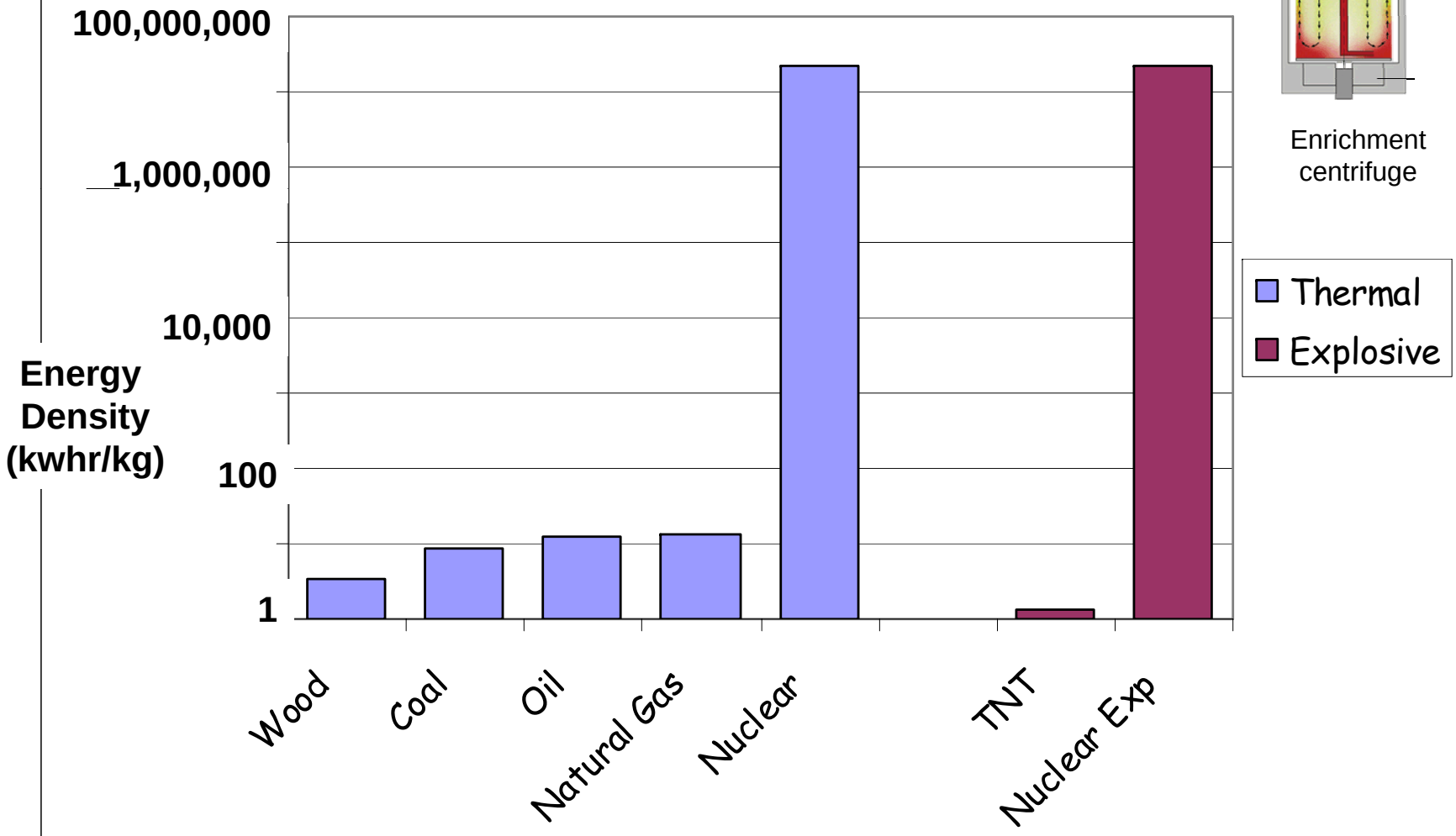
- The Nuclear Landscape
- President Bush's Nuclear Vision
- DOE Offices' Nuclear Visions
- DOE Accomplishments
- Alternative U.S. Strategies
  - Weapons
  - Power
- Integrating Policy & Programs
- Summary

The Atomic Dilemma: The industrial processes for nuclear material are similar for thermal and explosive uses

