Friendship Village
Lifelong Learning Series
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Nuclear Renaissance:
The Resurgence of Nuclear Energy

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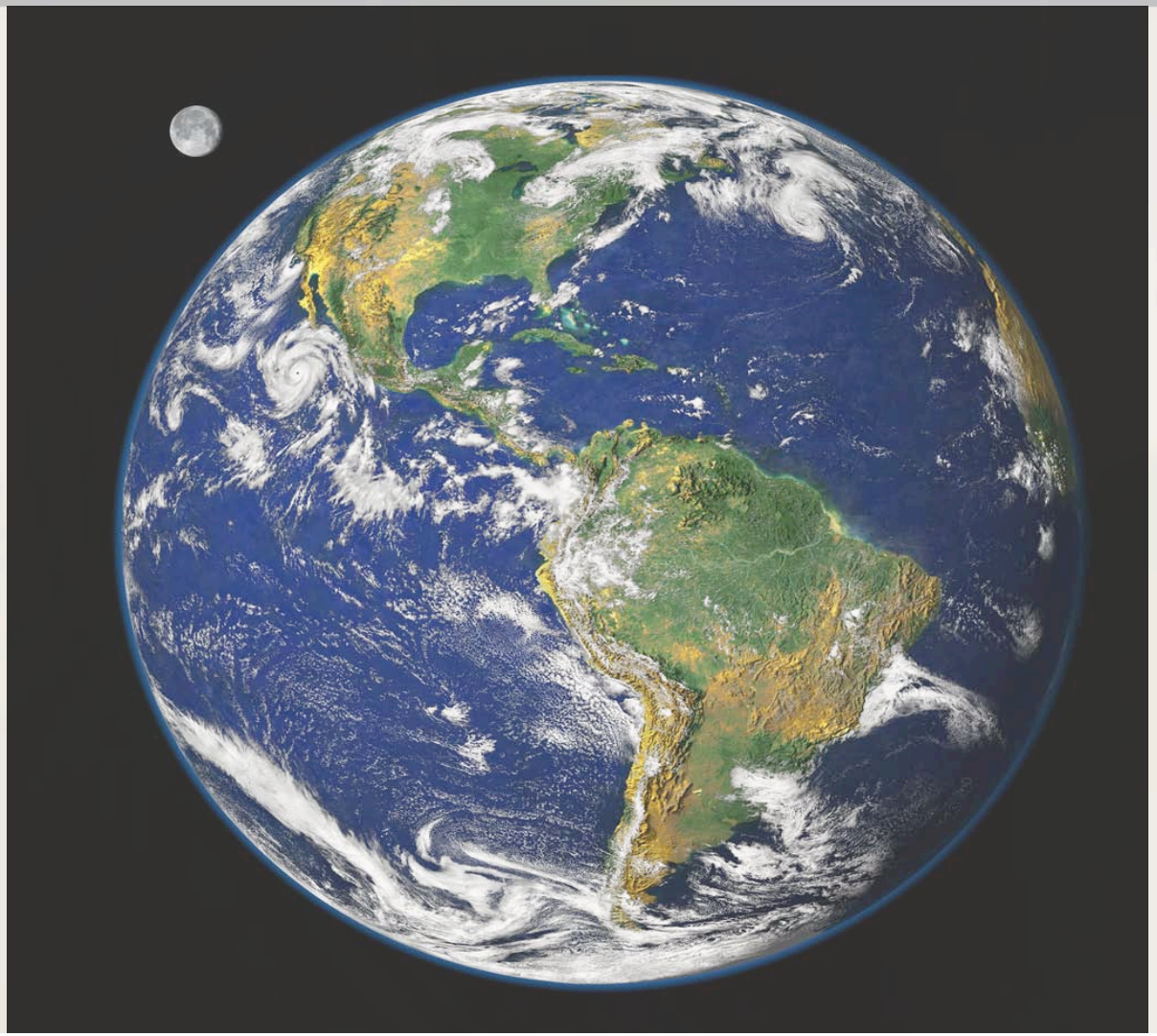
World View of Nuclear Energy



World View of Nuclear Energy

- 440 nuclear power plants
- 16% of world's electricity
- Displaces 2.5 billion metric tons of CO_2/year

Substantial New GW (gigawatt = 1 million kilowatts) Targets

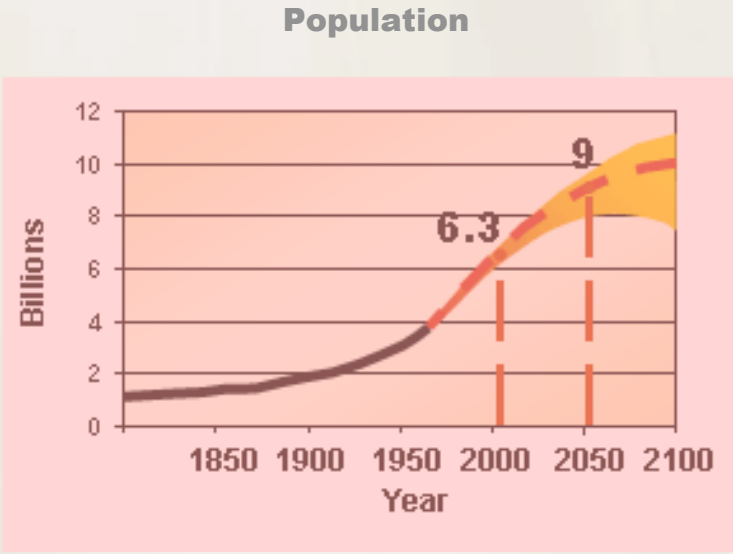
Country	Operating (GW)	Under Construction (GW)	Target (GW)
China	7	2.0	36 by 2020
India	3	4	24 by 2020
Japan	45	3.2	15 on order or planned by 2015
Russia	22	1.9	15-25 additional by 2020
South Korea	16	8.8	10 additional by 2015

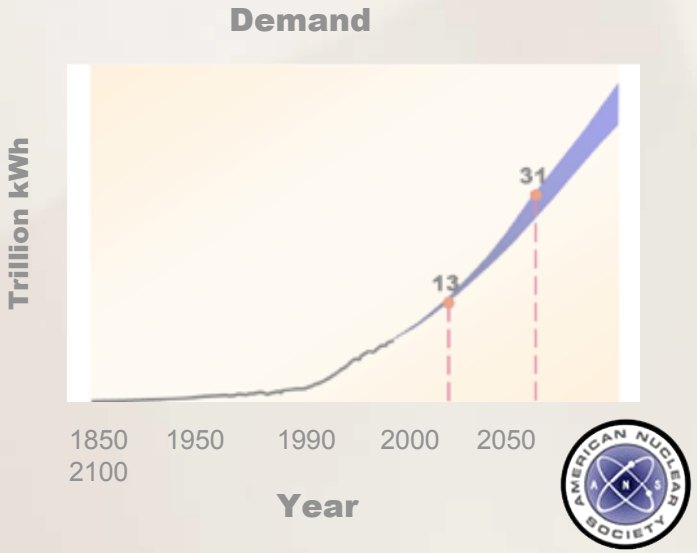
Plants and Capacity Factors

	Number	% CF	% of Total Generation
United States	103	92	20
France	59	88	78
Japan	52	70	34
Russia	30	68	17
Canada	21	64	13
South Korea	19	92	40
China	9	79	2
Taiwan	6	88	22
Mexico	2	79	5

World View

- **Global electricity demand to increase 50% by 2025**
  - 1.6%/yr for industrial world
  - 3.6%/yr for developing world

