US Commercial Nuclear Power Status

Scott Pugh

*ASPO-USA**

Nuclear Energy 2006: Status and Outlook

Department of Defense
Energy Conversation Series
September 18, 2006

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President and Chief Executive Officer
NUCLEAR ENERGY INSTITUTE

NEI
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Commercial Nuclear Power in the United States

Meeting with Chevron

John Stamos

Office of Light Water Reactor Deployment
Office of Nuclear Energy

September 20, 2007

MIT 66-144, Cambridge MA, 28 February 2006

Nuclear power: competitive economics and potential climate-protection role

Amory B. Lovins, CEO

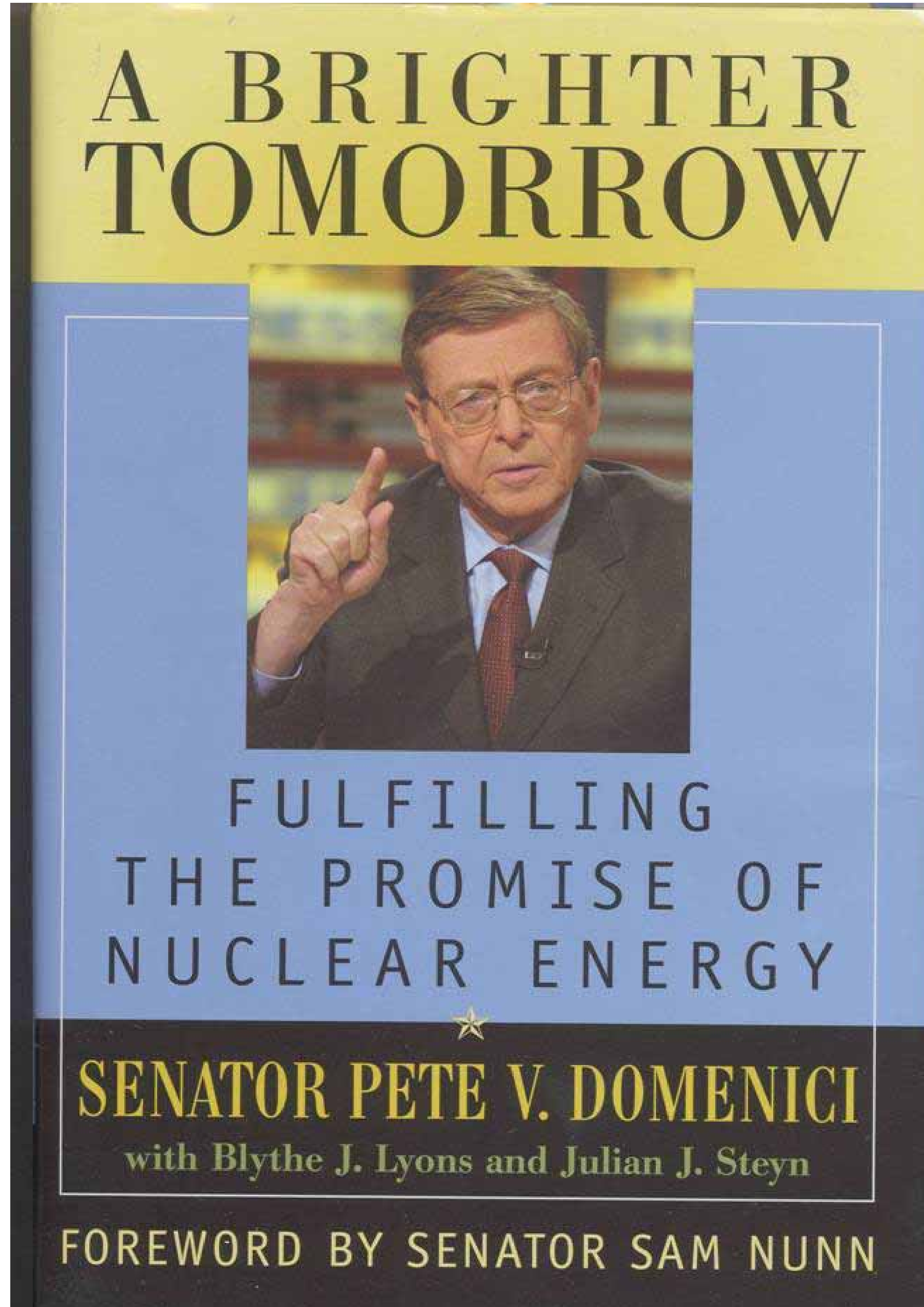
Rocky Mountain Institute, www.rmi.org

Documentation is at www.rmi.org/sitepages/pid171.php#E05-14, summarized …-15

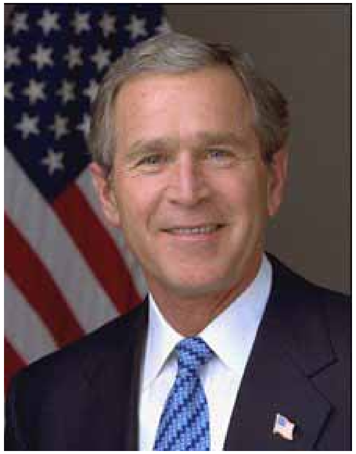
Key Nuclear Power Questions

1. **Cost** - competitive compared to other energy sources?
2. **Subsidies** - should it be supported by tax payers?
3. **Safety** – can it be operated without serious accidents?
4. **Security** - can it be protected against terrorism?
5. **Climate** – are other zero-emission options better?
6. **Waste** - can waste and "spent" fuel be safely managed?
7. **Fuel** - is there enough to support expanded operations?
8. **Workforce** - will it support industry growth?
9. **Proliferation** - will it lead to more nuclear weapons?
10. **Conflict** - will it cause international disputes?
11. **Net benefits** ***- do they outweigh the problems?***

“… we now face a future in which ***global oil production may already be peaking***, and the price of natural gas will soar …”
(Page 2)

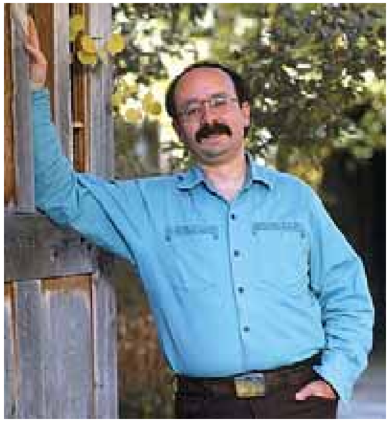


Which One Opposes Nuclear Power?



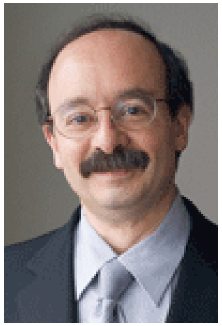
President George Bush
(Oil Industry)

James Lovelock
(Gaia Theory)

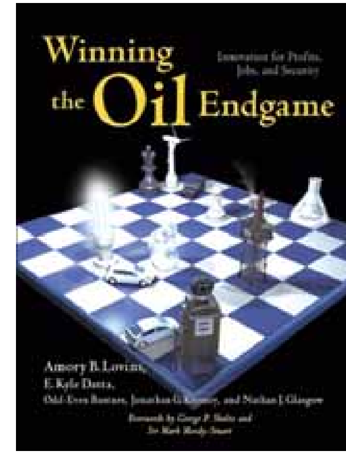


Nuclear Physicist Amory Lovins
(Rocky Mountain Institute)

Patrick Moore
(Greenpeace Founder)



Rocky Mountain Institute
abundance by design™



RMI's position on nuclear power is that:

Costs more & depends on subsidies

• **It's too expensive.** Nuclear power has proved much more costly than projected — and more to the point, more costly than most other ways of generating or saving electricity. If utilities and governments are serious about markets, rather than propping up pet technologies at the expense of ratepayers, they should pursue the best buys first.

Financially risky

• **Nuclear power plants are not only expensive, they're also financially extremely risky** because of their long lead times, cost overruns, and open-ended liabilities.

Not the best way to reduce GHG

• Contrary to an argument nuclear apologists have recently taken to making, **nuclear power isn't a good way to curb climate change**. True, nukes don't produce carbon dioxide — but the power they produce is so expensive that the same money invested in efficiency or even natural-gas-fired power plants would offset much more climate change.

Nuclear waste & weapons proliferation

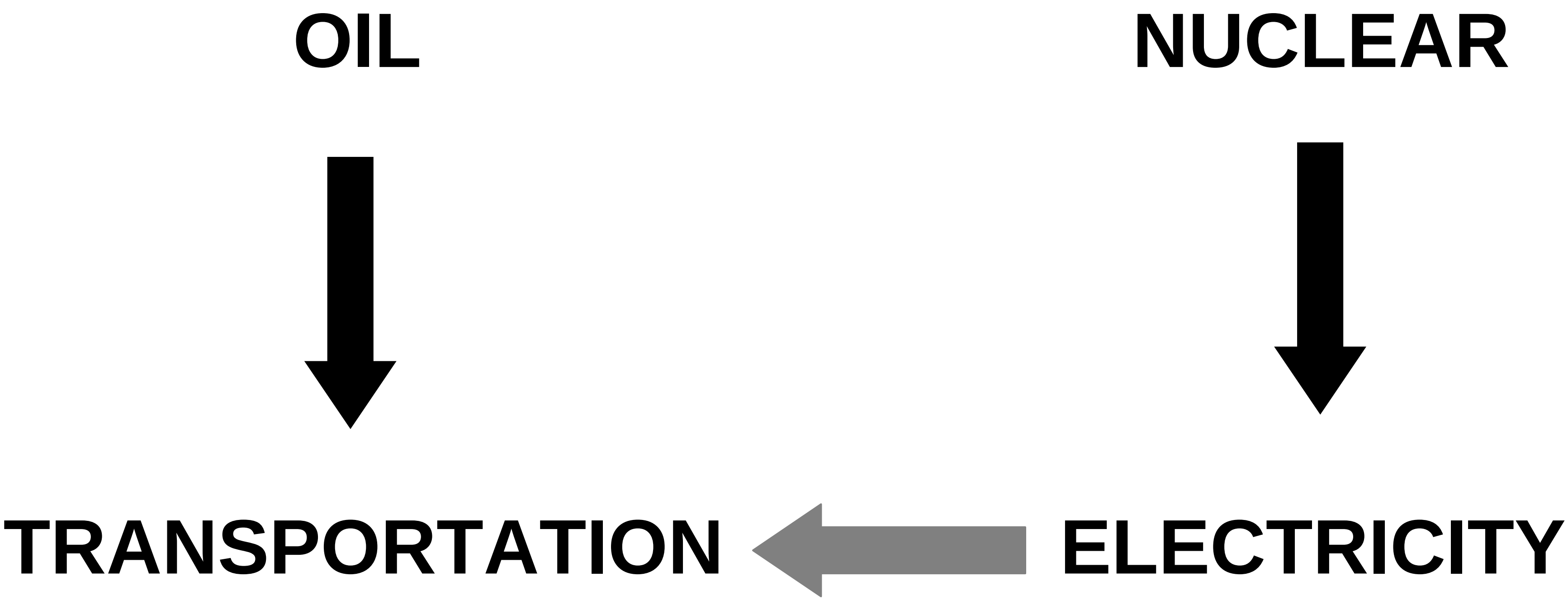
• And of course **nuclear power poses significant problems of radioactive waste disposal and the proliferation of potential nuclear weapons material**. (However, RMI tends to stress the economic arguments foremost because they carry more weight with decision-makers.)

Today

OIL → TRANSPORTATION

NUCLEAR → ELECTRICITY

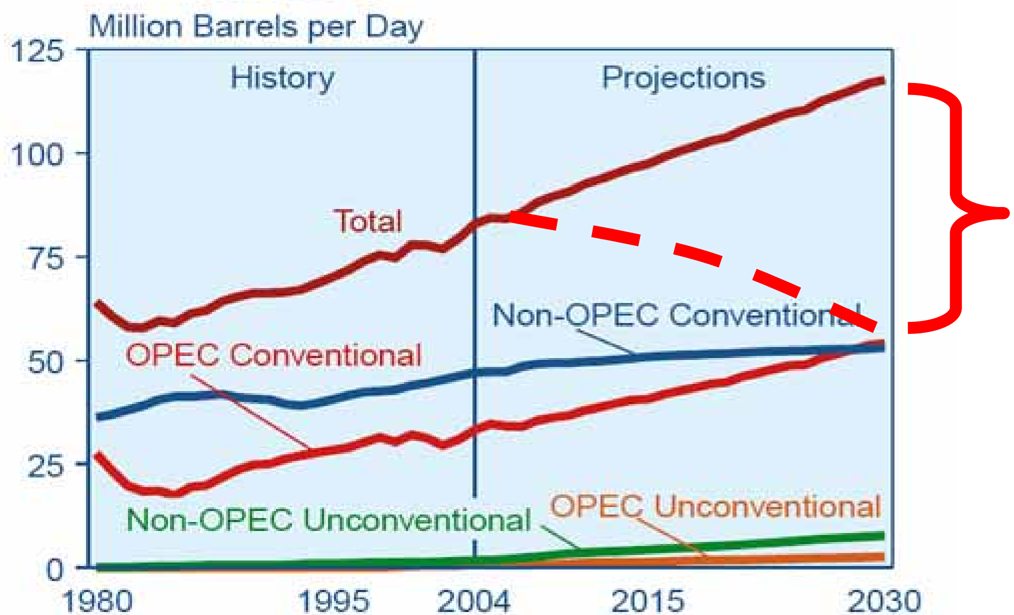
Tomorrow?



$$\frac{85{,}000{,}000 \times 30}{12 \times 6000} = 35{,}416 \text{ nm}$$

DOE/EIA Liquid Fuel Outlook

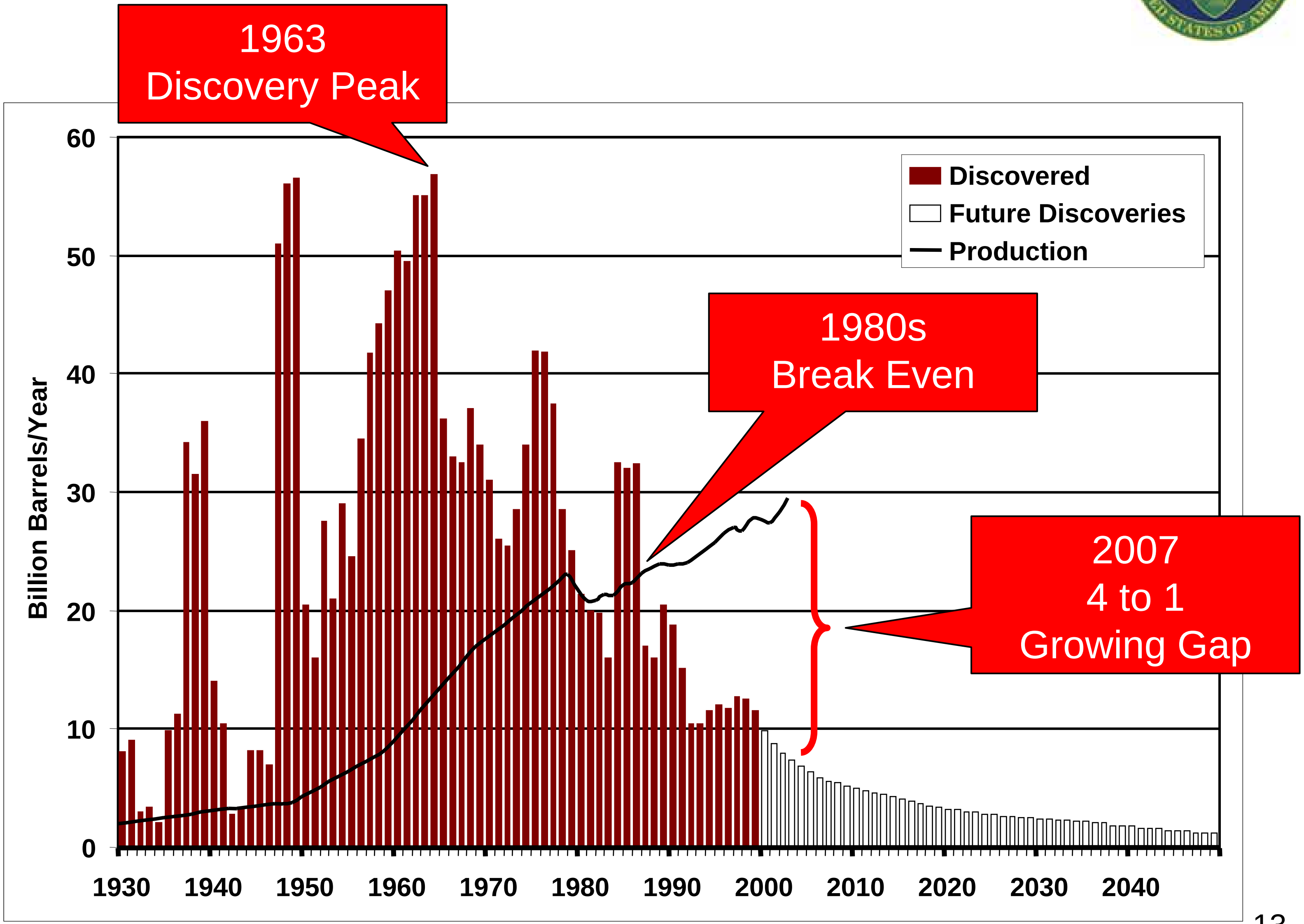
Figure 36. OPEC and Non-OPEC Conventional and Unconventional Liquids Production, 1980-2030



Sources: **1980-2004:** Energy Information Administration (EIA), *Short-Term Energy Outlook* (October 2006), and *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).