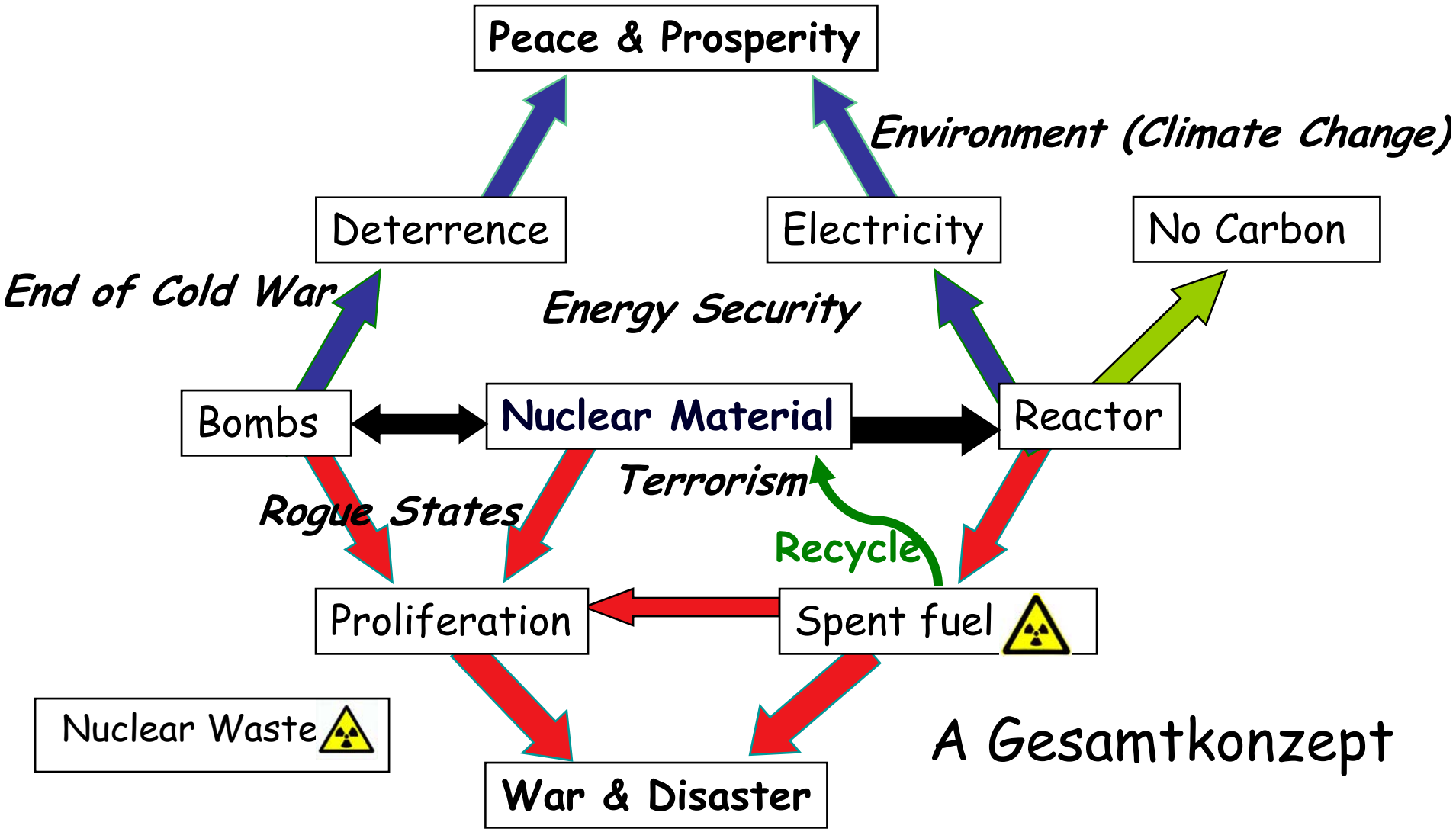


Enrichment centrifuge

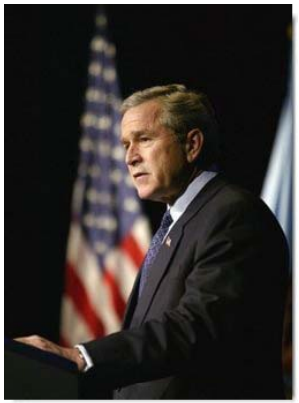
Nuclear Energy > 1,000,000 Chemical Energy



Global Nuclear System:



President Bush's Nuclear Vision: Weapons



"We can, and will change the size, the composition, and the character of our nuclear forces in a way that reflects the reality that the Cold War is over. I am committed to achieving a credible deterrent with the lowest-possible number of nuclear weapons consistent with our national security needs, including our obligations to our allies."

President Bush: Feb 2001

Each Party shall reduce and limit strategic nuclear warheads, …, so that by December 31, 2012 the aggregate number of such [deployed] warheads does not exceed 1700-2200 for each Party **Moscow Treaty, May 2002**

The third leg of the New Triad is a responsive defense infrastructure….

Maintaining our ability to respond to large strategic changes can permit us to reduce our nuclear arsenal and, at the same time, dissuade adversaries from starting a competition in nuclear armaments.

Nuclear Posture Review: December 2002

Reliable Replacement Warhead (RRW), Complex Transformation

The President has approved a significant reduction in the U.S. nuclear weapons stockpile to take effect by the end of 2007.

The reduction is part of the President's overall strategy to transform the U.S. nuclear weapons stockpile and its supporting infrastructure to better meet the security needs of the 21st Century. It is a comprehensive effort to reduce U.S. reliance on nuclear weapons and streamline and modernize our nuclear infrastructure.

December 2007

President Bush's Nuclear Vision: Energy: The Global Nuclear Energy Partnership

"As America and other nations build more nuclear power plants, we must work together to address two challenges: We must dispose of nuclear waste safely, and we must keep nuclear technology and material out of the hands of terrorist networks and terrorist states.