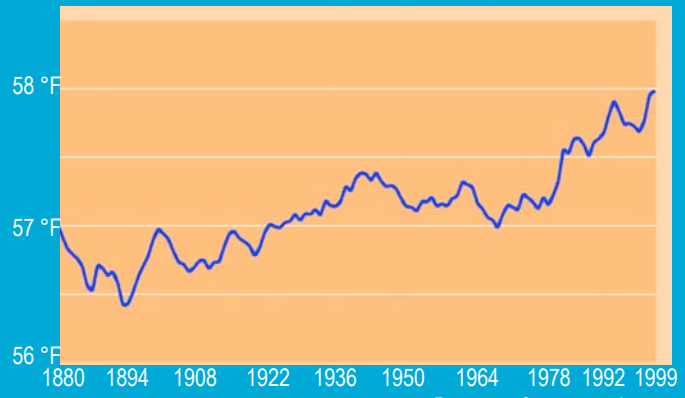




Environment

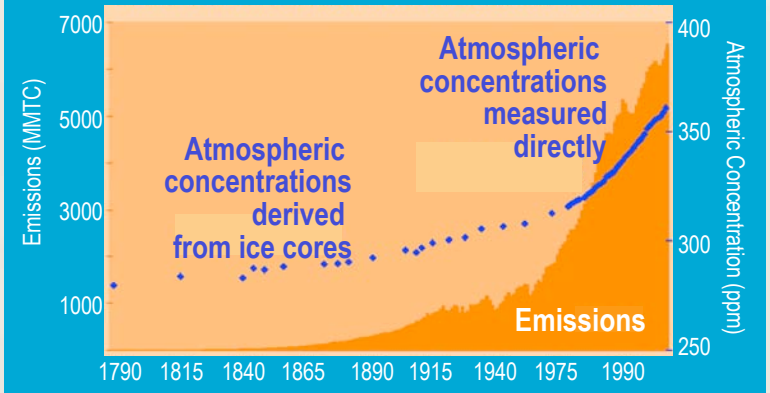
Nuclear
- Limits greenhouse gas emissions

Global Average Temperature



Source: NASA's Goddard Institute for Space Studies

Global Emissions and Atmospheric Concentration of CO_2



Source: Carbon Dioxide Information Analysis Center

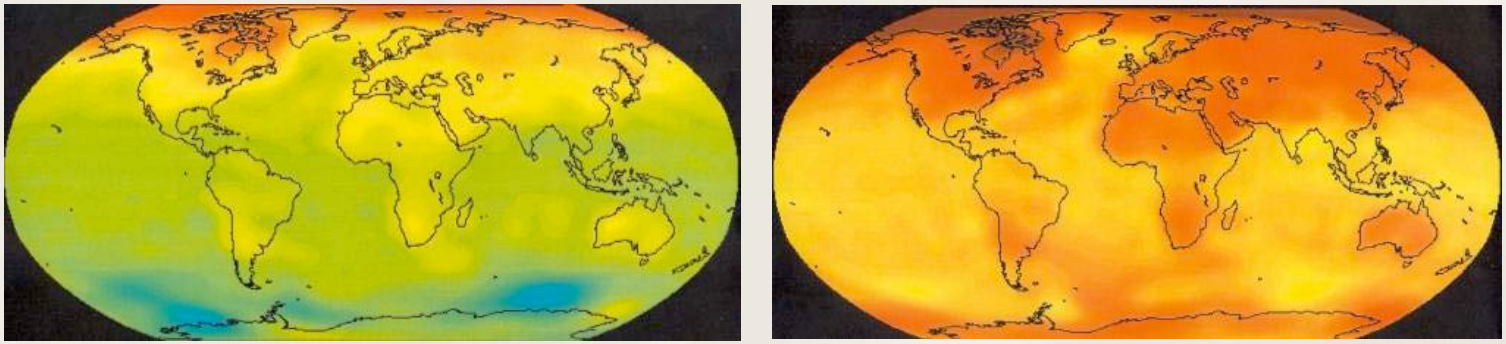
Cause of Disruption
- Emissions from CO_2 from fossil fuel
- Fossil fuel
  - 80% of world's energy
  - 80% of new capacity brought on line in 2003

EPRI

Environment

2 x CO_2 of Existing Levels

4 x CO_2 of Existing Levels



2030

2100

EPRI

Temperature Rise

-5 0 5 10 15 20 25

U.S. View

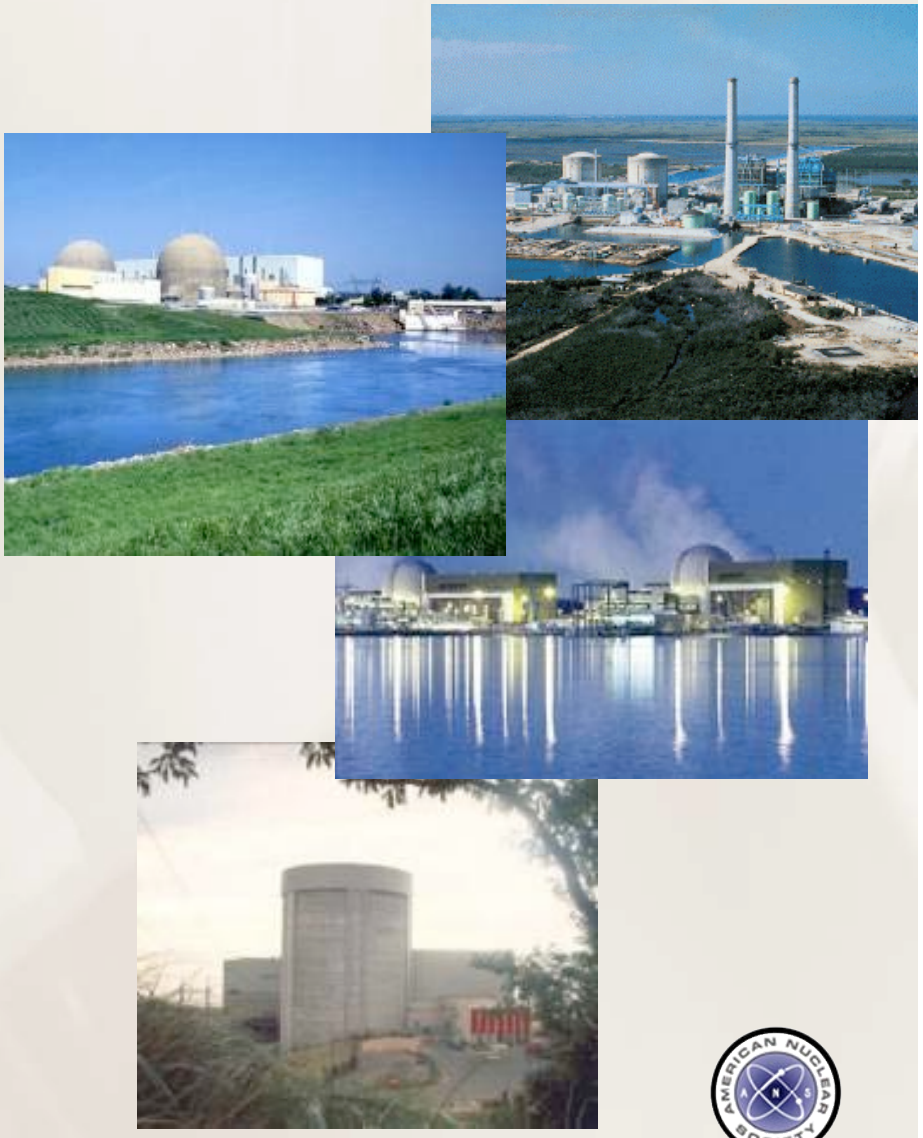
U.S. View of Nuclear Energy

- Quick facts
  - 104 nuclear plants
  - 20% of the nation's electricity

- Displaces 680 million metric tons of CO_2/yr
- Equivalent to 131 million passenger cars/yr