Growth 120-85	**35Mbpd**
Depletion (4%/year)	**25Mbpd**
Total	**60Mbpd**
Saudi Arabias	**6x**
Saudi Arabias/year	**1/4years**

Disparity Between Production and Discoveries



Source: Oil and Gas Journal, July 21, 2003 Future discoveries based on 2003 oil prices

Nuclear Power

- A fantastic way to power a navy
  - Is it also a good way to power a country?

More than 5000 reactor years of US Navy operations – ZERO nuclear accidents.


USS San Francisco after 30+ knot impact with uncharted seamount below 800 feet.
• Reactor plant unaffected.
USS Thresher (1963) and USS Scorpion (1968) sinkings
Still no detectable release of radioactivity

Two Great Americans Who Understood Energy

1900 - 1986

1957 - First US commercial reactor in Pennsylvania

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Published on 2 Dec 2006 by Energy Bulletin. Archived on 2 Dec 2006.

"Energy resources and our future" - remarks by Admiral Hyman Rickover delivered in 1957

by Rear Admiral Hyman G. Rickover, U.S. Navy

1903 - 1989

NUCLEAR ENERGY AND THE FOSSIL FUELS

BY

M. KING HUBBERT

CHIEF CONSULTANT (GENERAL GEOLOGY)

1956

Presented before the
Spring Meeting of the Southern District
Division of Production
American Petroleum Institute
Plaza Hotel, San Antonio, Texas
March 7-8-9, 1956

Scale Comparison of Nuclear to Oil

- **Using *current* reactor nuclear technology**
  - to run ***today's*** US fleet of about 220 million vehicles
  - on energy exclusively from nuclear power (electricity or hydrogen)
  - would require about:

Plants (2000MWe)	**1000***
Cost ($3-4B each)	**$3-4T**
Time (10/year)	**100 years**
U235 Reserves	**20 years****

* 6000 for the world

** Impossible without spent fuel reprocessing, breeder reactors or fusion

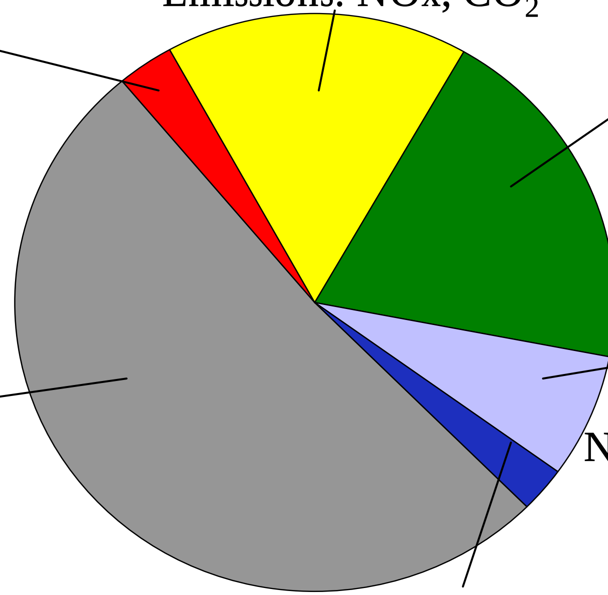
New high temperature reactors may reduce this challenge by about 3x.

Sources of U.S. Electricity

18.6% Natural Gas
Low construction cost
Volatile fuel cost
Combined cycle capacity factor: 37.7%
Steam plant capacity factor: 15.6%
Emissions: NOx, CO_2

3.0% Oil
Minimal construction
(as dual fuel w/ gas)
Volatile fuel cost
Capacity factor: 29.8%
Emissions: SO_2, NOx, CO_2

19.4% Nuclear
High construction cost
Stable fuel cost
Capacity factor: 89.6%
Emissions: None



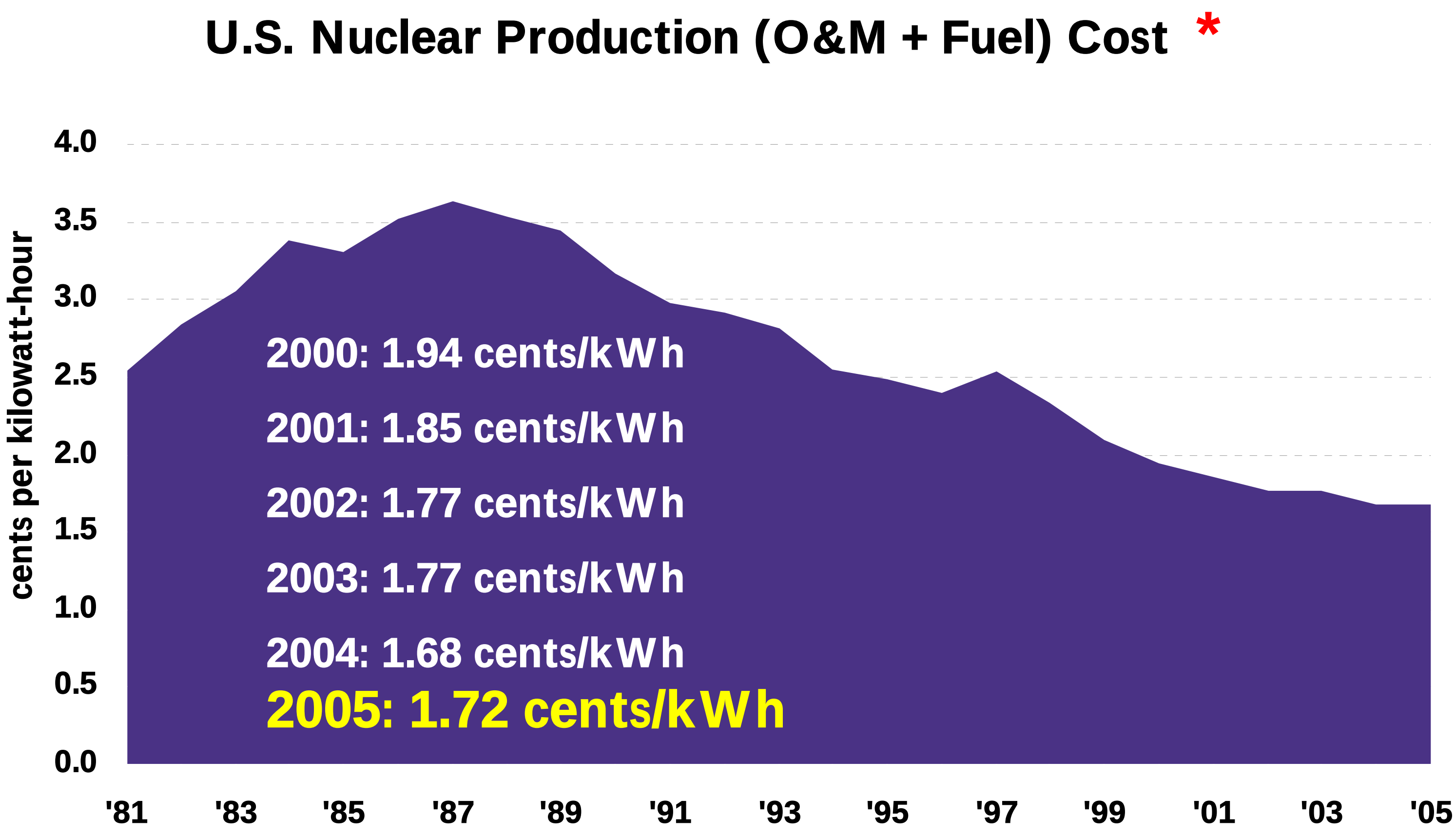
49.9% Coal
High construction cost
Recent increase in fuel cost
Capacity factor: 72.6%
Emissions: SO_2, NOx, CO_2, particulates, mercury, toxic metals

6.4% Hydro
Large-scale opportunities gone
No fuel cost, dependent on rain/snow
Capacity factor: 29.3%
Emissions: None

2.7% Renewables (and Other)
Very high construction cost
No fuel cost, production tax credit
Wind capacity factor: 26.8%
Emissions: None

Source: Global Energy Decisions / Energy Information Administration

Solid Economic Performance Continues



Source: Energy Information Administration

** NEI estimate for 2005*

* O&M excludes capital costs.

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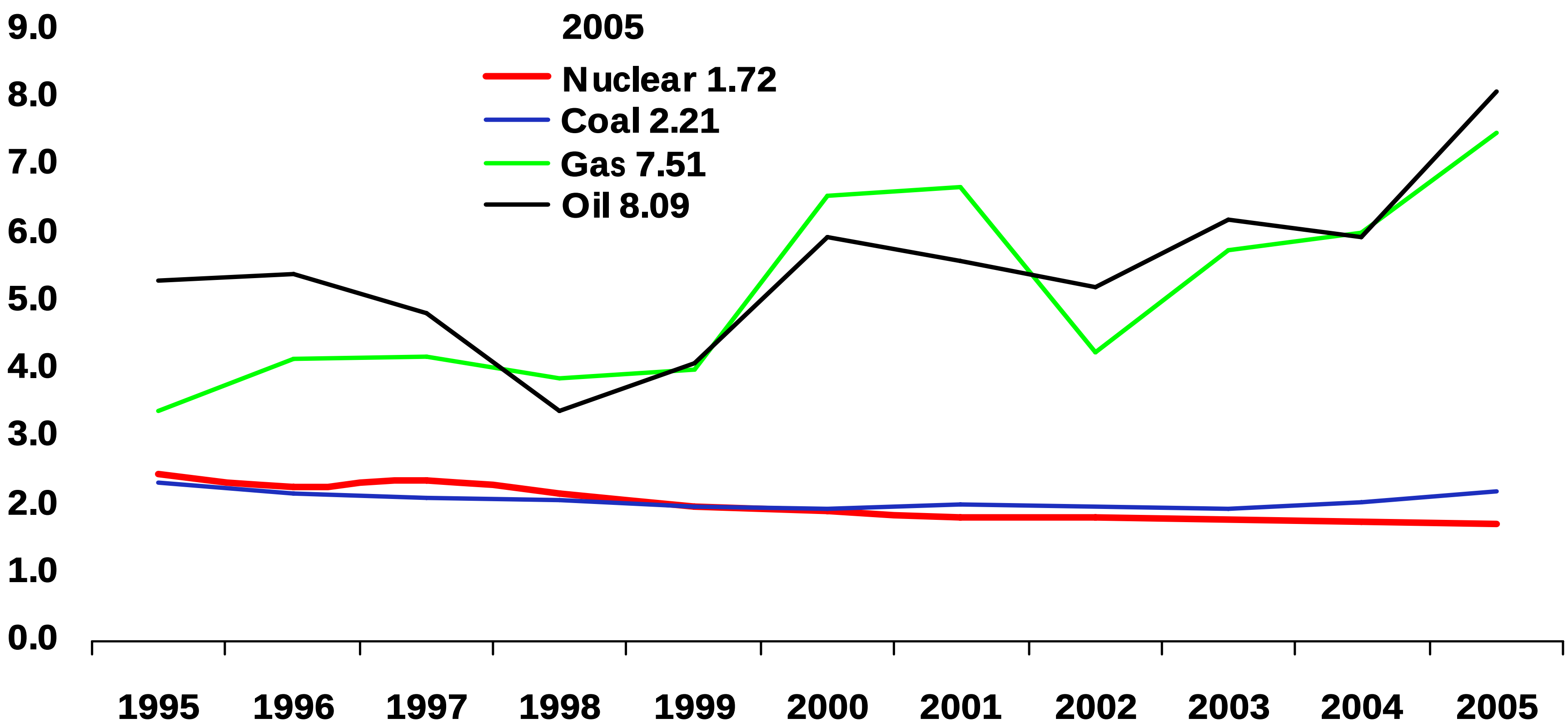
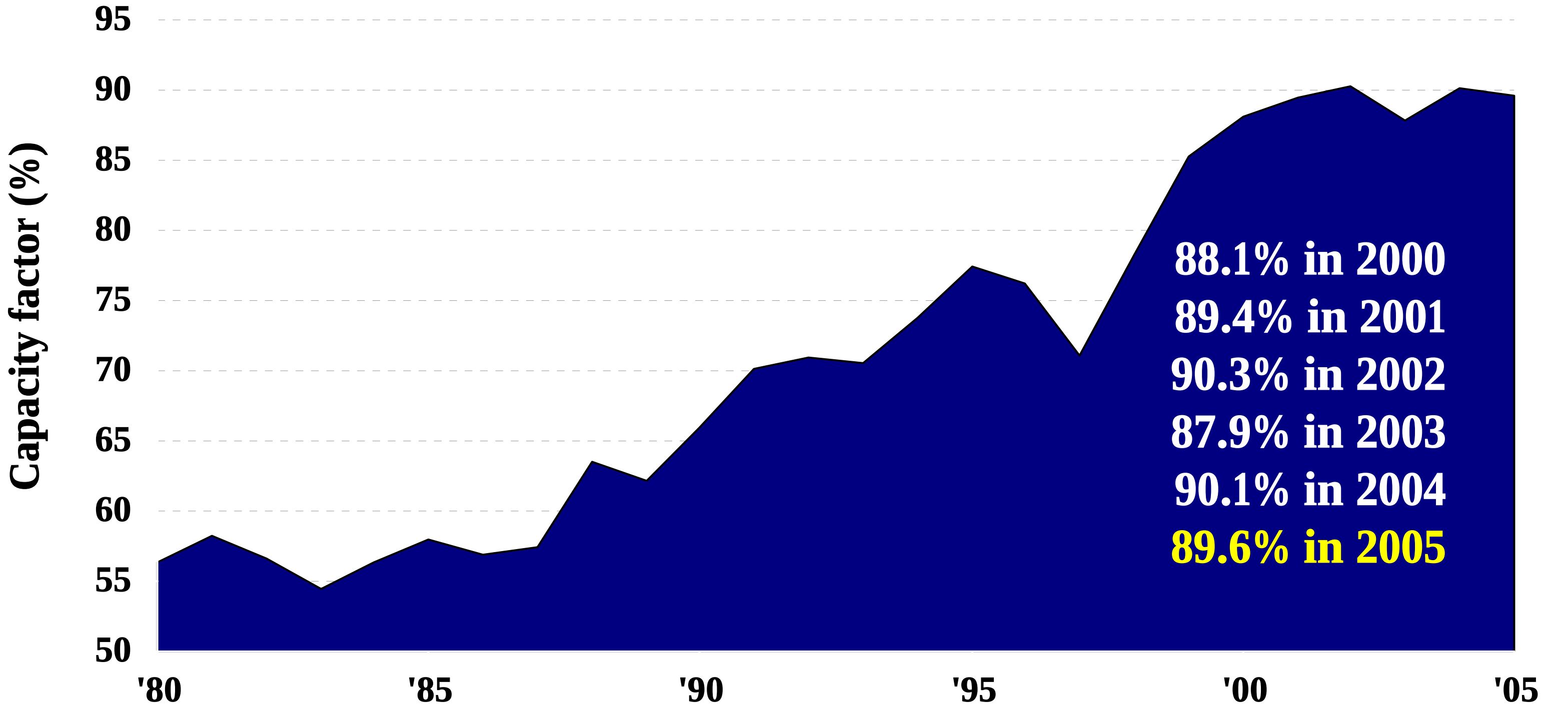
U.S. Electricity Production Costs
1995-2005 (*Averages in 2005 cents per kilowatt-hour)*