To meet these challenges, my Administration has announced a bold new proposal called the Global Nuclear Energy Partnership. Under this partnership, America will work with nations that have advanced civilian nuclear energy programs, such as France, Japan, and Russia. Together, we will develop and deploy innovative, advanced reactors and new methods to recycle spent nuclear fuel. This will allow us to produce more energy, while dramatically reducing the amount of nuclear waste and eliminating the nuclear byproducts that unstable regimes or terrorists could use to make weapons."

President Bush Jan 2006

DOE Nuclear Enterprise

(FY 2008 Appropriation)

DOE Office Projections (Visions) for next 2 Administrations (16 years)

- Office of Environmental Management ($6.3B)
  - Defense Cleanup almost complete
- NNSA - Defense Programs ($6.3B)
  - Stockpile Transformed (RRW),
  - Responsive Infrastructure
- Office of Science ($4.0B – Not all nuclear)
  - U.S. a global scientific powerhouse
  - DOE driving U.S. computing (X10,000)
- NNSA - Office of Defense Nuclear Non-Proliferation($1.7B)
  - All Russian Federation (and other) nuclear material under control
  - Effective Global Safeguards & Security
  - Nuclear Fuel Leasing Regime
- Office of Nuclear Energy ($0.96B)
  - U.S. 10 -20 new reactors & regional US recycling
  - Nuclear Fuel Leasing Regime
- NNSA -Naval Reactors ($0.77B)
  - New Carrier plant at sea
  - Trident replacement plant almost complete
- Office of Civilian Radioactive Waste Management ($0.39B)
  - Yucca Mountain Licensed and Operating

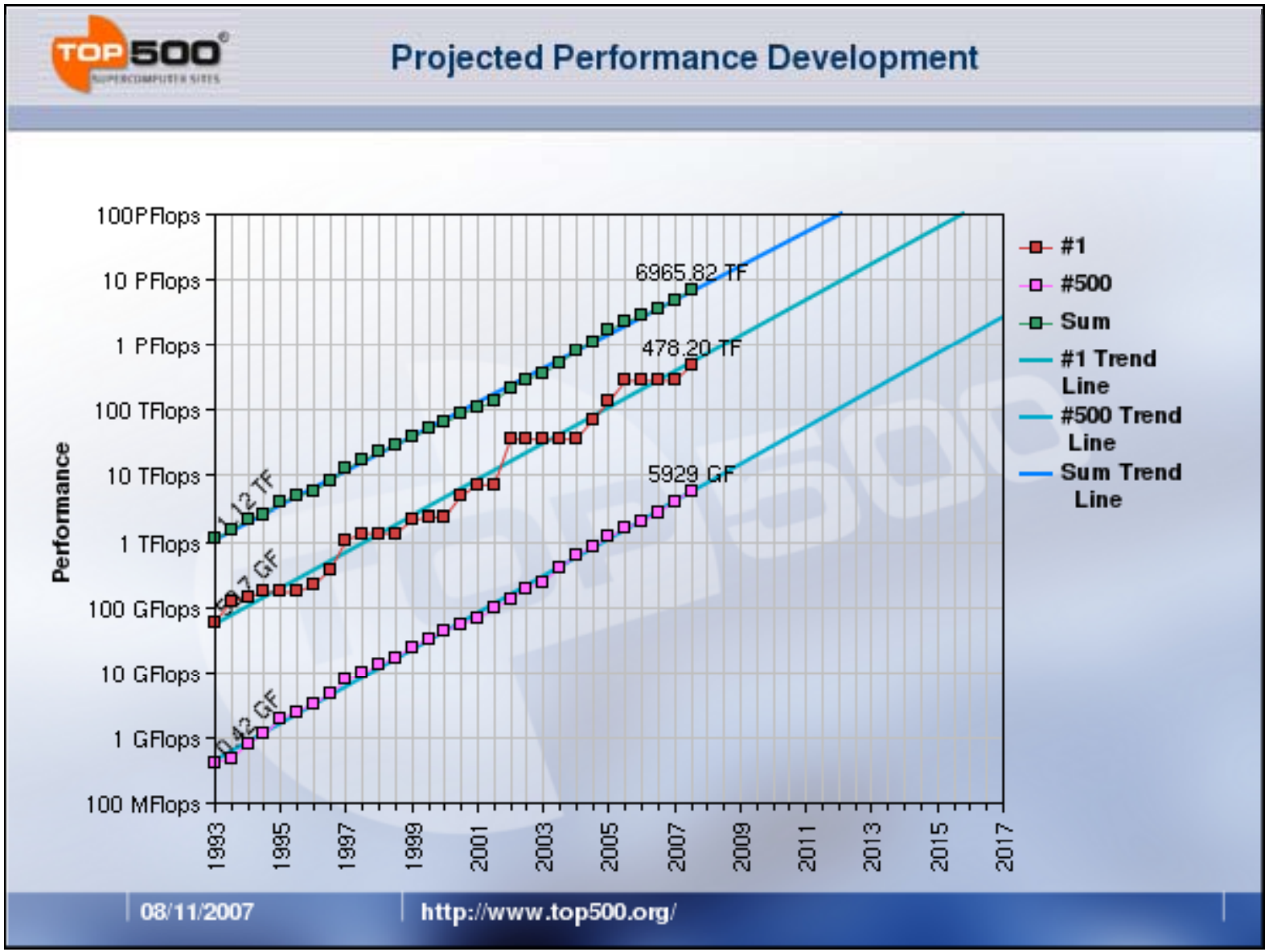
Sample DOE Accomplishments ~ last 15 years