U.S. Nuclear Drivers

- Safe
- Proven performance
- Cost effective
- Affordable
- Energy security/ energy independence
- Base load generation/ grid stability
- Emission-free



Nuclear has best safety record

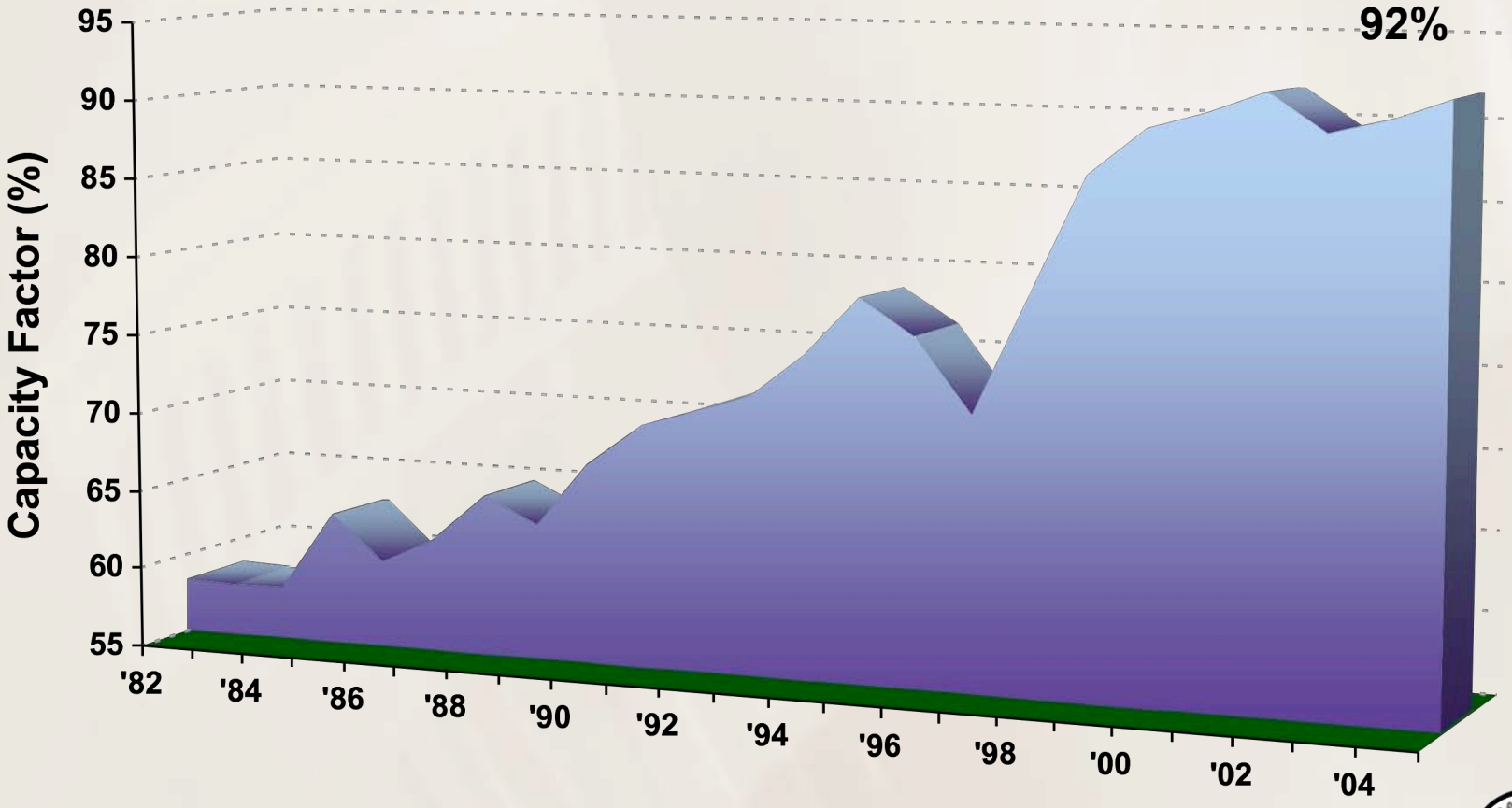
Deaths from Accidents from Generating Electricity per Billion MWe-hr

*Includes Chernobyl

400-page study of 4,290 energy-related accidents: 15,000 deaths related to oil, 8,000 related to coal, 5,000 related to gas.

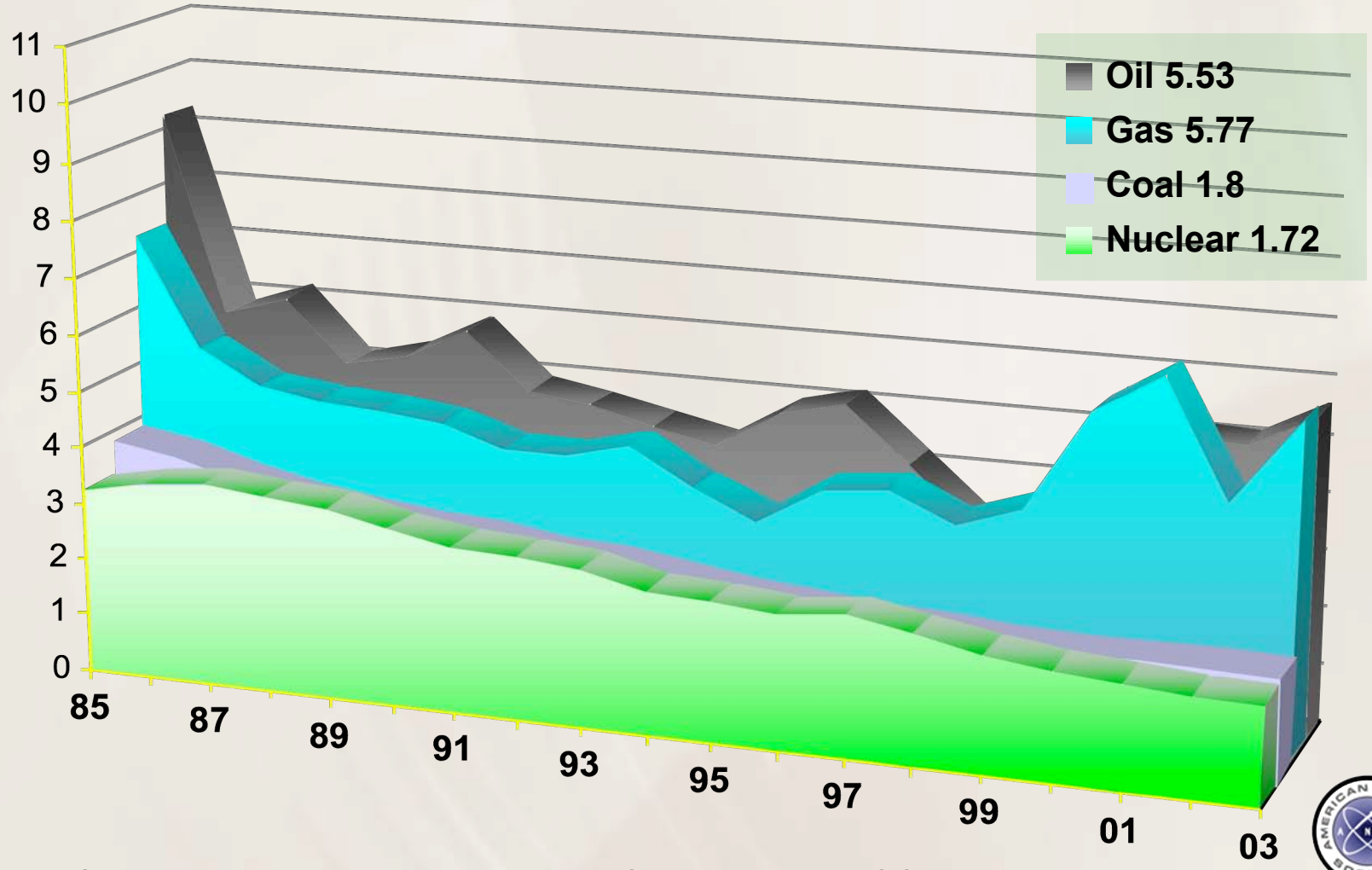
Paul Scherrer Institute, Switzerland, 2001