Production Costs = Operations and Maintenance Costs + Fuel Costs

Source: Global Energy Decisions
Updated: 6/06

Sustained High Levels of Reliability at U.S. Nuclear Plants



Source: Energy Information Administration

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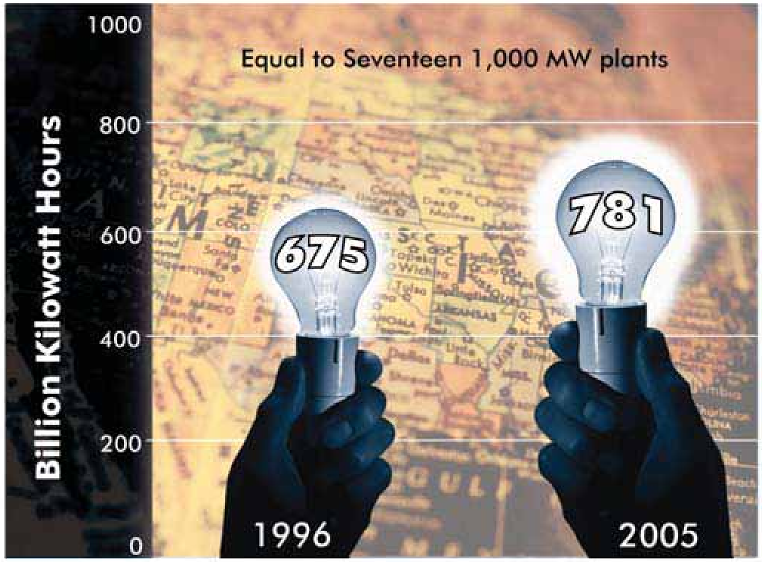
Nuclear Holds 20% Market Share Even With 25% Growth In U.S. Electric Supply

	1994	2005
US Electric Supply	3.2 trillion kWh	4 trillion kWh
Nuclear Production	640 billion kWh (**20%**)	782 billion kWh **(20%)**



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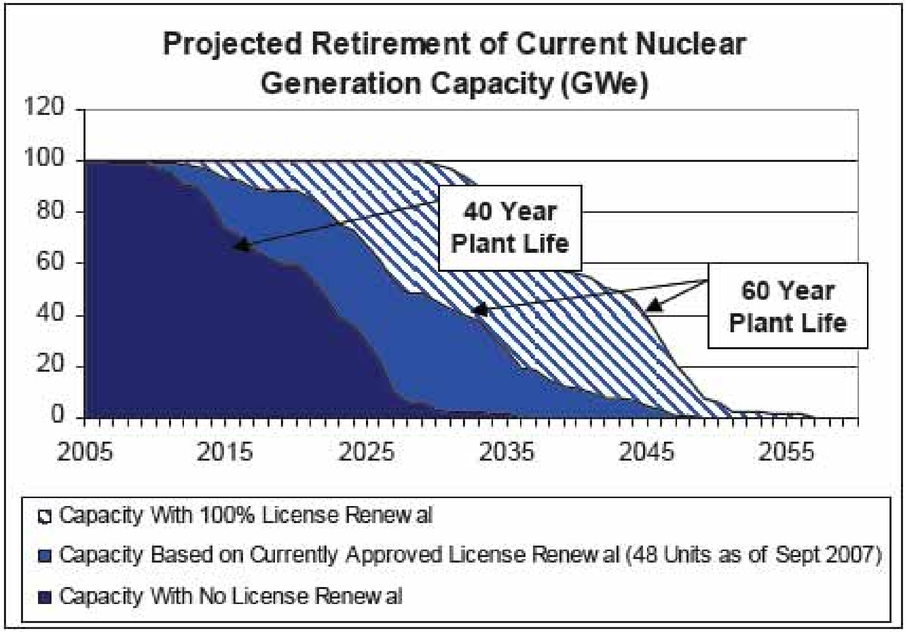
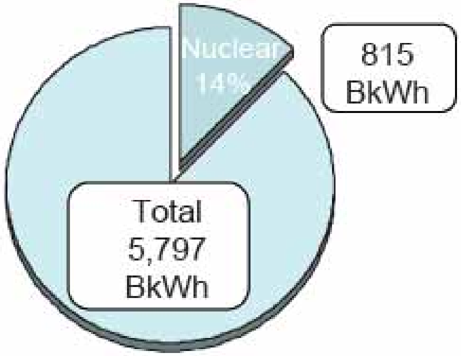
The Outlook for Nuclear Power in the United States Without New Builds

- **License renewal (allowing a 60-year operating life) can be expected for all 104 nuclear units.**
  - But even with 100% license renewal, without new construction, U.S. nuclear capacity will fall off rapidly in the mid-2030s and be non-existent by the mid-2050s.



Sources: NRC Data

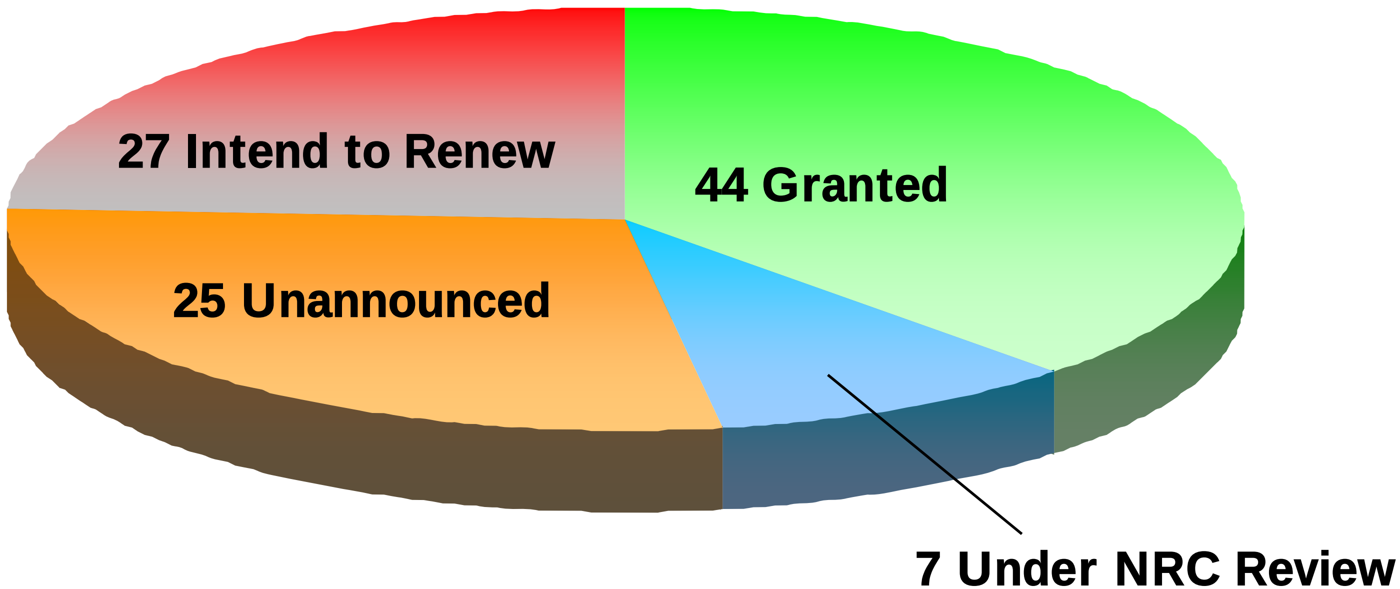


2030 Projected

Sources: Energy Information Administration and NE

- **Without new builds, nuclear power capacity would increase only due to uprates of currently operating plants and if TVA goes forward with Watts Bar 2.**

License Renewal (Additional 20 Years) Is Now Routine Activity



Source: U.S. Nuclear Regulatory Commission

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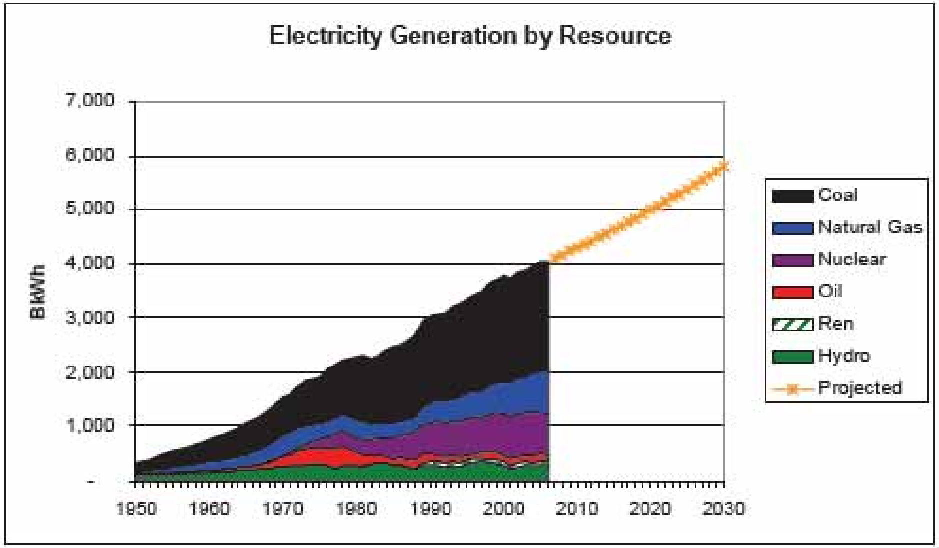
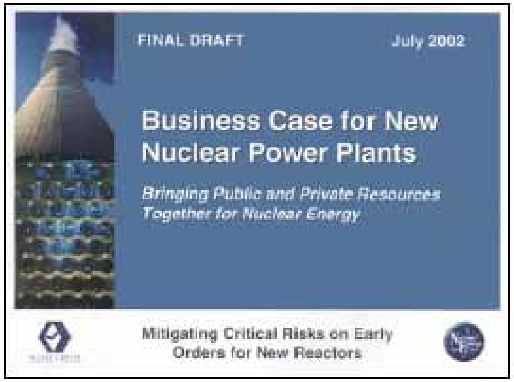
Nuclear Energy … Why Support Expansion of Commercial Nuclear Power

- **US Electricity Demand Increasing**
  - 300 GWe of additional capacity needed by 2030
  - 50 GWe new nuclear capacity needed to maintain current share
  - Only zero-emitting baseload technology that can be expanded by a significant margin





- **Unacceptable Risks Identified**
  - Regulatory Uncertainty
  - Litigation Risk
  - Economic Competitiveness of First Plants
    - Long Construction Durations
    - Higher Capital Costs for Early Plants
- **Power companies are unwilling to increase by a significant percentage their market capitalization to build new nuclear plants**

Near-Term Need for New Capacity

Projected Excess Capacity by NERC Region, 2005–12, Including Power Plants Under Construction *(megawatts)*						
Region	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
ISO-NE	861	213	**0**	**0**	**0**	**0**
NYISO	1,353	**0**	**0**	**0**	**0**	**0**
MAAC	1,583	**0**	**0**	**0**	**0**	**0**
ECAR	12,344	9,970	8,686	6,441	4,169	1,869
MAIN	6,740	7,390	5,661	4,884	4,367	3,024
MAPP-US	3,621	2,939	2,422	1,575	690	**0**
VACAR	**0**	**0**	**0**	**0**	**0**	**0**
Southern	2,738	1,029	**0**	**0**	**0**	**0**
TVA	1,317	236	**0**	**0**	**0**	**0**
Entergy	16,330	15,691	15,109	15,184	14,586	13,977
FRCC	2,472	1,488	145	**0**	**0**	**0**
SPP	5,729	4,690	3,746	2,750	1,759	750
ERCOT	**0**	**0**	**0**	**0**	**0**	**0**
WECC-US	20,731	17,931	15,945	14,140	11,547	8,900
US Total	**75,819**	**60,577**	**51,713**	**45,073**	**37,116**	**28,520**

Source: Cambridge Energy Research Associates and EV Power ®, Global Energy Decisions, Inc.

Notes: (1) Required reserve margin assumed to be 18 percent in New England, New York, PJM, WECC, and FRCC; otherwise it is 15 percent; (2) Includes only known scheduled retirements.

Growing Need for Additional Baseload Capacity

- Electricity demand in 2030 will be 45% greater than today
- To maintain current electric fuel supply mix would mean building:

>2 / year

50	Nuclear reactors (1,000 MW)
261	Coal-fired plants (600 MW)
279	Natural gas plants (400 MW)
93	Renewables (100 MW)

Source: 2006 Annual Energy Outlook, Energy Information Administration

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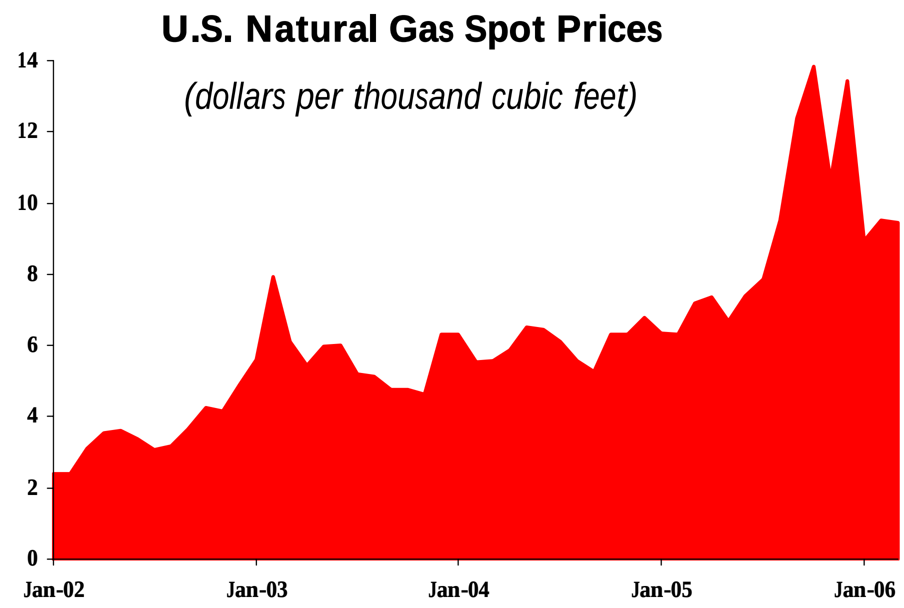
The Gas-Fired Boom and Bust

- In early 1990s, at $2-2.50/million Btu, natural gas was inexpensive
- No recognition of supply constraints
- Gas-fired generating capacity represented lowest investment risk at a time of punishing busines uncertainty
  - Industry structure
  - Market design
- Massive build of gas-fired capacity: Unsustainable pressure on gas supply and price
  - Periods of punishing volatility
  - Severe damage to other industries (chemicals, steel, plastics)



The Last 15 Years: Investment in Electric Infrastructure Collapsed

- Investment in new coal and nuclear generating capacity all but disappeared, even though they represent ...
  - 70 percent of U.S. electricity supply
  - Greatest forward price stability

New Generating Capacity: 1992-2005	
Coal	8,044 MW
Gas	288,576 MW*
Nuclear	2,485 MW
Oil	4,933 MW
Renewables	9,983 MW
Hydro	2,629 MW
Other	223 MW

* Total US nuclear is only about 100 GW

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Interest In New Nuclear Construction

- Performance of today's plants
- Growing need for baseload generation
- Increasing environmental constraints and compliance costs, potential controls on carbon emissions
- Chronic volatility in natural gas prices and supply

President Bush, second from right, visited the Calvert Cliffs Nuclear Plant last year with Constellation Energy officials.