- Major New Science Installations
  - Spallation Neutron Source – Oak Ridge
  - Advanced Photon Source - Argonne
  - National Ignition Facility - Livermore
  - Linac Coherent Light Source - SLAC
  - Relativistic Heavy Ion Collider - Brookhaven
  - Microsystems and Engineering Sciences Application (**MESA**) - Sandia
- Stockpile Stewardship
  - Weapon Certification without underground testing
  - High Performance Computing Leadership
  - Much deeper understanding of nuclear explosive process
  - Stockpile Life Extension
- Non-Proliferation
  - Russian Weapons and Material Security much improved
  - International Safeguards
- Defense Clean Up
  - Rocky Flats
  - Mound
- Radioactive Waste Disposition
  - Waste Isolation Pilot Plant (WIPP)

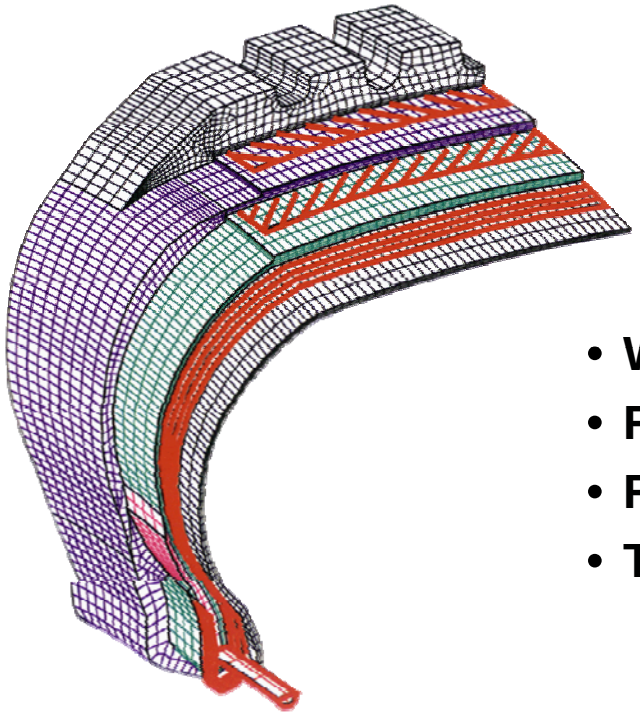
DOE Accomplishment: Supercomputing
From November 2007 list of Top 500 Computers

SITE	COUNTRY	Vendor	SPEED (terraflops) 10^9
LLNL	U.S.	IBM	478
Julich	Germany	IBM	167
NMCAC	U.S	SGI	127
Tata Group	India	HP	118
FRA	Sweden	HP	103
SNL	U.S.	Cray	102
ORNL	U.S.	Cray	102
Watson	U.S.	IBM	91
LBNL	U.S.	Cray	85
BNL	U.S.	IBM	82

DOE has led the modern Super Computing Industry

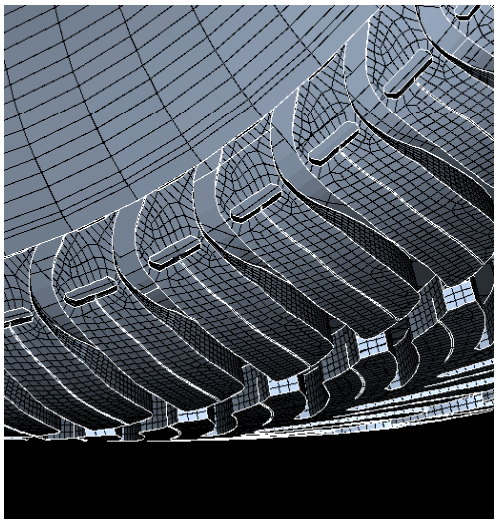


DOE Accomplishment: Sandia helped Goodyear use advanced simulation to transform tire design and manufacture.



Challenges

- Wear and failure
- Road handling
- Ride, vibration and noise
- Traction in all weather



Goodyear Assurance w/
TripleTread Technology

Accumulated slip distribution
=> wear prediction

DOE Accomplishment: Rocky Flats Cleanup

DOE's Rocky Flats Cleanup Site Named 2006 Project of the Year By Project Management Institute

"With the transfer of nearly 4,000 acres from the Department of Energy, the U.S. Fish and Wildlife Service will establish the Rocky Flats National Wildlife Refuge in order to conserve the rare and unique tallgrass prairie found along Colorado's Front Range," U.S. Department of Interior's Director of the Fish and Wildlife Service H. Dale Hall said. "As intended by Congress, the refuge will preserve a lasting wildlife and habitat legacy for future generations."