United States
Nuclear Power's Proven Performance



Source: Energy Information Administration/Nuclear Regulatory Commission

United States
Cost Effective *(in constant cents/kWh)*

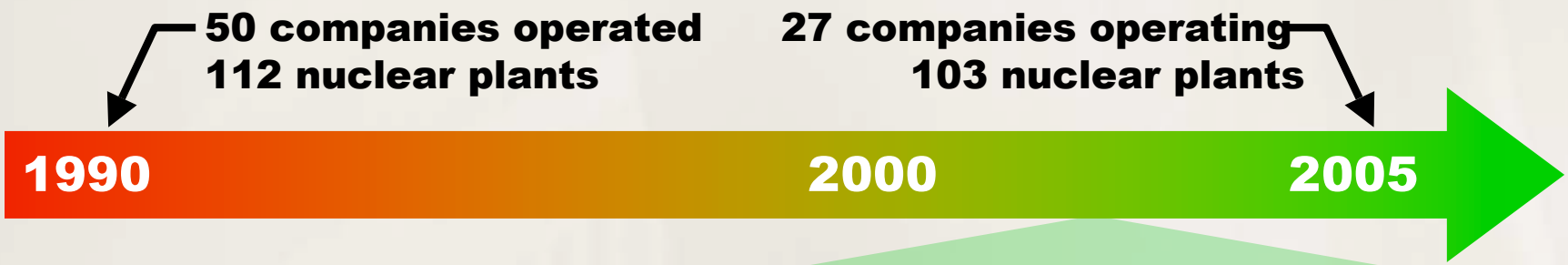


Source: Federal Energy Regulatory Commission /EUCG

Fossil Fuel Supplies

- Western World must reduce their dependence on oil
  - **Limit influence on foreign policy**
  - **Reduce cost to economy of oil price shocks**
  - **Reduce greenhouse gas emissions**
  - **Prepare for inevitable resource depletion**
  - **Husband oil for other uses**
- Reducing oil use is not a solution to terrorism but it may help

Consolidation of Nuclear Ownership



Last 5 years

- Substantial consolidation
- Top 10 operators have 61% of nuclear market
- Top 5 operators have 42% of nuclear market

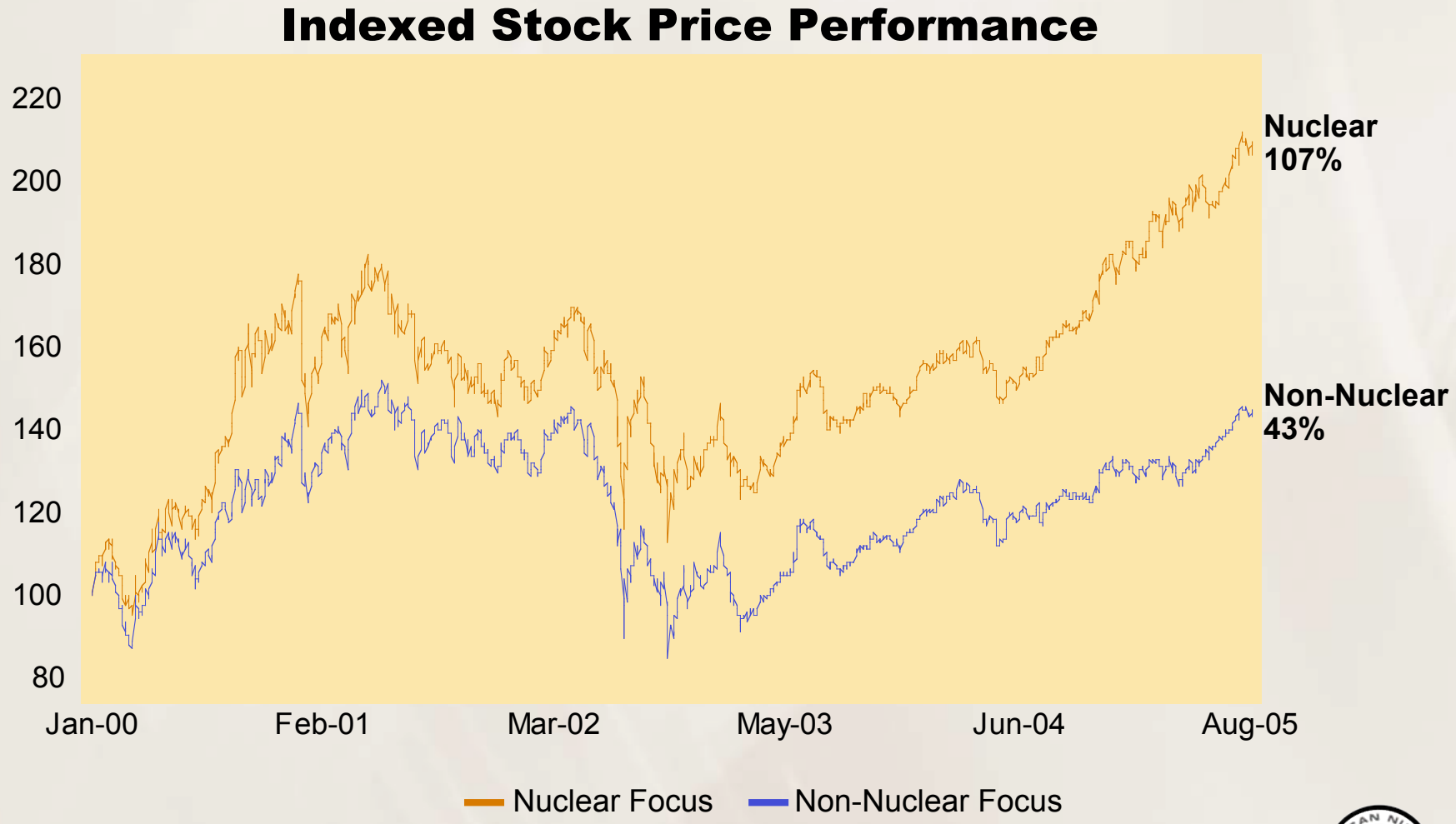
Consolidation of Ownership *resulted*

- Corporate M&A
- Asset sales by companies desiring to exit nuclear ownership

Top U.S. Nuclear Owners

Company	Total Nameplate Capacity (MW)	Recent Acquisitions (MW)	Percent of U.S. Total
Exelon Corp.	15,557	2,329	16
Entergy Corp.	9,010	3,998	9
Tennessee Valley Authority	6,695	—	7
Dominion Resources, Inc.	5,175	2,576	5
Duke Energy Corp.	5,020	—	5
FPL Group, Inc.	3,962	1,581	4
FirstEnergy Corp.	3,760	—	4
Constellation Energy Group, Inc.	3,748	2,045	4
Southern Co.	3,598	—	4
Progress Energy, Inc.	3,597	—	4
All others	39,090	—	39
Total	99,210	12,529	100