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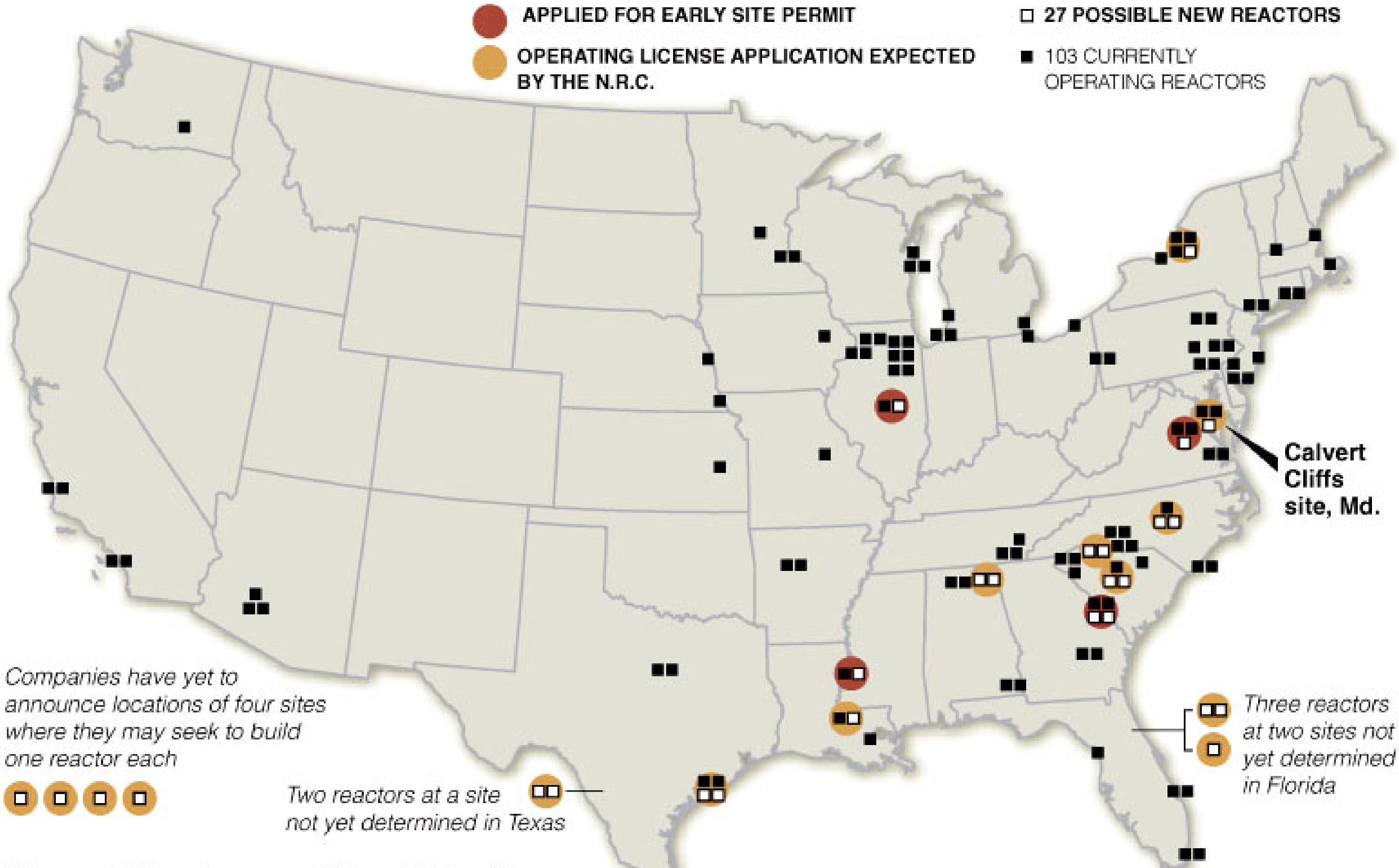
The New York Times



New Plants on the Way?

A handful of utility companies have expressed interest in building new nuclear power plants. But none have made a firm commitment yet, and industry experts doubt that more than a few of the 27 possible new reactors identified by the Nuclear Regulatory Commission will be built anytime soon. At least initially, any new reactors are expected to be added to existing nuclear power sites.

Source: Nuclear Regulatory Commission

Status of New Nuclear Plant Development

Company	Design	Units	Date for Filing COL Application
Dominion	ESBWR	1	2007
NuStart Energy (TVA)	AP1000	2	2007
NuStart Energy (Entergy)	ESBWR	1	2007/2008
Entergy	ESBWR	1	2008
Southern Co.	AP1000	1-2	2008
Progress Energy	AP1000	2-4	2007
South Carolina Electric & Gas	AP1000	1-2	2007
Duke Energy	AP1000	2	2008
UniStar Nuclear	U.S. EPR	1-4	2008
Florida Power and Light	TBD	TBD	2009
NRG (at South Texas Project)	ABWR	2	2007
Amarillo Power	ABWR	2	~2007
TXU	TBD	2-5	~2008

4 standardized designs

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Financing New Nuclear Power Plant Construction

Market Values*	
Exelon	*$34.3 billion*
Duke Energy	*$27.8 billion*
Dominion	*$27 billion*
Southern	*$24.9 billion*
FPL	*$17.3 billion*
Entergy	*$15.9 billion*
Progress Energy	*$11.1 billion*
Constellation	*$9.9 billion*
NRG	*$6.5 billion*
SCANA	*$4.7 billion*

- Electric power companies are small relative to the size of the $3-4 billion nuclear power projects they intend to build.

- The companies planning new nuclear plants in the United States have a combined market cap of $179.4 billion, less than one-half the market cap of ExxonMobil ($396.8 billion).

* *Number of shares outstanding times share price on 7.20.2006*

Energy Policy Act of 2005: Investment Stimulus for New Plants

- **Federal loan guarantees**
  - Covers up to 80% of project cost
  - Allows project financing, more highly leveraged capital structure, reduces project cost
- **Production tax credits**
  - $18/MWh for up to 6,000 MW
  - Worth up to $125 million in tax credits per year for 8 years for 1,000 MW of capacity
- **Federal standby support**
  - $2 billion of risk coverage for first six plants
  - Covers delays resulting from licensing or litigation

Taxpayers pay these costs

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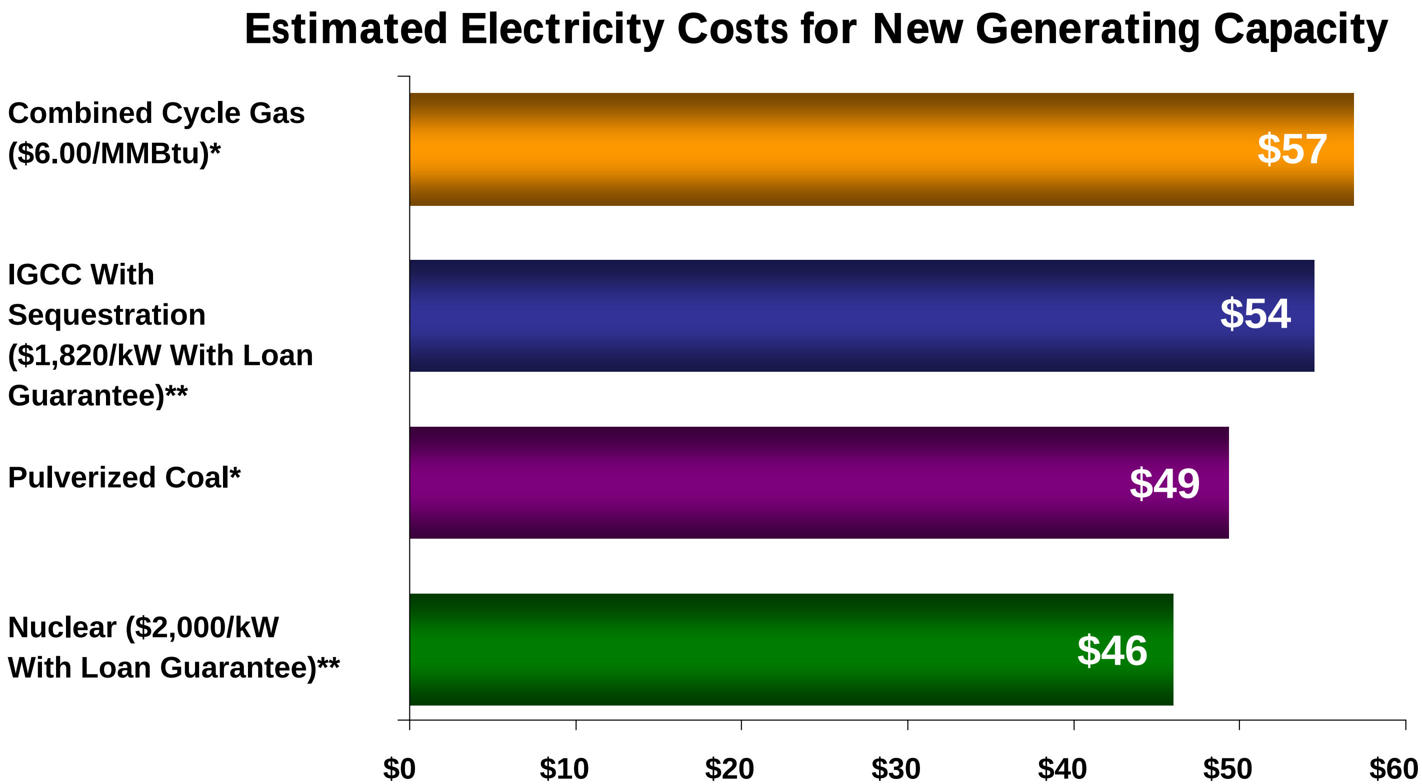
Investment Stimulus Offsets Higher Cost of First New Plants



**Assumes 15% cost of equity, 8% cost of debt and a 50/50 debt/equity structure.*

***Assumes 15% cost of equity, 6% cost of debt and an 80/20 debt/equity structure.*

Source: NEI analysis of first-year operating costs using EIA data

Nuclear Plant Construction: "Then and Now"

ISSUE	Then	Now
Regulatory Process	Changing regulatory standards and requirements	More stable process: NRC approves site and design, single license to build and operate, before construction begins and significant capital is placed "at risk"
Standard Designs	No design standardization	Standard NRC-certified designs
Construction Practices	Inefficient construction practices	Lessons learned from nuclear construction projects overseas incorporated, and modular construction practices
Design Changes	Design as you build	Plant fully designed before construction begins
Frivolous Interventions	Multiple opportunities to intervene, cause delay	Opportunities to intervene limited to well-defined points in process, and must be based on objective evidence that ITAAC have not been, will not be, met
Technological Maturity	Technology still evolving	Technology mature, stable designs

Worldwide Nuclear Construction

Country	Units	Total MWe
Argentina	1	692
Bulgaria	2	1,906
China	4	3,610
Taiwan	2	2,600
Finland	1	1,600
India	7	3,112
Iran	1	915
Japan	1	866
Pakistan	1	300
Romania	1	655
Russia	4	3,775
South Korea	1	960
Ukraine	2	1,900
USA	**0**	**0**
Total	**27**	**22,891**

Source: International Atomic Energy Agency

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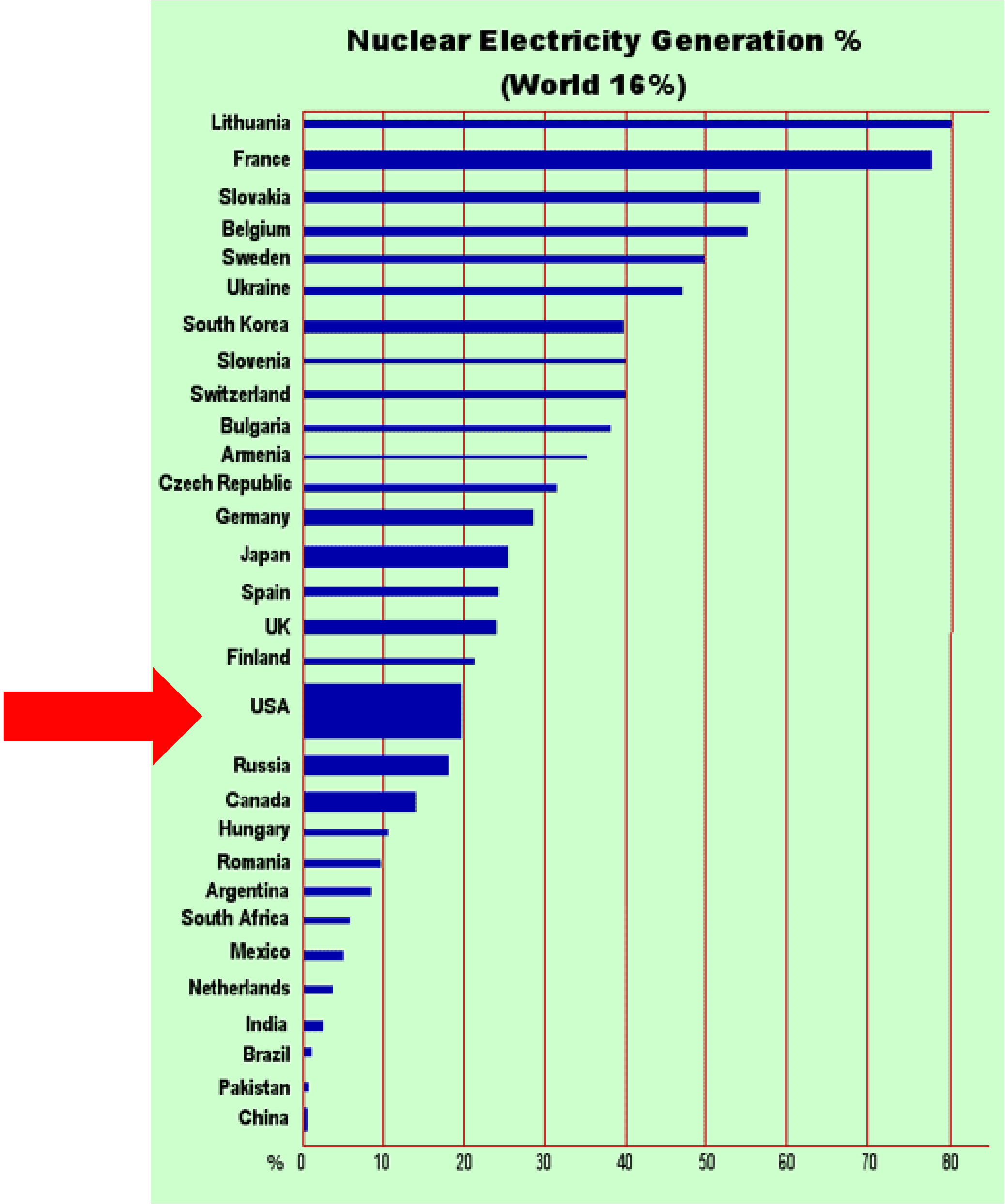
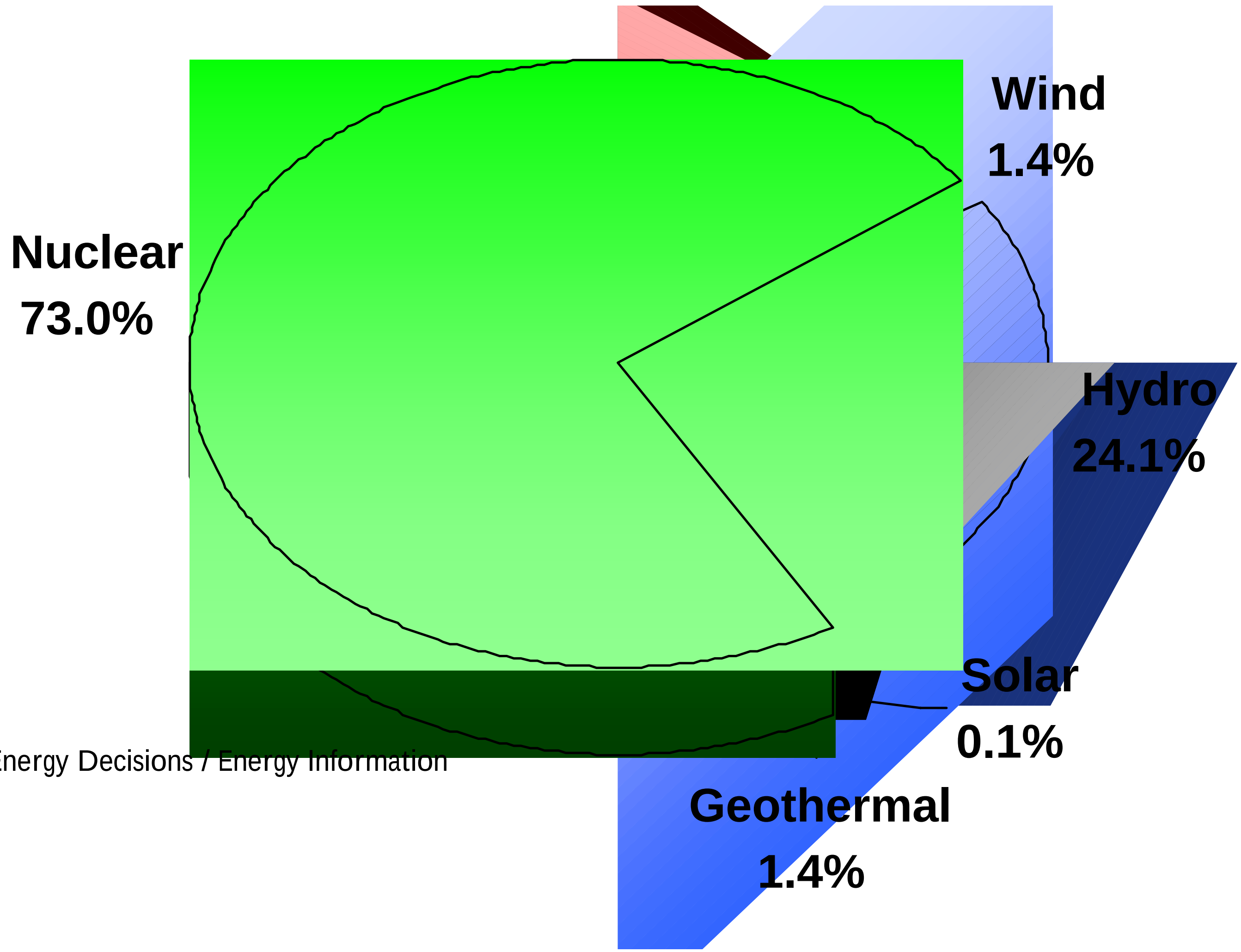


17 countries get a larger fraction of their power from nuclear compared to the US.