July 12, 2007

The 10-year environmental cleanup of the site cost approximately $7 billion and finished more than 50 years ahead of initial forecasts and for nearly $30 billion less than estimated in 1994

Strategies: Nuclear Weapons

Goals:

Fewer Nuclear Weapons (How Many?)

- Characteristics ?

– Responsive Infrastructure ? (Nuclear Posture Review –'03)

-Comprehensive Test Ban Treaty (CTBT)?

1. Gradual Reduction of Stockpile — CTBT
2. Gradual Reduction of Stockpile + RRW ← Program of record
3. Sharp Reduction of Stockpile + RRW — CTBT
4. Sharp Reduction of Stockpile — CTBT

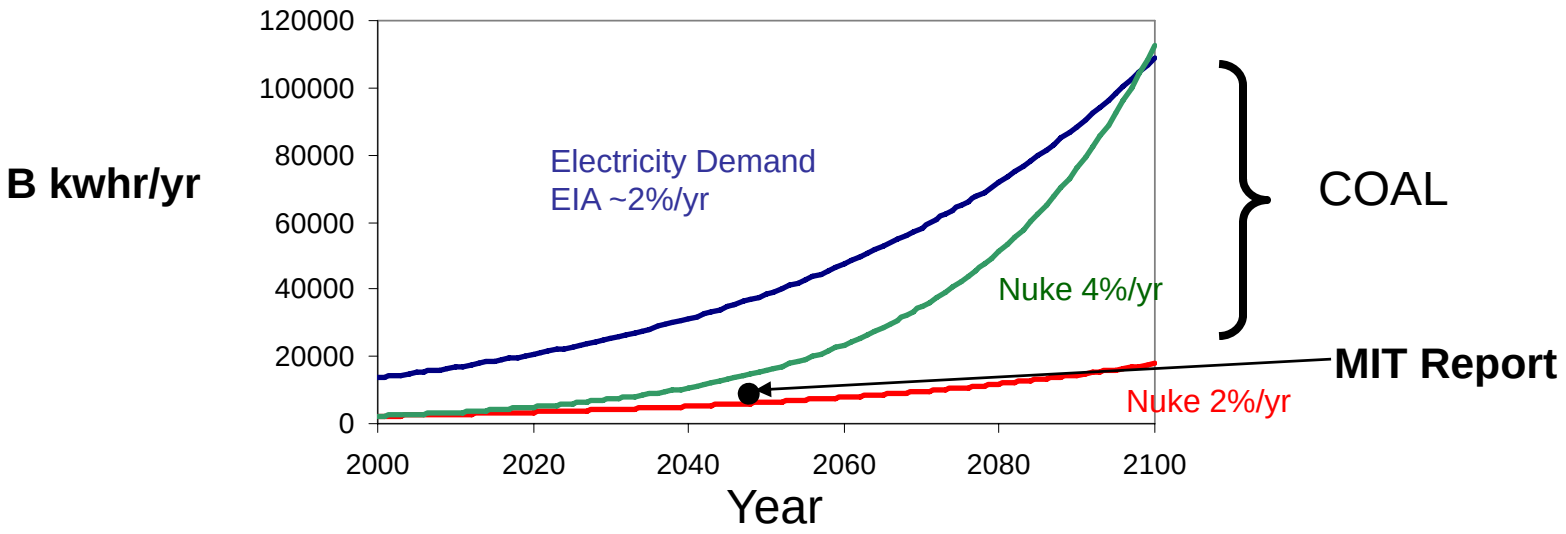
Role of Science?

Strategies: Nuclear Energy

1) Phase out Nuclear Energy (Former U.S)
   - Nuclear Power is too proliferation prone, waste an issue
   - Maintain Safety, discourage international reprocessing

2) Nuclear Energy remains "Part of the Mix" (Current US)
   - Should compete with alternatives – Coal, Renewables
   - International arrangements for non-proliferation

3) Nuclear Energy becomes primary global source of base-load electricity
   - Climate Change
   - International arrangements for non-proliferation



Government Policies for U.S Nuclear Energy Development

- Reduce Financial Risk for New Nuclear Power Starts
  - Loan Guarantees, Production Tax Credits, Startup Risk Insurance (EPAct 2005), NP2010
- Geologic Storage for Waste
  - License Yucca Mountain Repository

- Global Nuclear Energy Partnership (International Principles)
  - Expand Nuclear Power
    - Safe & effective waste management
  - Improve Safeguards
    - IAEA
  - Supply Framework for Fuel Services
  - Fast Reactors
    - Develop, Demonstrate & Deploy
  - Appropriate Sized Reactors for Developing Countries
  - Develop & Demonstrate Advanced Recycling
    - Eventually eliminate stocks of separated Pu
  - Used Best Available Fuel Cycles

GNEP Partners
(As of February 26, 2008)