Utility Stock Performance

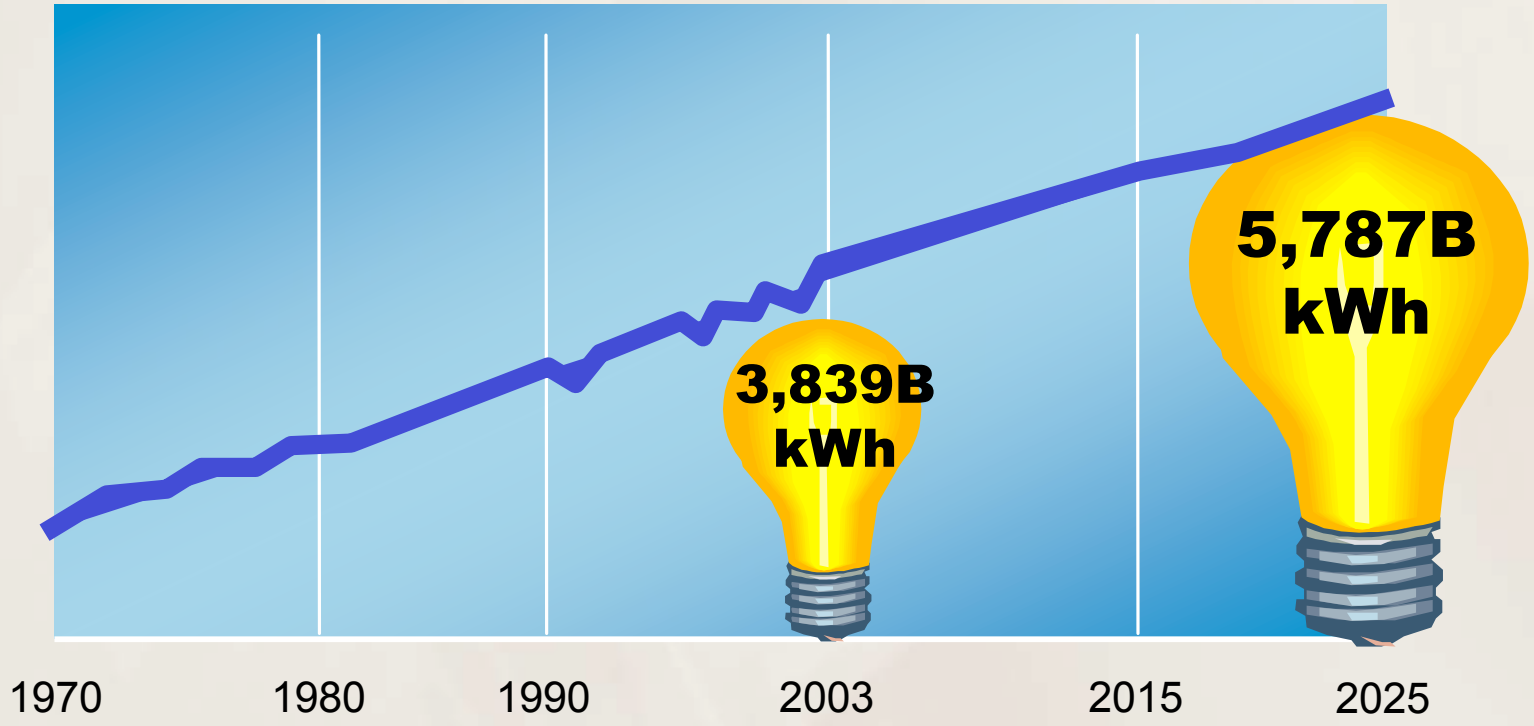


Financial Repercussions of Nuclear Announcements

Company	Stock Price before announcement	Stock Price at close on Dec 5, 2006	% Change
Constellation Energy Group, Inc.	$53.85 (10/26/05)	$70.10	30
Duke Energy Corp.	$27.45 (2/15/05)	$32.69	19
Entergy Corp.	$72.25 (9/21/05)	$91.95	27
Exelon Corp.	$61.30 (9/28/06)	$62.43	2
FPL Group, Inc.	$40.14 (3/31/06)	$53.90	34
NRG Energy	$47.13 (6/20/06)	$58.63	24
Pinnacle West	$40.12 (5/17/06)	$50.00	25
Progress Energy, Inc.	$43.06 (8/26/05)	$48.70	13
SCANA	$41.73 (8/23/05)	$41.91	0.4
Southern Co.	$33.04 (5/11/05)	$36.71	11
TXU	$65.00 (8/30/06)	$57.80	-11
Average			16