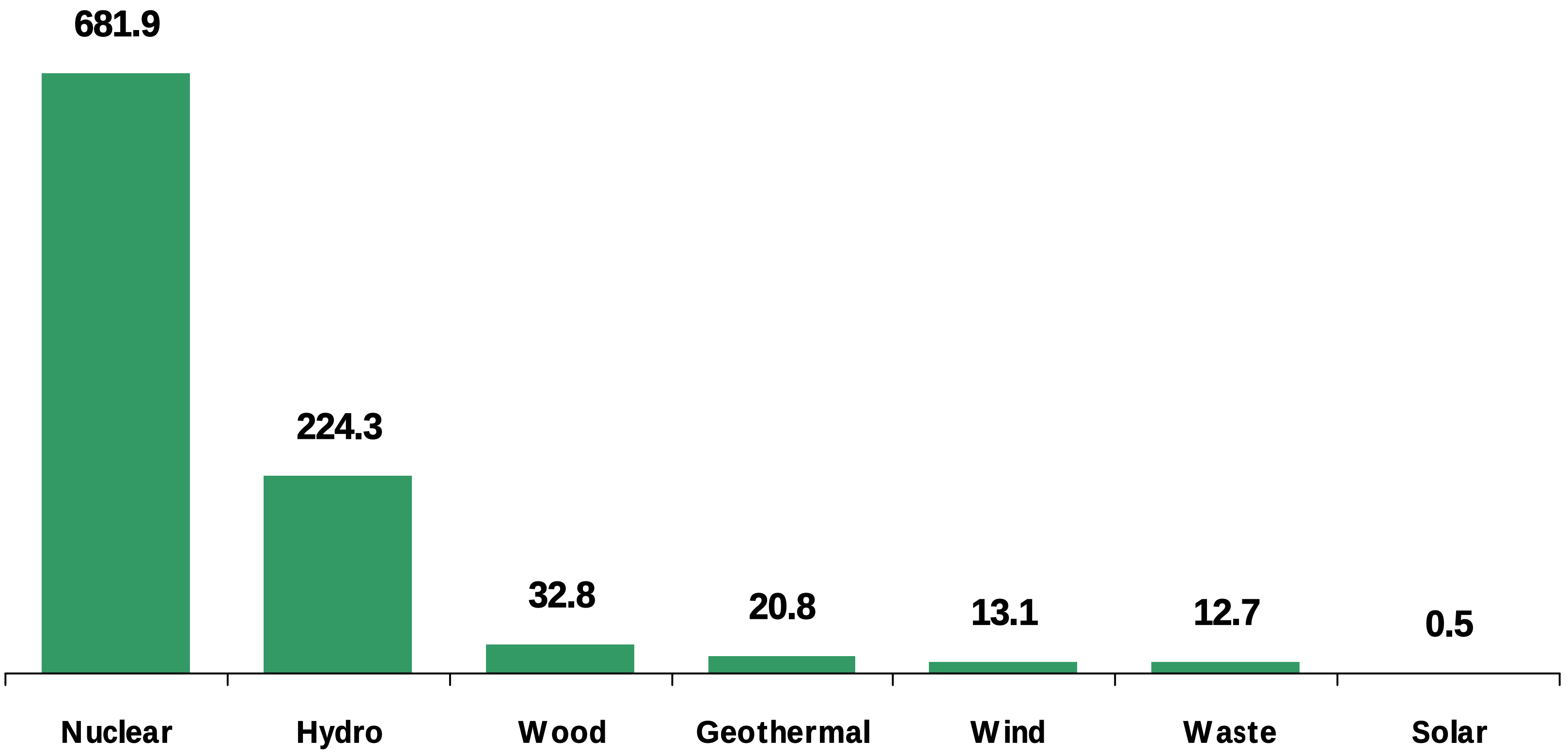
U.S. Sources of Emission Free Electricity (2006)



Source: Global Energy Decisions / Energy Information Administration

U.S. Electric Power Industry CO_2 Avoided

Million Metric Tons, 2005



Source: Emissions avoided are calculated using regional and national fossil fuel emissions rates from the Environmental Protection Agency and plant generation data from the Energy Information Administration.

Updated: 4/06

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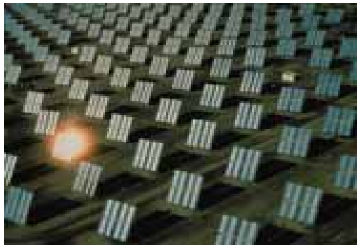
Investing - Nuclear or Renewables?

1000 MWe	Nuclear	Renewables
Load Factor	High	Variable
Lifetime	Limited	Indefinite
Fuel	Hazardous Expensive	None
Decommissioning	Expensive	Inexpensive
Waste	Hazardous Enduring	None
International	Disagreement	Agreement
Time	7-10 years?	???
COST	$3-4B?	???

Nuclear and Climate

- Does nuclear power always mean reduced GHG?
  - Suppose $1B can buy
    - 1,000MWe nuclear plant
    - 1,500 MWe renewable solar, wind, ocean energy
    - 5,000 MWe gas
  - Then buying the nuclear plant means that
    - 500-4000 MWe of coal can't be displaced
    - more GHG are ultimately emitted
- If slowing climate change is urgent
  - Then reducing CO2 emissions sooner is better
    - In most cases, renewables can be built and start operating faster than an equivalent nuclear plant

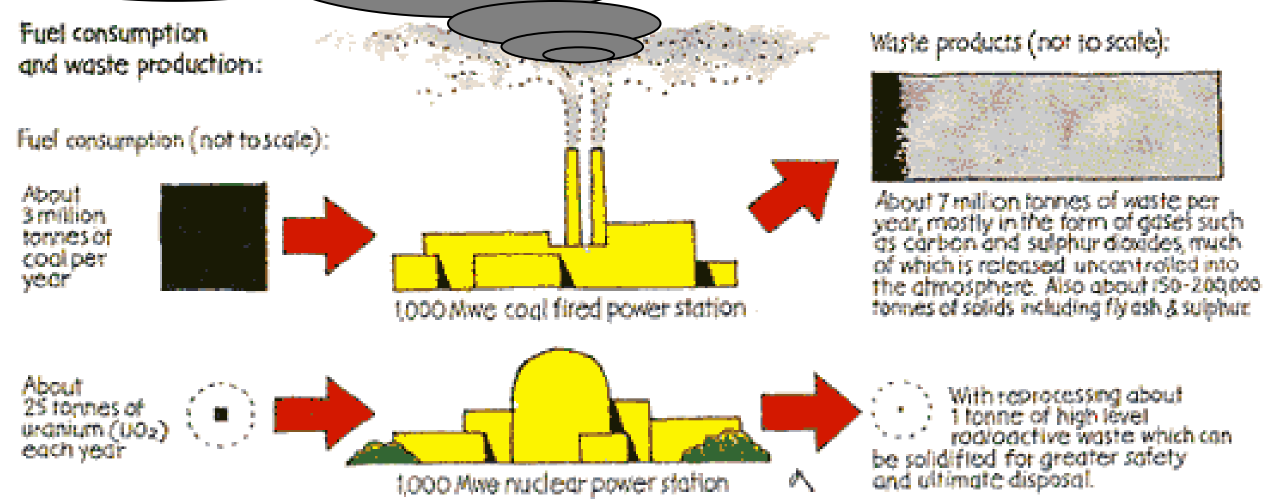


Comparing Nuclear to Coal

CO_2, SO_2, NO_x,
Mercury, Arsenic, Lead, Cadmium,
Fly Ash, ***Uranium***

COAL

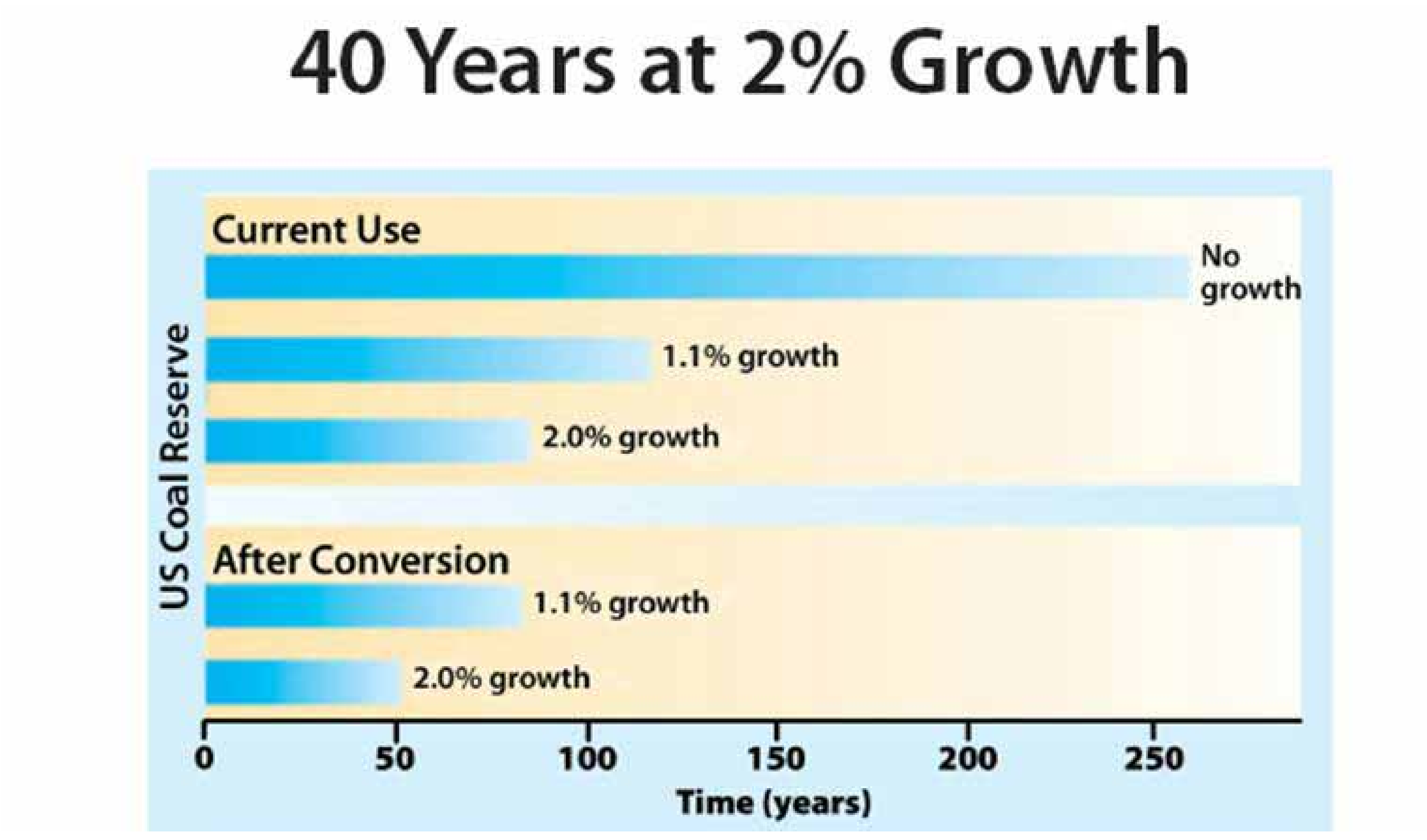
NUCLEAR



1000 MW plant	Cost	Fuel (tons/year)	Waste (tons/year)	***Uncontrolled*** Waste Release (tons/year)
Coal	$750M?	3,000,000	7,000,000	7,000,000
Nuclear	$3-4B?	25	24.9 (1*)	0

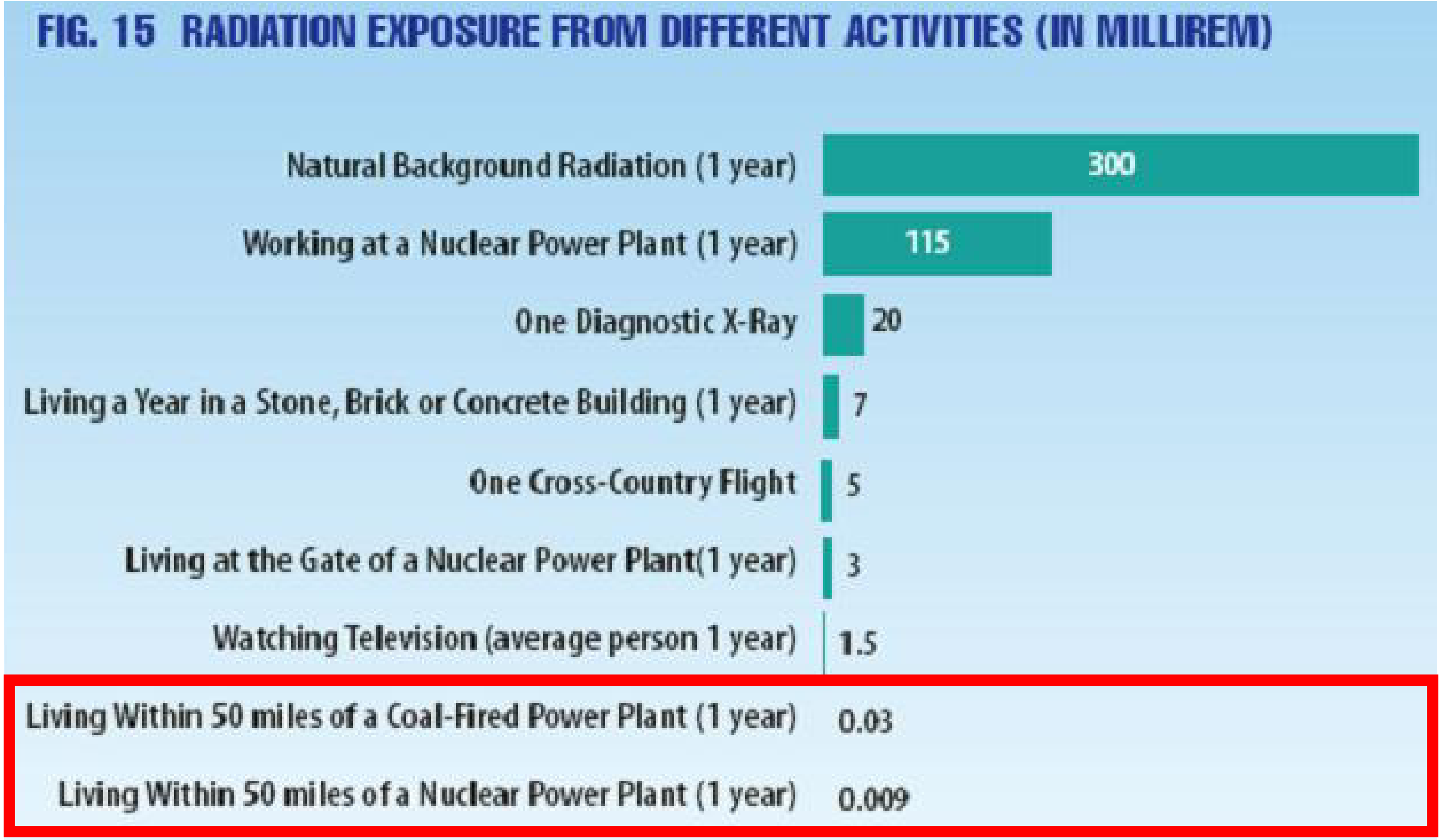
Carbon taxes would increase coal operation costs. CCS would increase coal capital costs.

US Coal Reserves



Coal reserves will not last for centuries at current rates of demand growth.