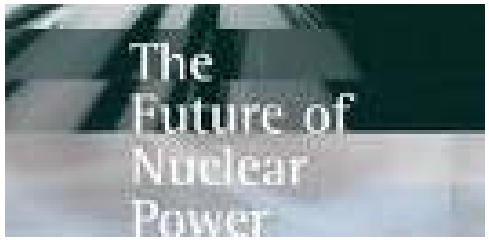
1. Australia
2. Bulgaria
3. Canada
4. China
5. France
6. Ghana
7. Hungary
8. Italy
9. Japan
10. Jordan
11. Kazakhstan
12. Lithuania
13. Poland
14. Romania
15. Russia
16. Senegal
17. South Korea
18. Slovenia
19. Ukraine
20. United Kingdom
21. United States

Proposed U.S Nuclear Growth Strategies

- Program of Record
  - Commercial Business Model for Industrial Recycling
    - Build upon Available Recycling Technology
      - Separation
      - Thermal & Fast Reactors
    - Process Storage of Spent Fuel
    - Modest R&D
      - Industry driven
      - International Partnerships
        - » Gen 4 International Forum

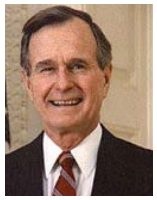
Current Congressional Program

- Alternative Program
  - Government Model
    - Interim Storage
    - Alternative Repositories
    - Strong R&D
      - Reactor & Fuel Cycle
        - » Laboratory, University, Industry
        - » International Partnerships



Closing the Policy Circle

Fewer Nuclear Weapons



NPT Article 6

"0"

More Excess Weapons Material

A lot more Nuclear Power

Climate Change
Energy Security

Effective Non-Proliferation Regime
Material Control, Fuel Leasing

NPT Article 4

CTBT

More Stable International Political Regime

Atoms for Peace

A Structure for DOE Nuclear Integration

MISSION

Weapons
RRW

Energy
GNEP

Nonproliferation

Stockpile Stewardship

Material Control

Intelligence
Technological Surprise
Counter Terrorism

Climate Change

Wpns Plants
Complex
Transform

Industry

Core Competence

> Petaflop Computing

State of the Art Experimental Facilities

Academia

Labs
(Brains)

Material & Radiation Science

Surety
(Integrated safety and security)