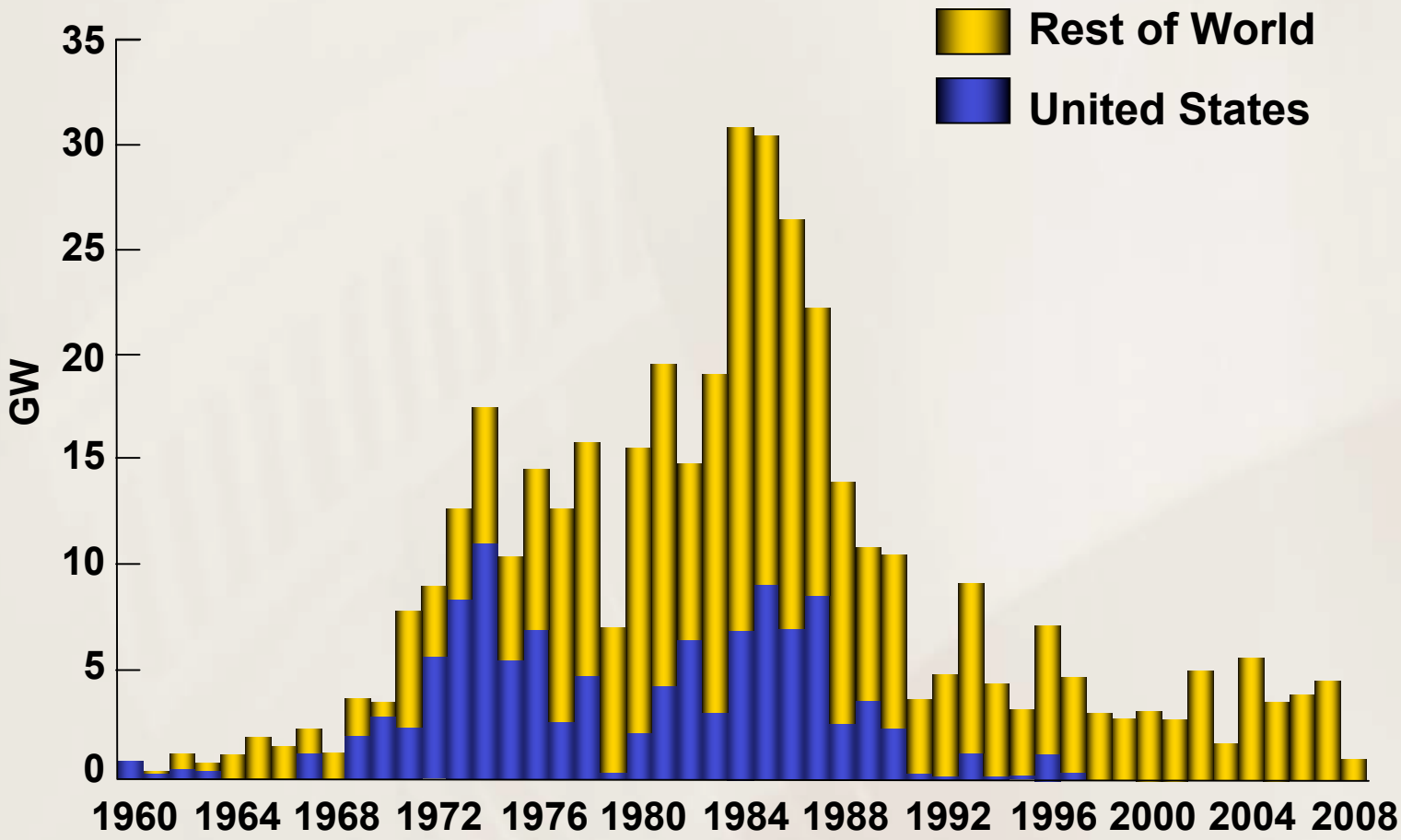
U.S. Energy Demand

America Is Projected to Need 50% More Electricity by 2025

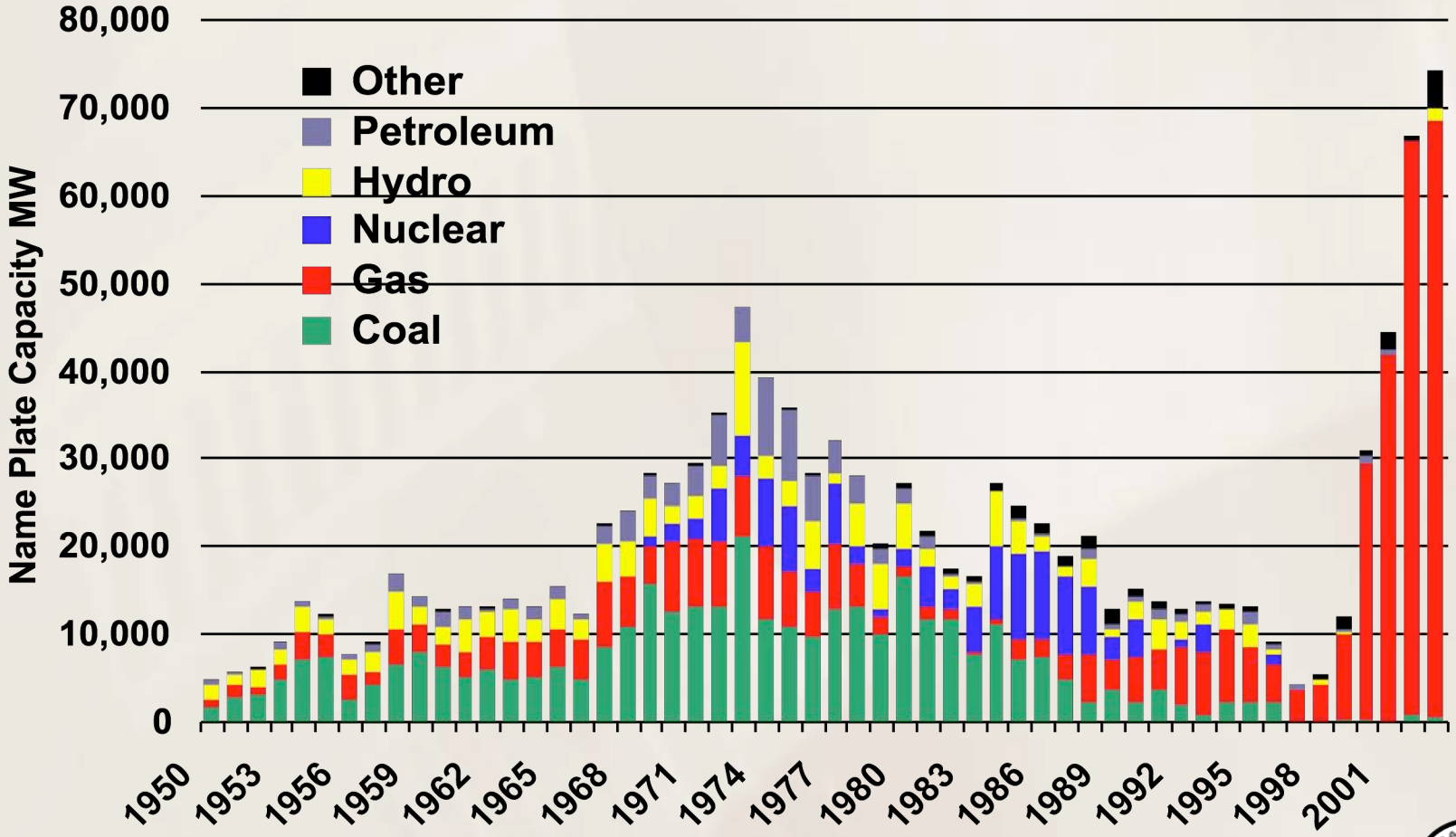


Source: U.S. Department of Energy

United States vs. Global Nuclear Capacity Additions 1960-2008



Capacity Brought on Line by Fuel Type (1950-2002)



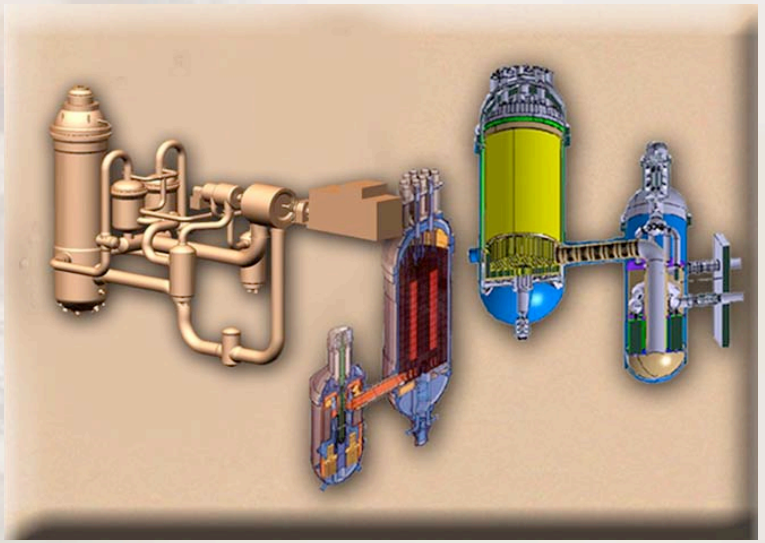
Source: RDI PowerDat database. Last updated 9/15/03.