Average Yearly Radiation Exposures



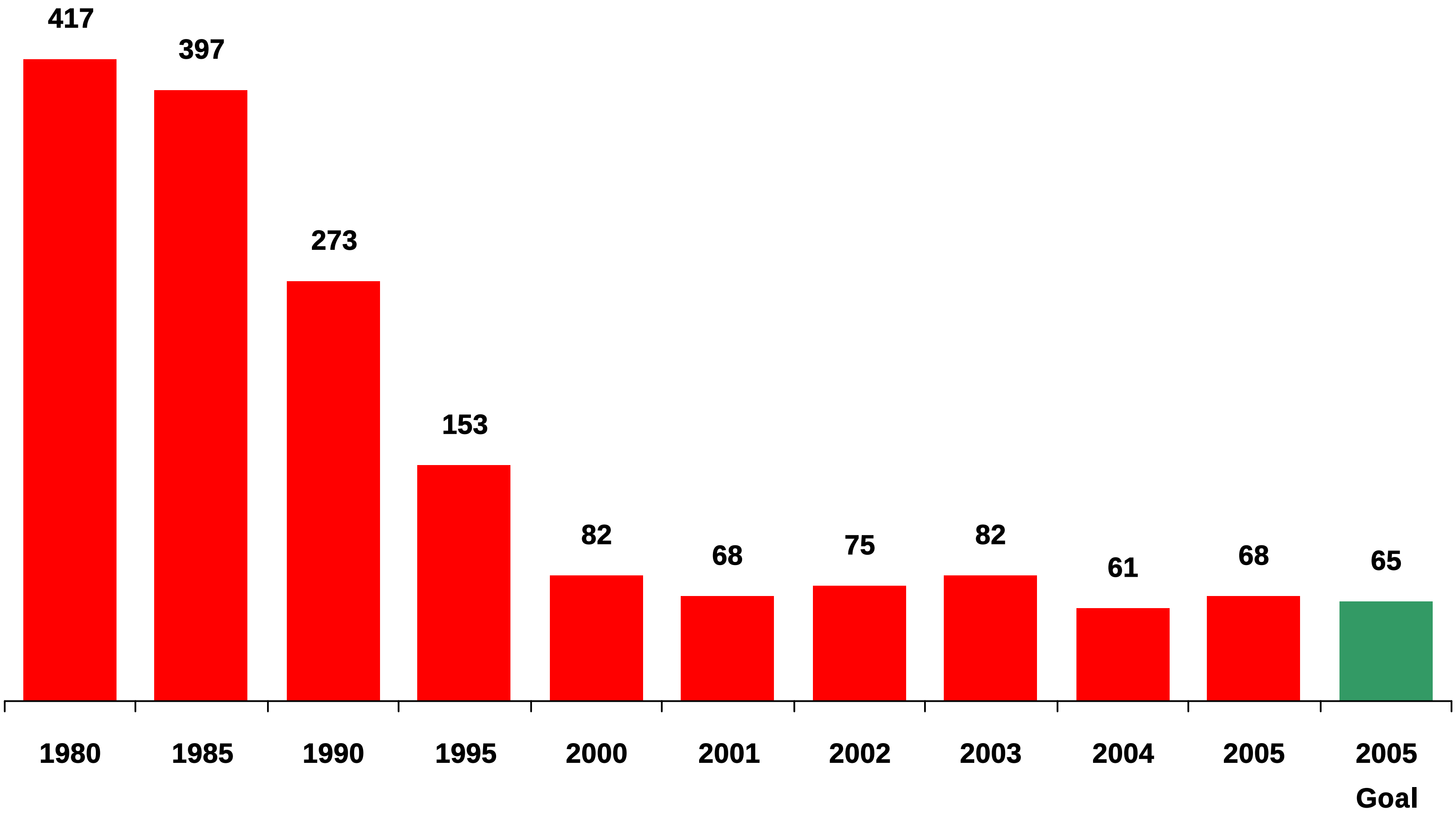
Coal plants release 3 times more radioactivity than nuclear plants (but both are small effects)

Nuclear Power Plant Safety: Multi-Faceted Approach Ensures Safe Operation

- Multiple safety systems
- Highly trained professionals
- Long-term maintenance plans
- Comprehensive materials management program

Collective Radiation Exposure (PWR)

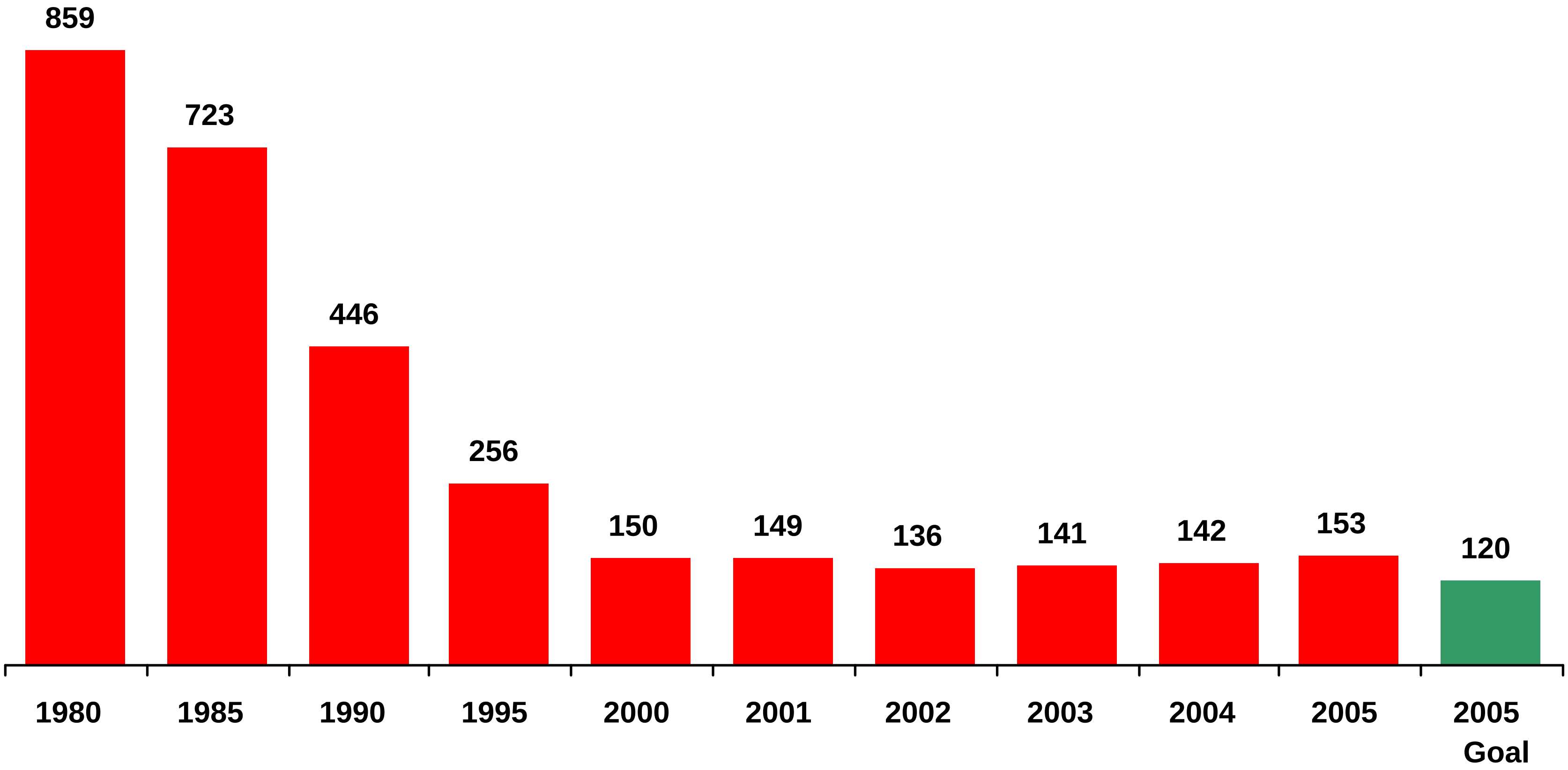
One-Year Median Values



Source: WANO
Updated: 2/06

Collective Radiation Exposure (BWR)

One-Year Median Values



Source: WANO
Updated 04/05

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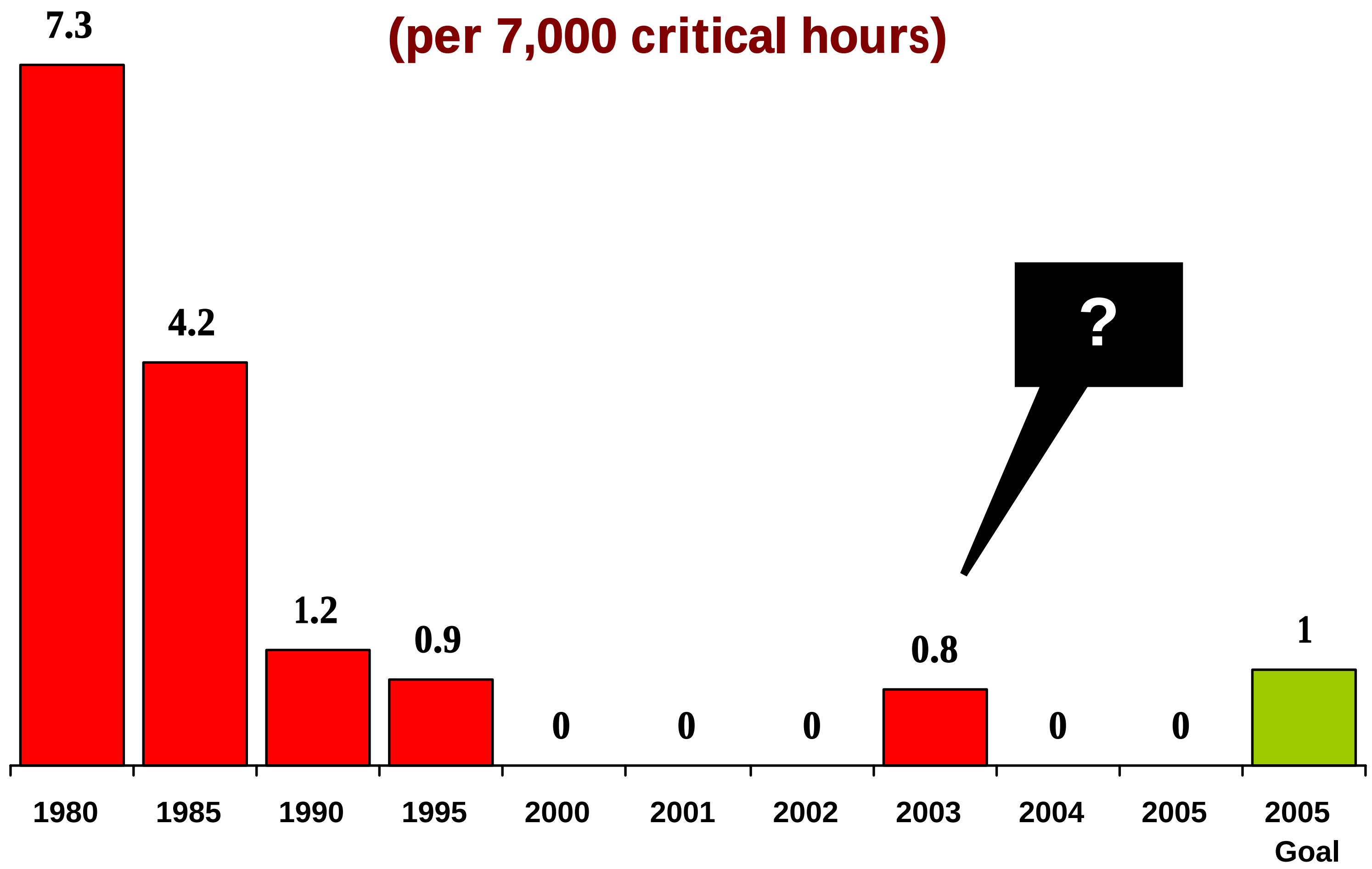
Decrease in Unplanned Automatic Scrams

(per 7,000 critical hours)



Nuclear plants shutdown automatically if grid fails and can't restart for over a week.

Source: WANO

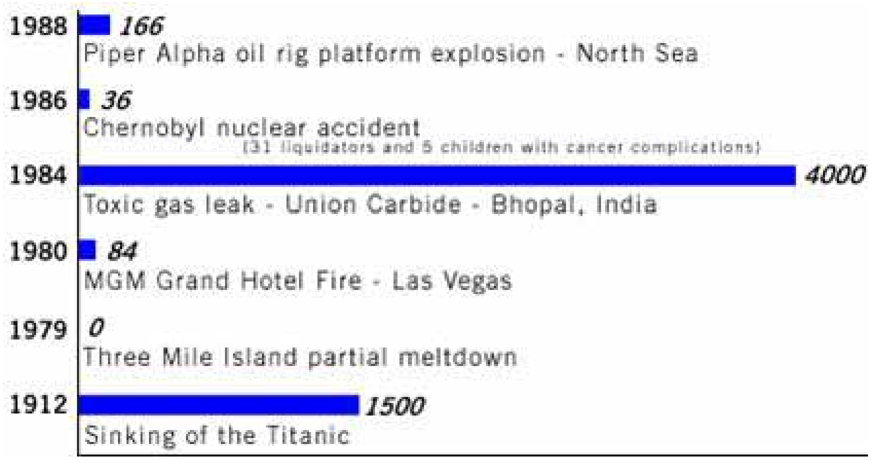
Nuclear Safety Record

Three Mile Island

- Worst US nuclear "accident" (fuel damage)
- Success story
  - Containment building worked as designed
  - No measurable fission product environmental release
  - No injuries or deaths
  - Second unit still operates today

Worldwide Power Industry Fatalities			
TMI	**US Nuclear**	**Chernobyl**	**Coal**
0	**0**	**36**	**> 5000 / year**

Comparing Nuclear Safety



Historic US Fatalities	
US Coal Mining (1931-1995)	33,134
Oil / Gas Industry (1992-1995)	719
Chemical Manufacturing (1992-1995)	201
US Automobile (1899-1995)	2,903,036
Smoking per year	419,000
US Civil Aviation (1938-present)	>54,000
US Commercial Nuclear Power	0

Nuclear Power Plant Security: Formidable and Tested

Security tower at the Clinton nuclear plant.

- Plants meet or exceed all NRC requirements
- DHS recognizes industry as leader among 17 critical industrial sectors
- $1.2 billion invested in security since 9/11
- 60% increase in security forces
- Security tested through "force on force" exercises
- Enhanced coordination with intelligence and law enforcement
- DHS comprehensive reviews at all plants

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Paramilitary Security Force At All Nuclear Plant Sites

- Nationally, 8,000 trained professionals
- 67% have previous security-related experience
- 90% retention rate indicates high job satisfaction
- Hundreds of hours of training

Used Fuel Management: Where We Stand Today

- Yucca Mountain site judged suitable in 2002
  - 20 years of scientific investigation
  - $6-7 billion of research
- License application expected in 2008
- Complex program with many moving parts:
  - A collision of science, politics, the federal budget, technology, federal versus state prerogatives, business imperatives, and international policy issues

Today's existing spent fuel inventory would fill Yucca Mountain to its *legal* capacity.

Promised opening in 1987 did not occur.
US will owe at least $7B in fines to affected utilities IF open by 2017.