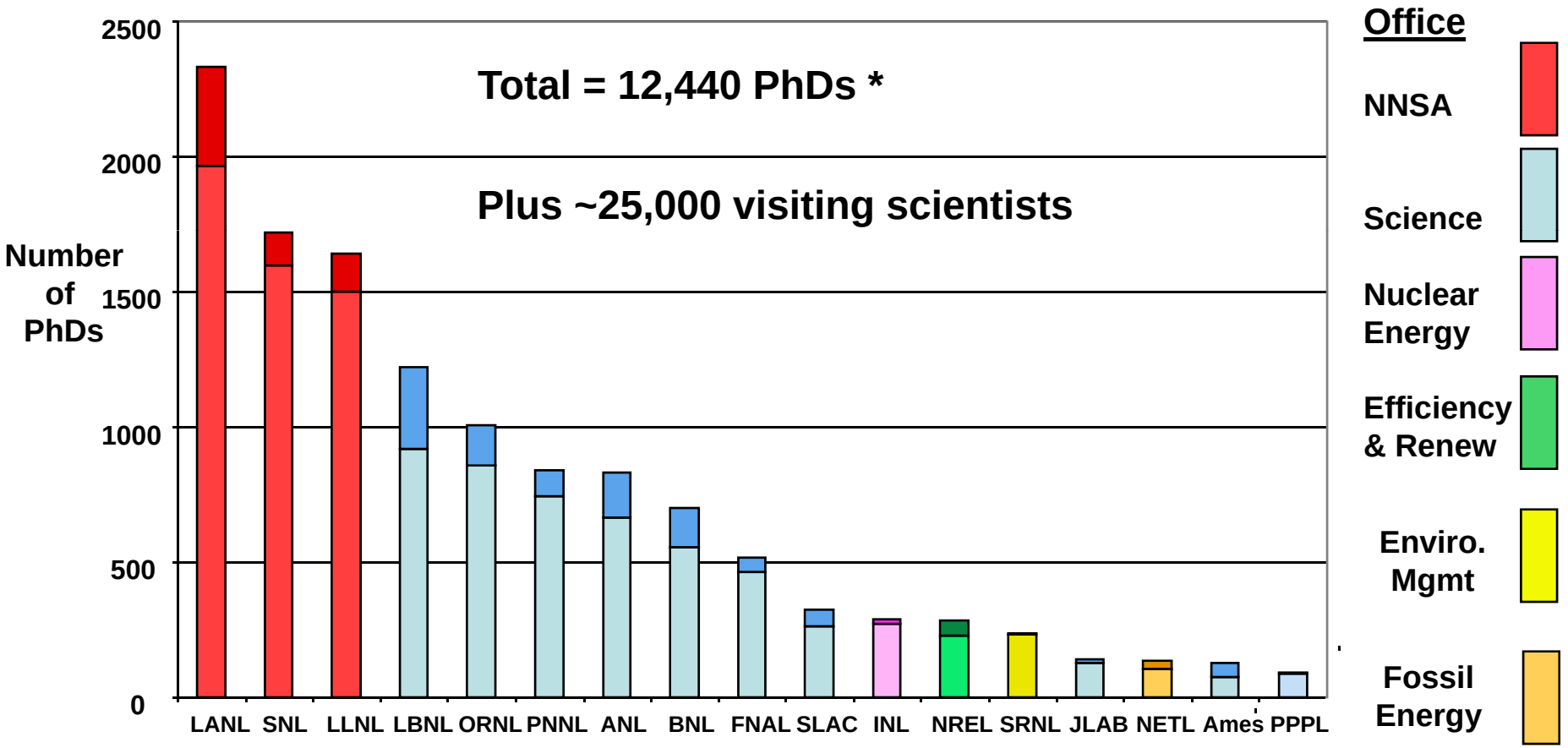
Potential Integrating Themes

Full Fuel Cycle Materials Management

Maintaining DOE Nuclear Core Competence
-- Laboratory Vitality --

- Balancing Pure and Applied Science for National needs.
  - Energy Security
  - National Security
  - Environment
  - U.S. Competitiveness
  - Nuclear Science
- Maintaining leadership (core competence) in relevant science and technology
  - Challenge Problems
    - Boost Initiative
    - Advanced materials
    - Deep understanding of Environmental Impact
    - ....
  - Signature Facilities
    - SNS, LCLS, NIF, APT, etc
  - Computing & Simulation
- Creating a DOE System of Labs
  - Federal & Lab “Team”
    - Control & Governance in a FFRDC/GOCO world.
    - Federal technical competence
  - Capacity (user facilities) & Capability (NIF)
  - Competition & collaboration
  - Office Ownership vs Program needs
  - Integrating with Industry & Academia
    - IBM, Goodyear, etc.
  - Classified vs Open Research
    - Foreign interactions

DOE has a large collection of PhD scientists at 17 labs



17 labs

*** October 2007**

Integrated Safety and Security (Surety) as a DOE/Nuclear Integrating Factor (From DOE Workshop)

MILITARY

Palomares

CIVILIAN

Three Mile Island

"Principle Based "Surety

"SAFE – 3 I's "

IHE, ENDS, FRP…,

W-80, B-83, B61

W-88, W76-1

RRW

Probabilistic Risk Assessment

"Risk informed" licensing

AP1000, ESBWR…..

4th Generation

Fully Integrated Design Process (FIDP)