Reactor Technologies

Gen III+

Today's Designs

Gen IV



Future Designs

Today's New Design—*Generation III+*

Advanced Light Water Reactors (ALWRs)

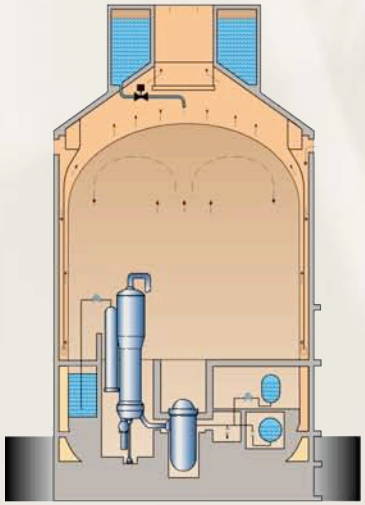
- Simplified design
- Passive or redundant systems to enhance safety
- Standardized designs based on modularization producing shorter construction schedules
- Enhanced resistance to proliferation

Today's New Design—*Generation III+ ALWR*

- General Electric ➔ ESBWR
- TOSHIBA/ Westinghouse ➔ AP 1000
- AREVA/ Framatome-ANP ➔ EPR

Today's New Design—*Generation III+ ALWR*

- **Westinghouse—AP 1000 (1,148 MWe)**
  - Passive safety systems permit simplification and improve safety
  - Modularization reduces construction schedule
  - NRC design certification provides regulatory certainty:
    - AP 600—December 1999
    - AP 1000—January 2006



Westinghouse

Status of Reactor Designs

Applications for Design Certification

	Design	Vendor	Type	Design Certification Status
Generation III	ABWR	GE Nuclear	BWR	Approved
	System 80+	Westinghouse	PWR	Approved
	AP-600	Westinghouse	PWR	Approved
Generation III +	AP-1000	Westinghouse	PWR	Certification January 2006
	ESBWR	GE Nuclear	BWR	Application—August 2005 Certification—2008
	EPR	Framatome ANP	PWR	Application—August 2007 Certification—June 2010

Future Designs—*Generation IV - ARS*

- **Technology (VHTR)**
  - Top priority ➔ Next Generation Nuclear Plant
    - High temperature
    - Passive safety
    - Improved economics
    - Demonstrates hydrogen production
    - High efficiency direct-cycle electricity production
    - Nonproliferation

  - Technology suppliers
    - PBMR (Pty) Ltd. ➔ Pebble Bed Modular Reactor (PBMR)
    - AREVA/Framatome ➔ ANTARES
    - General Atomics ➔ GT-MHR

The Energy Policy Act of 2005

Energy Policy Act of 2005

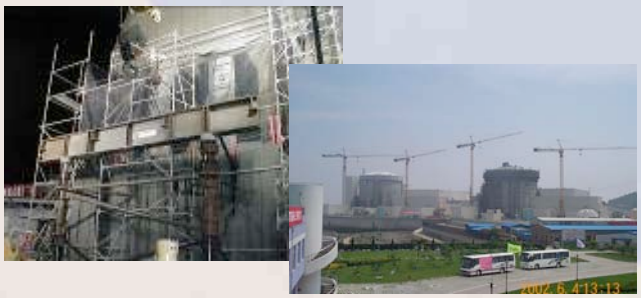
Nuclear

New Plant Construction

- Loan guarantees
- Risk assurance
- Production tax credit
- Price-Anderson
- Decommissioning funds

R&D

- Next generation nuclear plant
- Nuclear hydrogen production
- Advanced fuel cycle initiative
- Nuclear engineering program
- Medical isotopes



New Plant Construction Key Provisions

Loan guarantees	80% of project cost	▪ Higher leverage ▪ Lower debt cost
Production tax credit	$18/MW hr	▪ Through 2021 ▪ $125M/1000 MW per year ▪ 6,000 MW eligible ▪ IRS rule making: February 2006
Risk assurance	Delay protection	▪ $500M for 1st 2 plants ▪ $250M for next 4 plants ▪ Final rules: August 2006
Price-Anderson	Nuclear liability insurance	▪ Reauthorization for 20 years
Decommissioning funds	Updates for treatment	▪ Allows companies to establish funds and make contributions ▪ Allows transfer of nonqualified funds to qualified funds

The Licensing Process

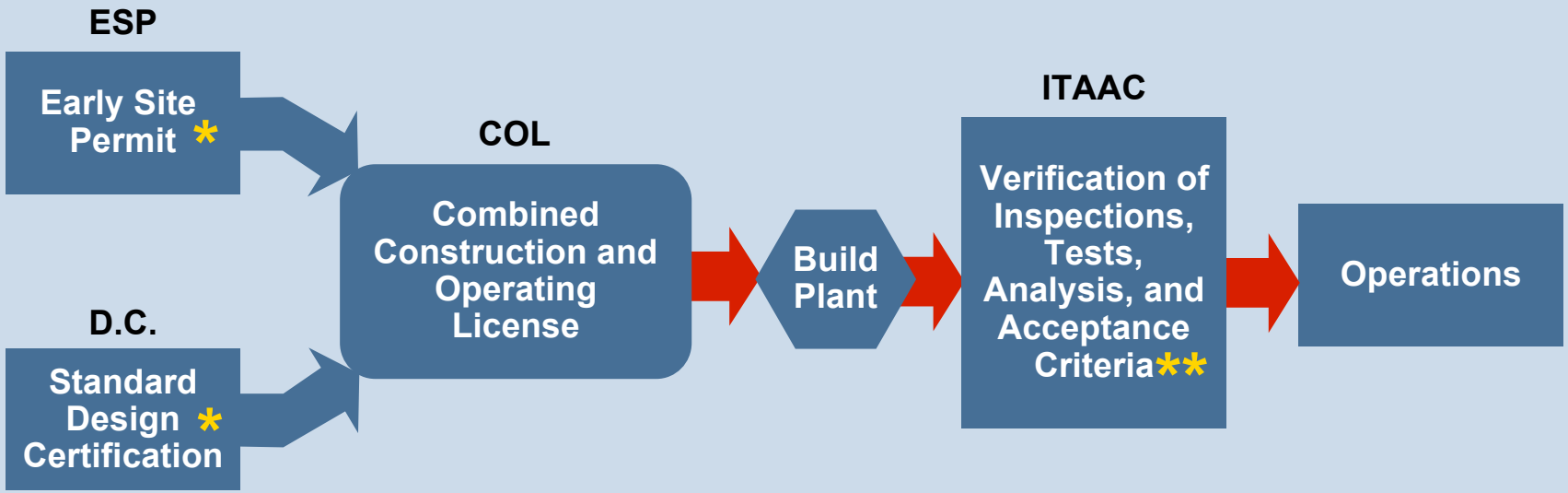
Old Process

Two-step licensing process (10 CFR 50)

*Opportunity for intervention, hearings, and delay

New Process

Combined licensing process (10 CFR 52)



* Opportunity for public comment
** Opportunity for hearing

9 Years

New U.S. Licensing Process

Early Site Permit (ESP)

Design Certification

Combined Construction and Operating License (COL)

Early Site Permits

- Site approval obtained before a utility decides to build a new plant
- Utility "banks" site up to 20 years
- Decision made, design chosen later
- Reduces risk to a utility