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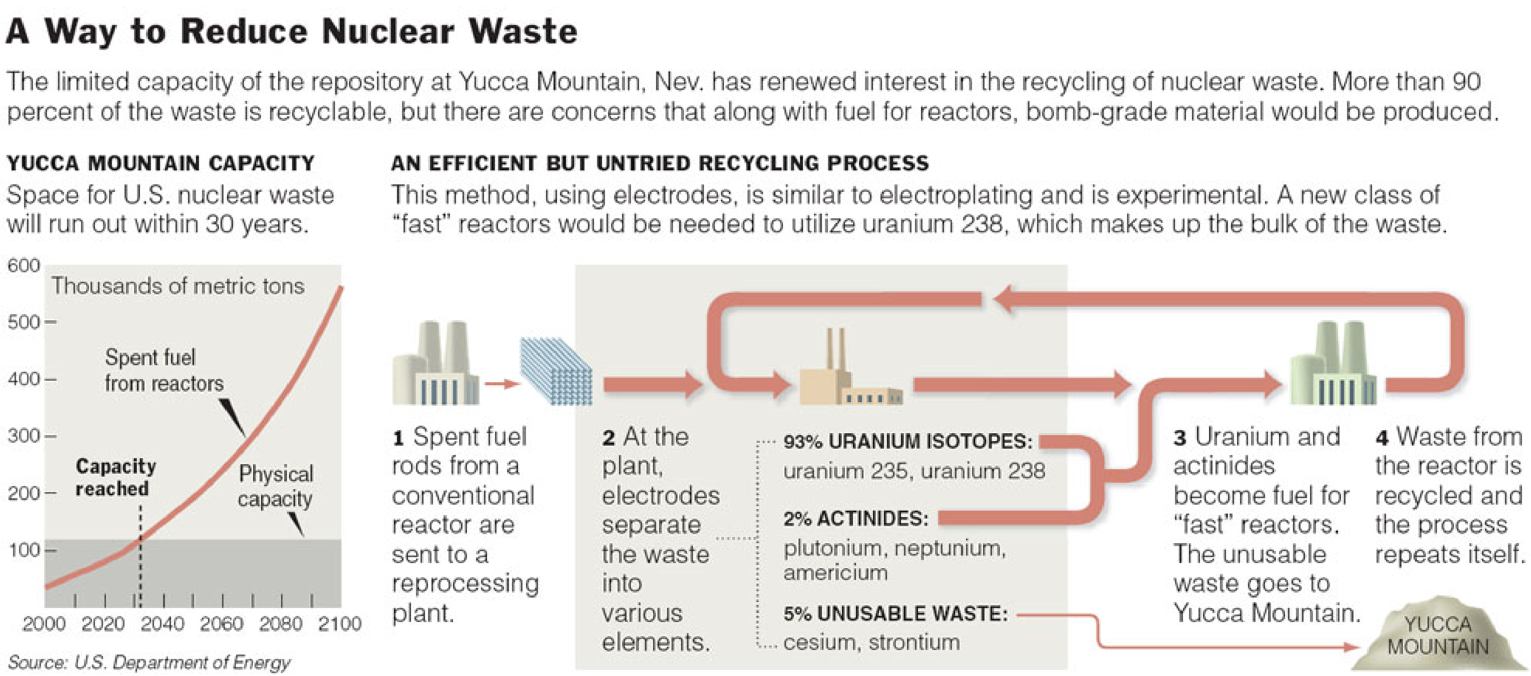
Options for Spent Fuel Management

- ~ 95% of “spent” fuel is currently unused (only 5% of U235 is fissioned)
- Reprocessing used fuel can
  - Yield 20 times more total energy (U235 is not wasted)
  - Reduce lifetime of hazardous nuclear waste from 300,000 to 1,000 years
  - Reduce volume of hazardous nuclear waste by about 20x
- US reprocessed fuel until 1977 when stopped by President Ford
- France, Japan, UK and Russia reprocess fuel today



Used Fuel Management: Short-Term and Long-Term Goals

- Long-term goal: License and build disposal facility for waste by-products at Yucca Mountain
- Short-term goal: Maintain flexibility as we move toward long-term goal
  - Accommodate advances in fuel processing and recycling technologies
  - Provide federal storage capability before shipment to Yucca Mountain
- Federal storage options:
  - Centralized storage at Yucca Mountain
  - State/regional storage sites to consolidate used fuel away from nuclear plant sites
  - Storage at sites that will host advanced fuel processing facilities

Costs highly uncertain until data is available from a successful project.

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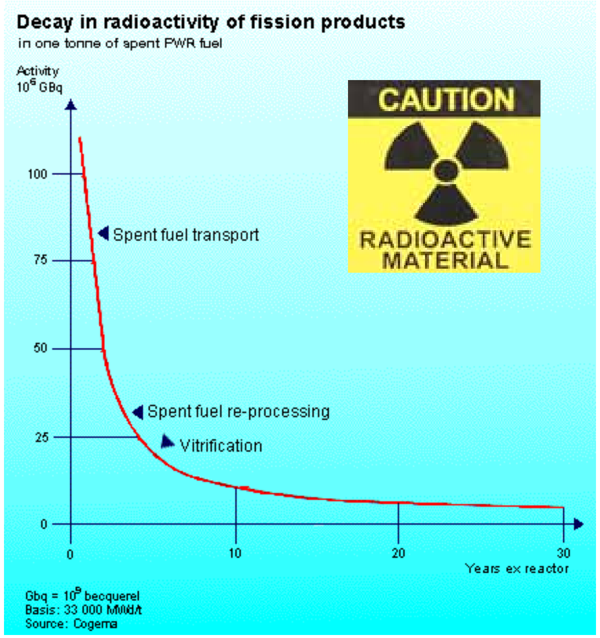
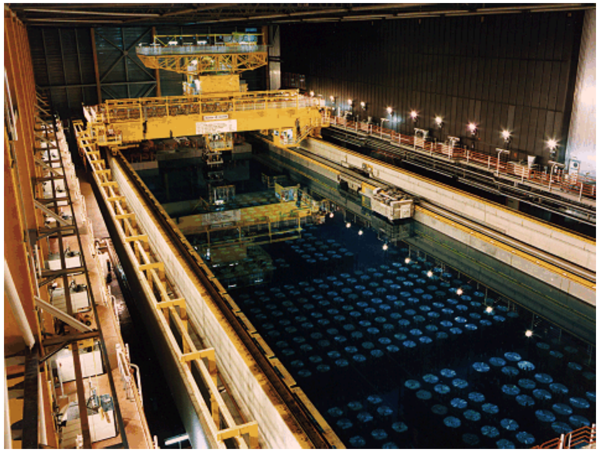
Spent Fuel Management

- 1000MW reactor produces about 27 tons HLW each year
  - Only 3 cubic meters
- After 40 years, spent fuel activity decays by 1000x
- Can be contained, controlled and secured
  - Unlike waste from coal plants

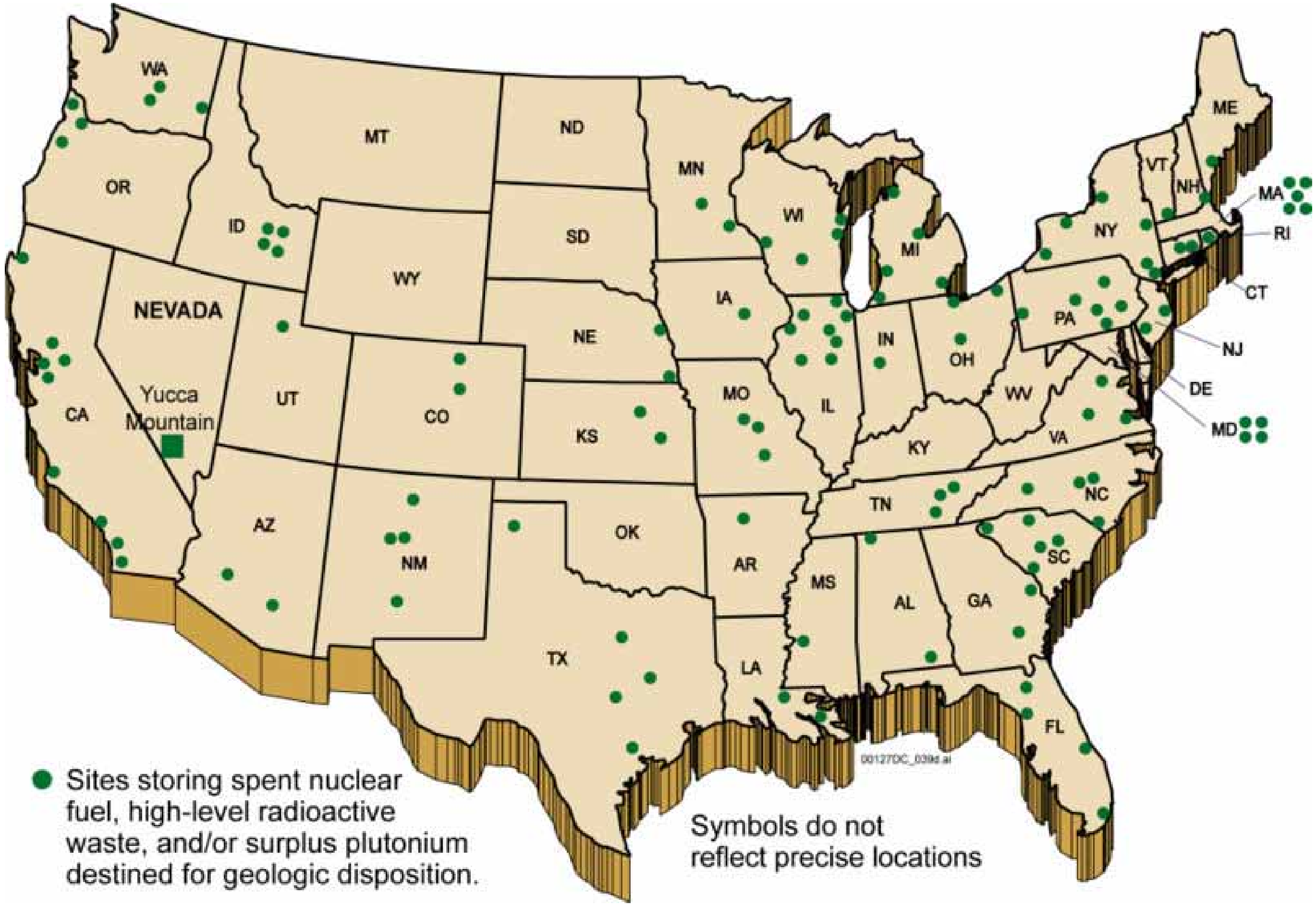
Dry Cask Storage





Cooling Pool Storage

Spent Fuel Temporary Storage



- 131 above ground sites in 39 states
- Each must be secured against terrorist attack

Putting Spent Nuclear Fuel in Perspective

U235 equivalent to 6B barrels (~ANWR)

3 feet of concrete will shield to background

Total US "Spent" Fuel Inventory After 50 Years

Source: "Nuclear Energy: Poised for Expansion,"
Harold McFarlane, Idaho National Laboratory,May 2006

Spent Fuel Radioactivity Hazard

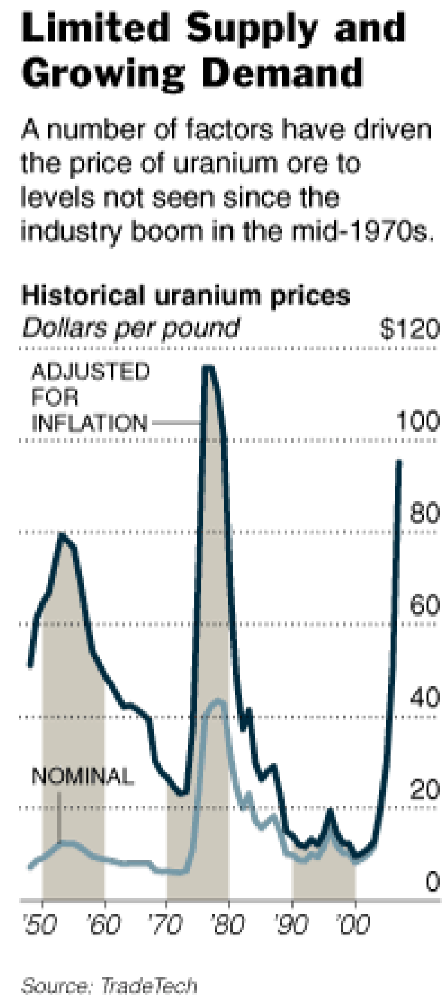
A serious issue but …

- Completely safe today:
  - Alamogordo Trinity site
  - Eniwetok (46 bombs)
  - Nevada test site
  - Hiroshima
  - Nagasaki
  - Oklo, Africa
    - Natural reactor operated for over 1,000,000 years
    - 5 tons fission products
    - 1.5 tons Plutonium and transuranics
    - ***Migrated only feet in 1.5 billion years***

Nuclear Fuel Challenges

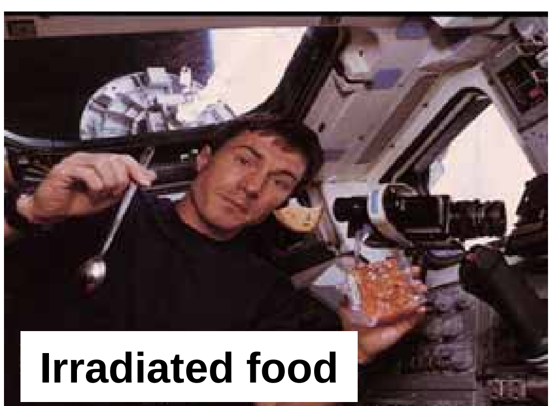
- About 50% of US commercial nuclear fuel is currently obtained from retired FSU nuclear weapons.
  - 10% of US electricity
  - HEU from 20,000 nuclear weapons
  - Stops in 2013
- MIT 2003 Study “The Future of Nuclear Power”
  - By 2050 world nuclear grows from 360 to 1,000 GWe
  - Fuel requirement to 2080 is 3 times known reserves

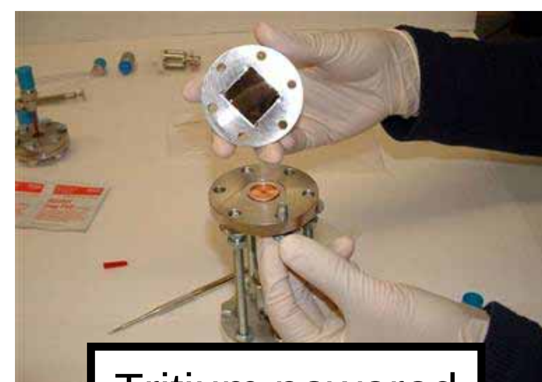
Pandora mine in Utah



Nuclear Technology

- Examples
  - Nuclear medicine
  - MRI was NMR
    - Only the name changed
  - Food preservation
    - Irradiated food
      - Does not spoil
      - Does not require refrigeration
      - Is not radioactive
    - Vast amounts of electricity used for refrigeration could be displaced
    - Refrigerators run 24/7/365
    - Countless items are first refrigerated then heated





Tritium powered
12 year battery

Key Nuclear Power Questions

1. **Cost** - competitive compared to other energy sources?
2. **Subsidies** - should it be supported by tax payers?
3. **Safety** – can it be operated without serious accidents?
4. **Security** - can it be protected against terrorism?
5. **Climate** – are other zero-emission options better?
6. **Waste** - can waste and "spent" fuel be safely managed?
7. **Fuel** - is there enough to support expanded operations?
8. **Workforce** - will it support industry growth?
9. **Proliferation** - will it lead to more nuclear weapons?
10. **Conflict** - will it cause international disputes?
11. **Net benefits** ***- do they outweigh the problems?***

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October 17-20, 2007

ASPO USA

Hilton Americas, 1600 Lamar, Houston, Tx

2007 HOUSTON WORLD OIL CONFERENCE

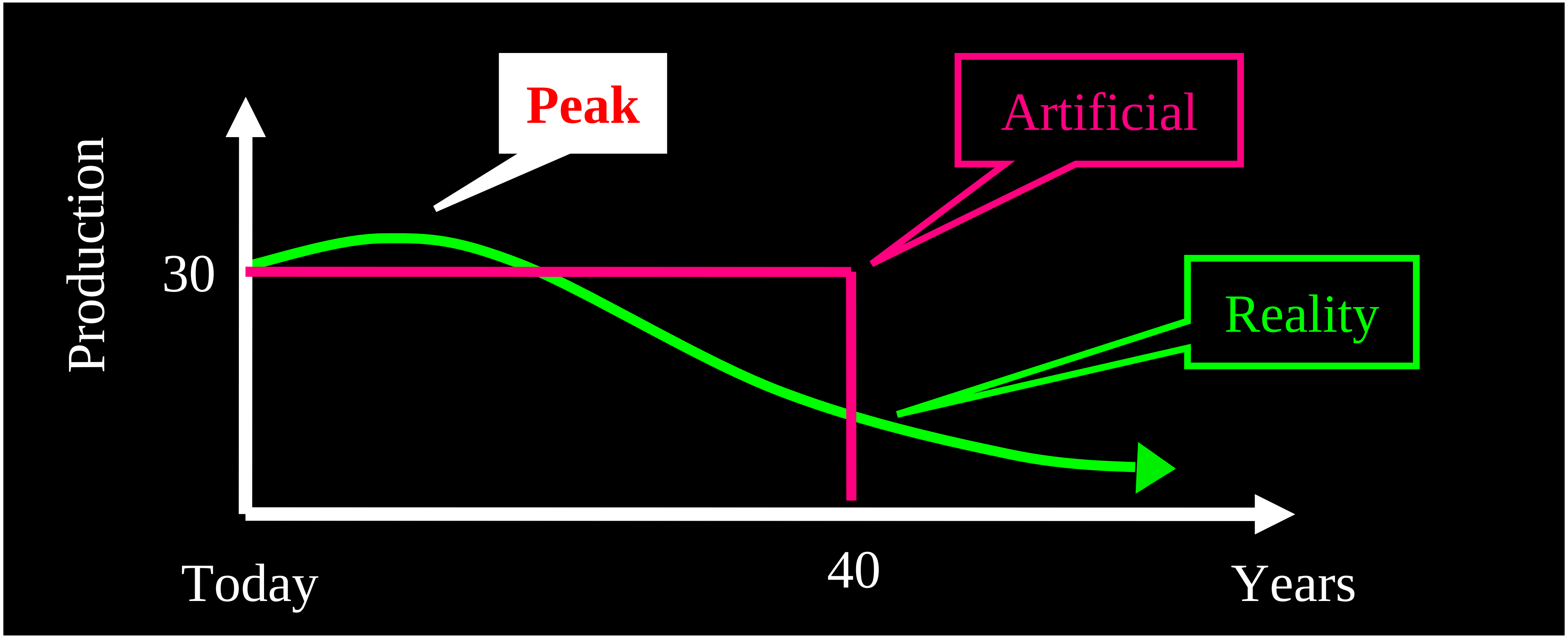
"Houston ... we have an Opportunity!"