Advanced Systems and Facilities

Active Strategies

Secure Transport

GNEP

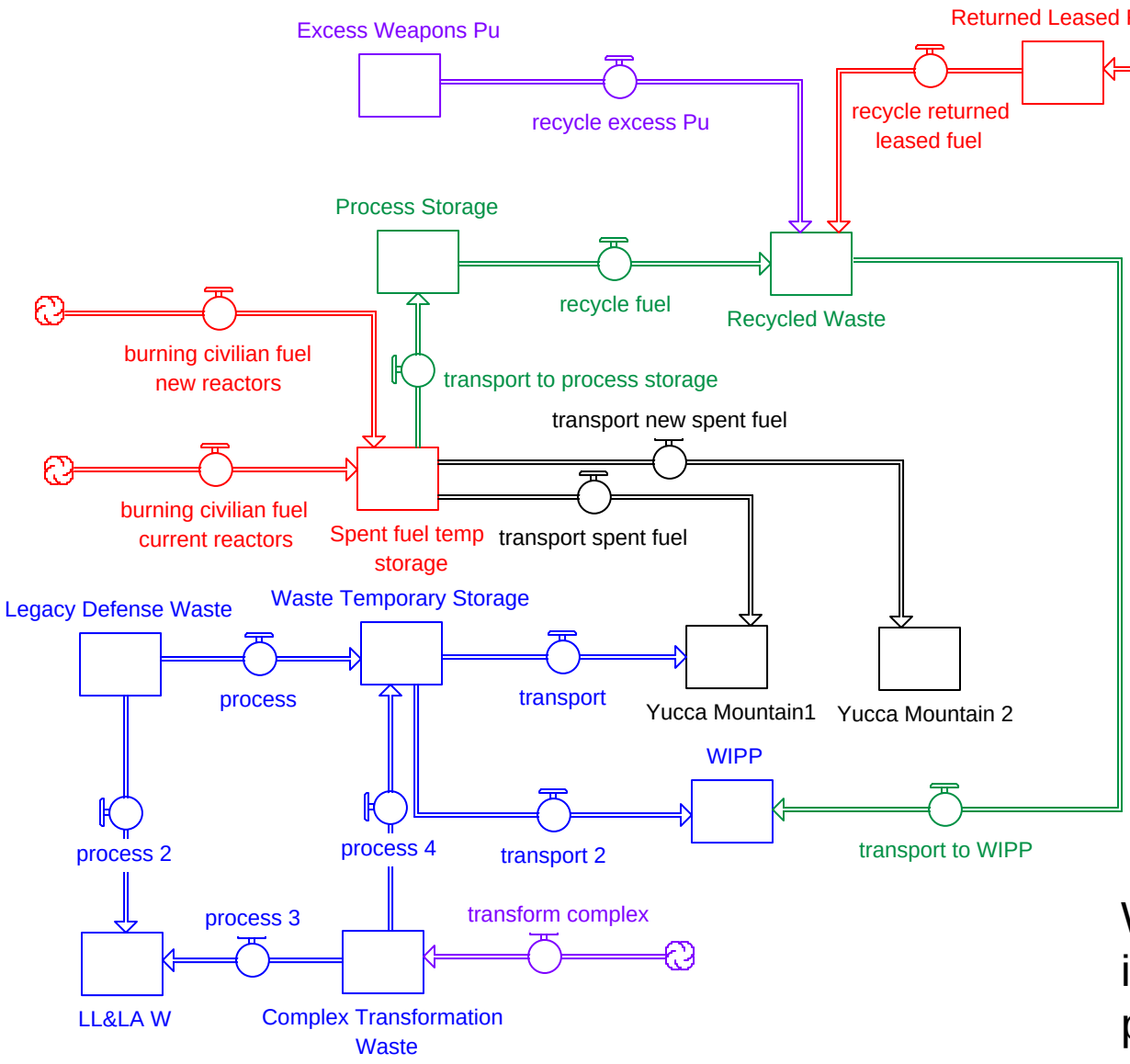
Weapons Complex Transform

Safeguards & Security

Cyber

Advanced Sensors & Simulation

Notional "Backend" Stock and Flow of "Radioactive Waste" Material



Primary Responsibility

Commercial

DOE (Office)

Environmental Management

Nuclear Energy (GNEP)

Civilian Radioactive Waste

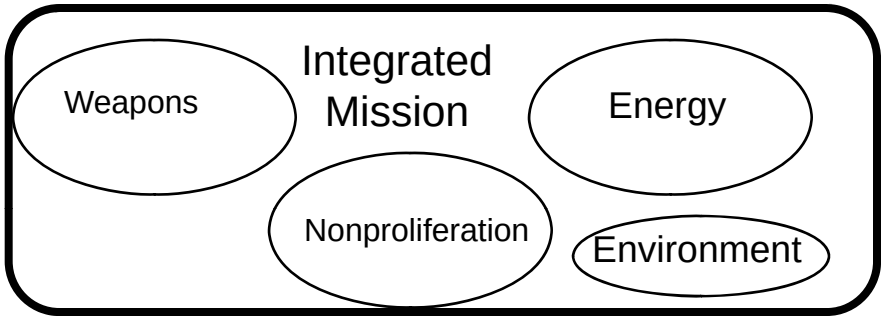
NNSA

Workshop: developing an integrated "picture" for a possible integrated program

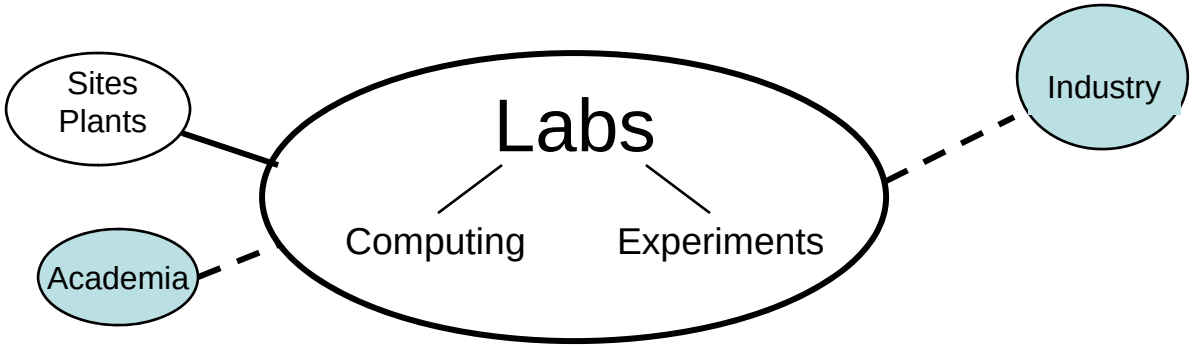
The Energy density from Fission > 1,000,000 than anything else

Vision: 21st Century "Atoms for Peace"
(and prosperity, and environment)

Strategy:



Assets:



Operating Principle:

Nuclear Integration Project
Preliminary Summary

Based upon DOE accomplishment, capability - and industry support - the next President has the opportunity to provide international nuclear leadership:

Catalyze U.S. nuclear construction

Significantly reduce number of nuclear weapons, while maintain extended deterrence & avoid testing

Invigorate U.S. scientific, technological and industrial vitality, laying the foundation for a large increase in nuclear power – energy security, climate change

Develop effective international non-proliferation regime & help provide an effective response to nuclear terrorism

A more effective and integrated DOE

Toward “Atoms for Peace”

“To the making of these fateful decisions, the United States pledges before you – and therefore before the world – its determination to help solve the fearful atomic dilemma –to devote its entire heart and mind to find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.”

President Eisenhower, December 1953