College of Technology - Future Studies Program

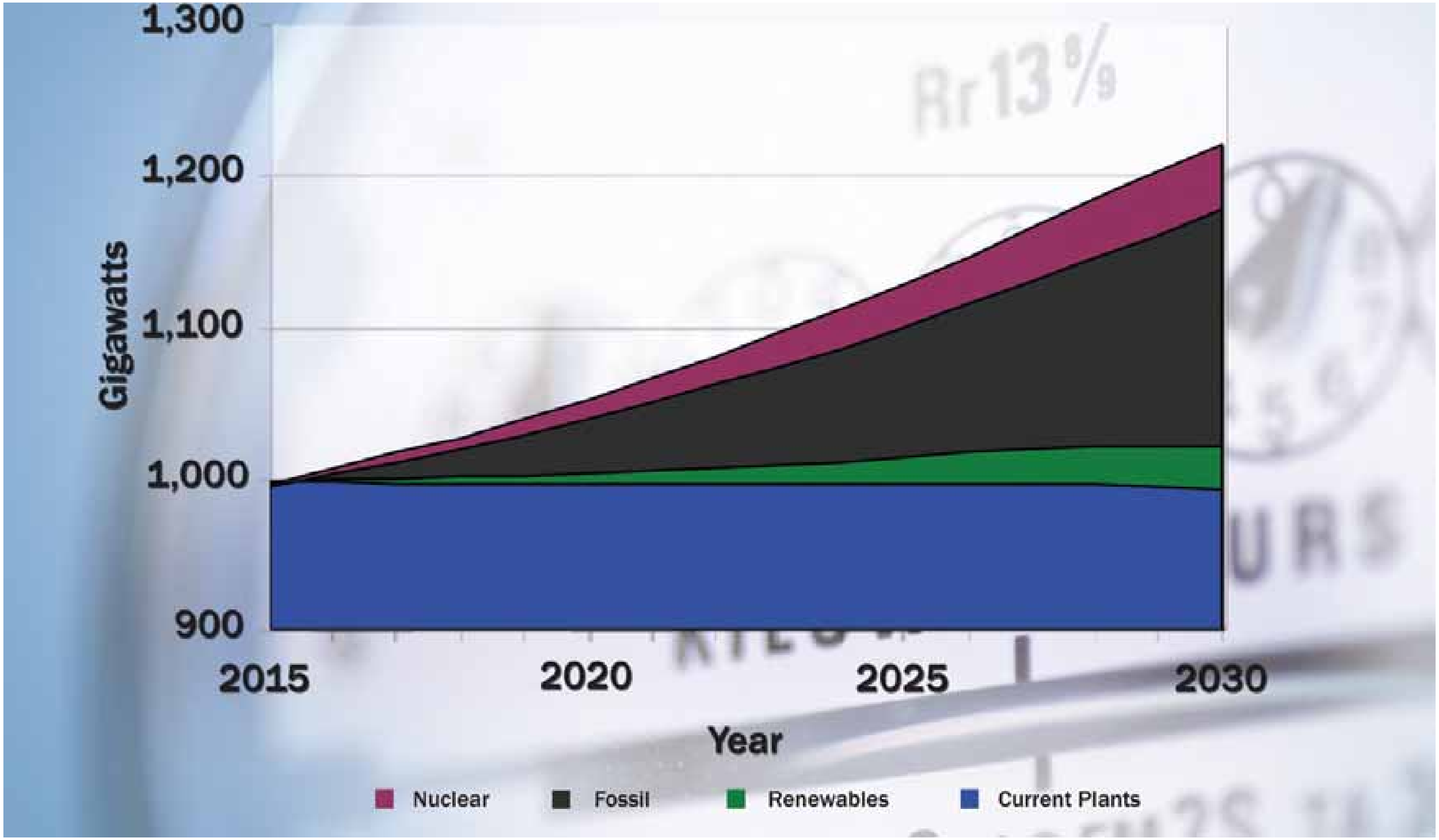
Houston Texas - Energy Capital of the World

"Reserves to production is 40 years" (IOC CEO 2006)

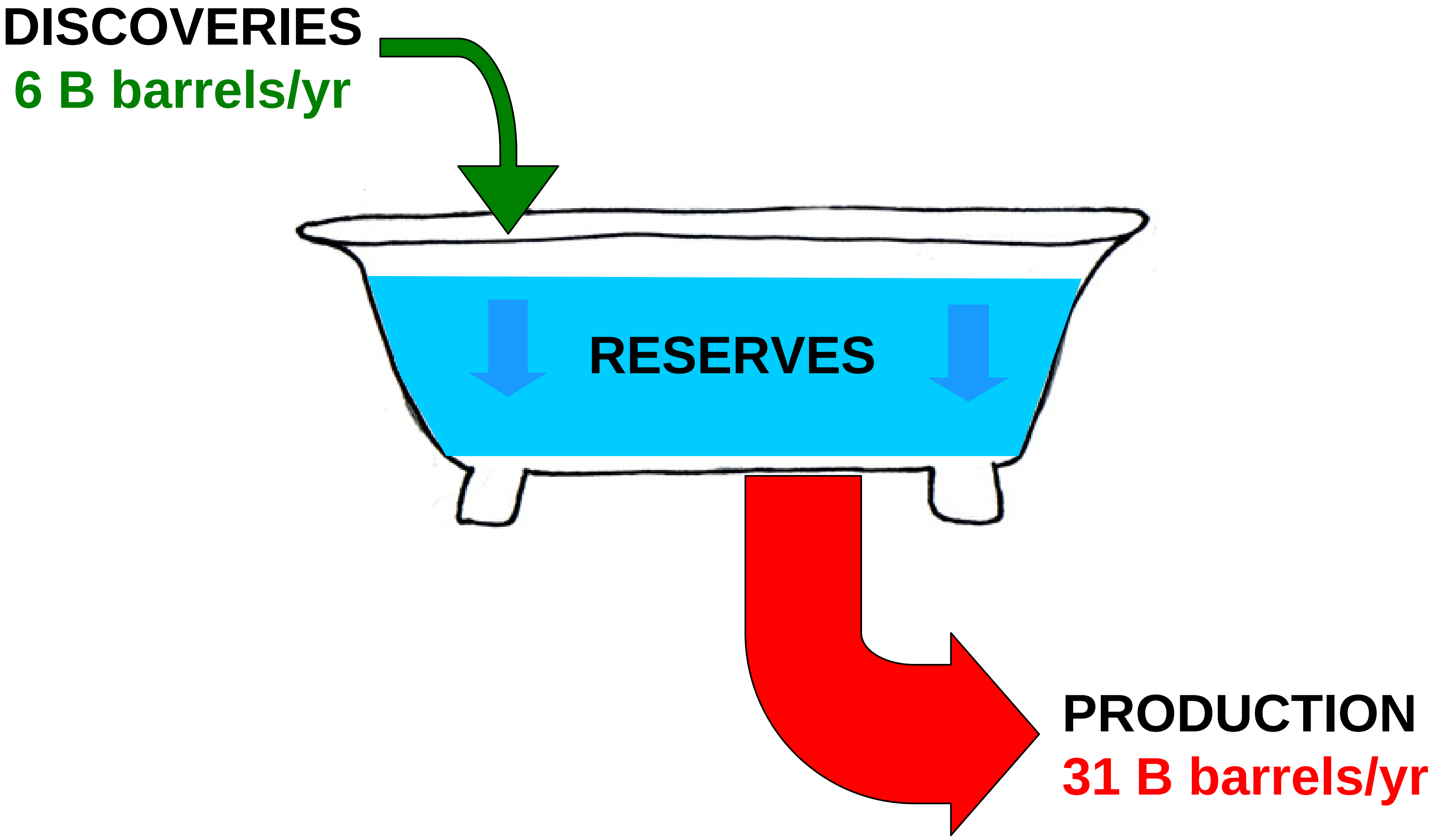
$$\frac{R}{P} = \frac{1200 \text{ billion barrels}}{30 \text{ billion barrels/year}} = 40 \text{ years}$$



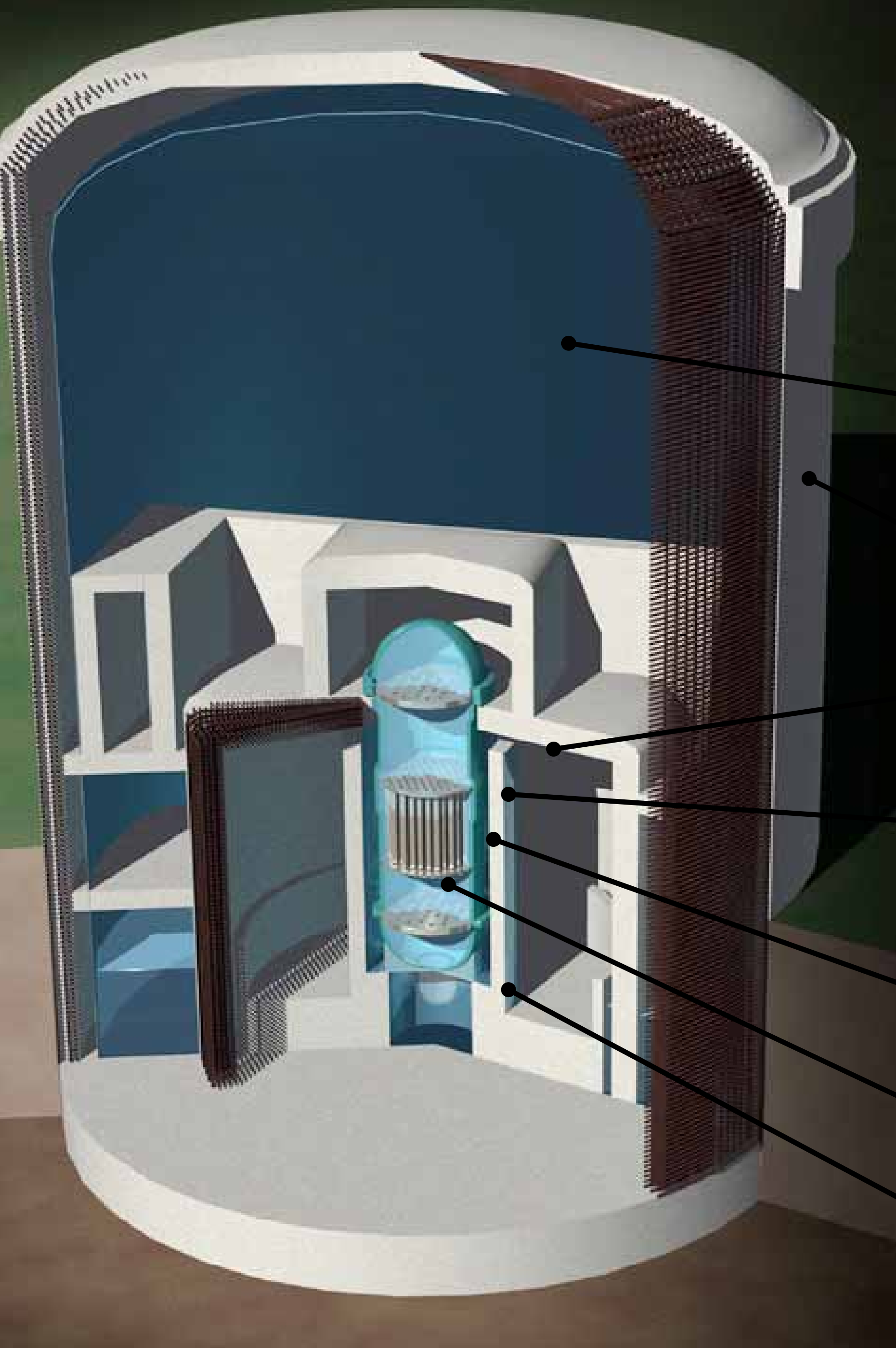
Future Need for Additional Generating Capacity



World Oil Depletion



Multiple Layers of Protection



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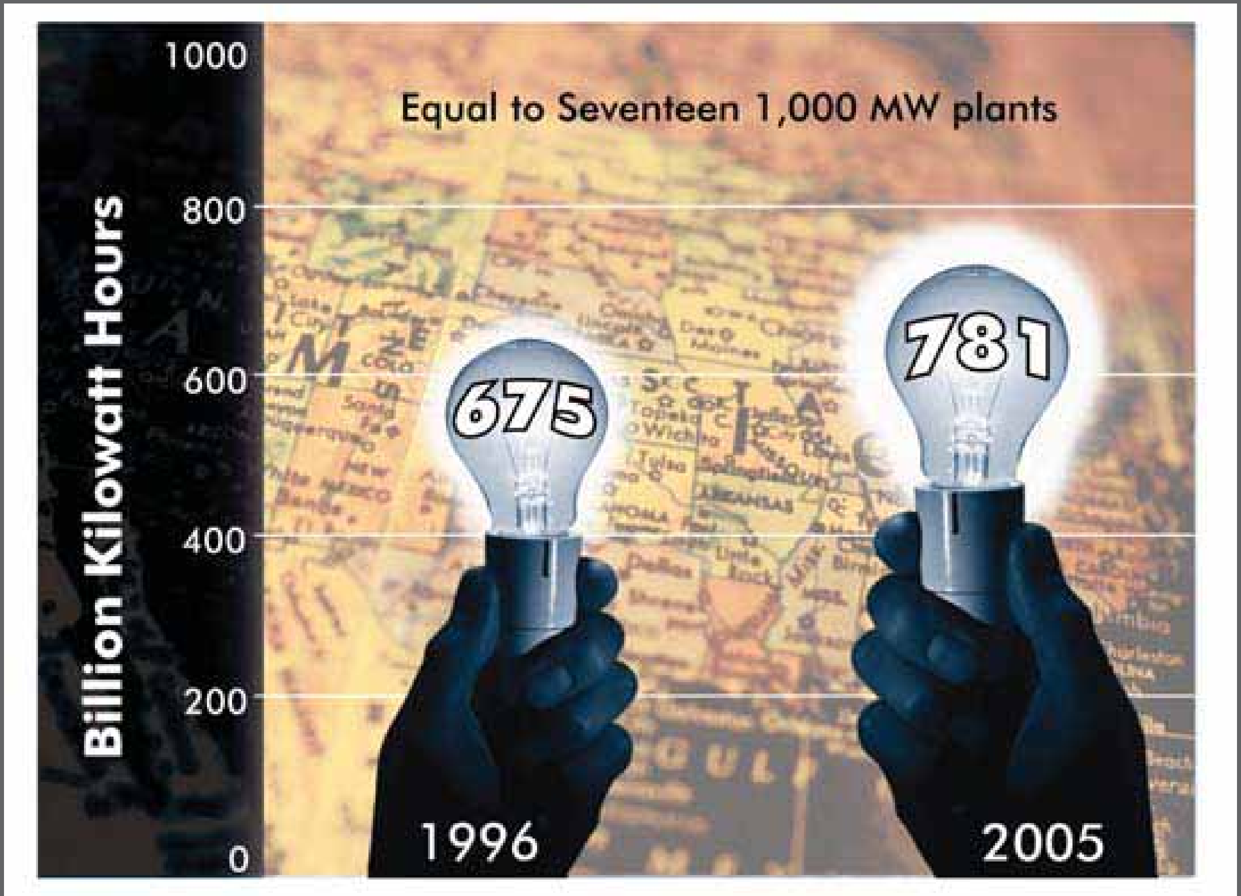
Increased Electricity Production by U.S. Nuclear Plants, 1996 – 2005



Source: Energy Information Administration net generation data, "Electric Power Monthly," May 2006; and U.S. Department of Energy, Office of Nuclear Energy

“Closing” the Nuclear Fuel Cycle Is a New Imperative

- Worldwide expansion of nuclear energy prompting renewed interest in:
  - recycling used nuclear fuel
  - advanced used fuel reprocessing technologies
  - new reactor designs able to consume fissile materials recovered from used fuel
- Together, these advanced technologies reduce volume and toxicity of nuclear waste
- But [illegible] still need Yucca Mountain disposal facility

France, UK, Japan, Russia reprocess spent fuel today.

2007 Houston World Oil Conference

Proceedings

ASPO USA

Association for the Study of Peak Oil & Gas - USA

Energy Action for a Healthy Economy and a Clean Environment

- Conference Program
- Conference DVD
- Video Highlights
- Peak Oil Review
- ASPO-USA