Design Certification

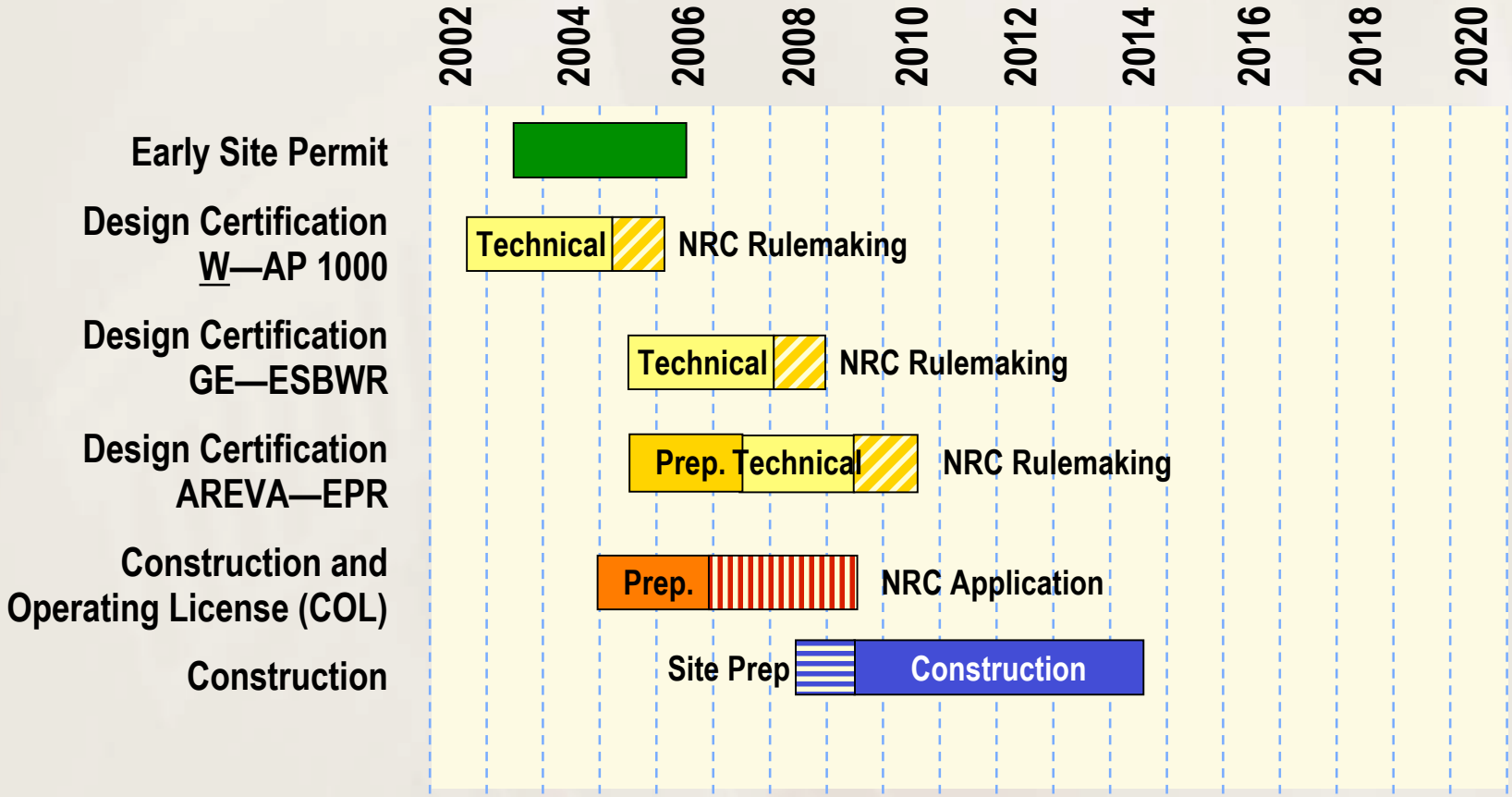
- Provides NRC's advanced approval of a reactor design
- Lengthy delays avoided before site preparation and construction begins

Combined Construction and Operating License

- One license for building and operating a new nuclear power plant
- Early focus of public comment
- Intended to provide greater regulatory certainty

Timeline to New Nuclear Construction

Best-Case Scenario

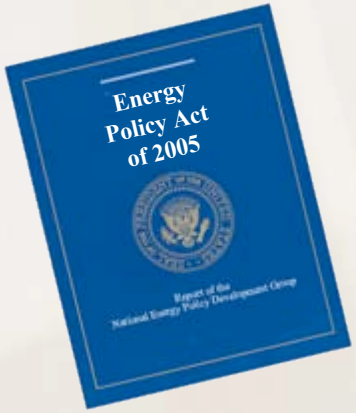


U.S. Path Forward

Evidence of U.S. Nuclear Revival

Congress

- **Energy Policy Act of 2005**
  - Supports nuclear energy as a major component of national energy policy



DOE

- **Nuclear Power 2010 program**
  - Cost sharing initiative between industry and government for new deployment

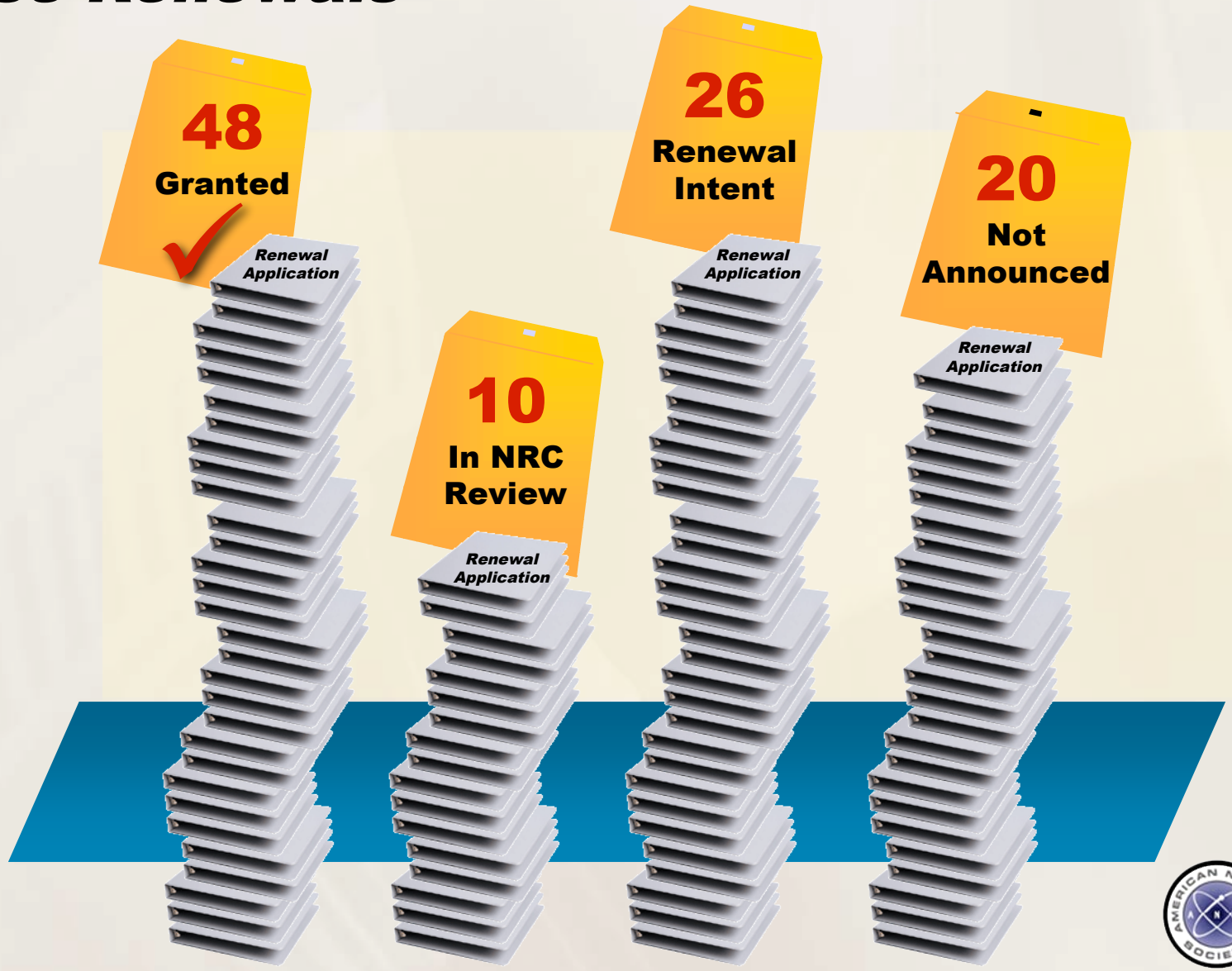
Utilities

- **Several utilities developing ESPs and COL applications for new reactors**

Evidence of U.S. Nuclear Revival

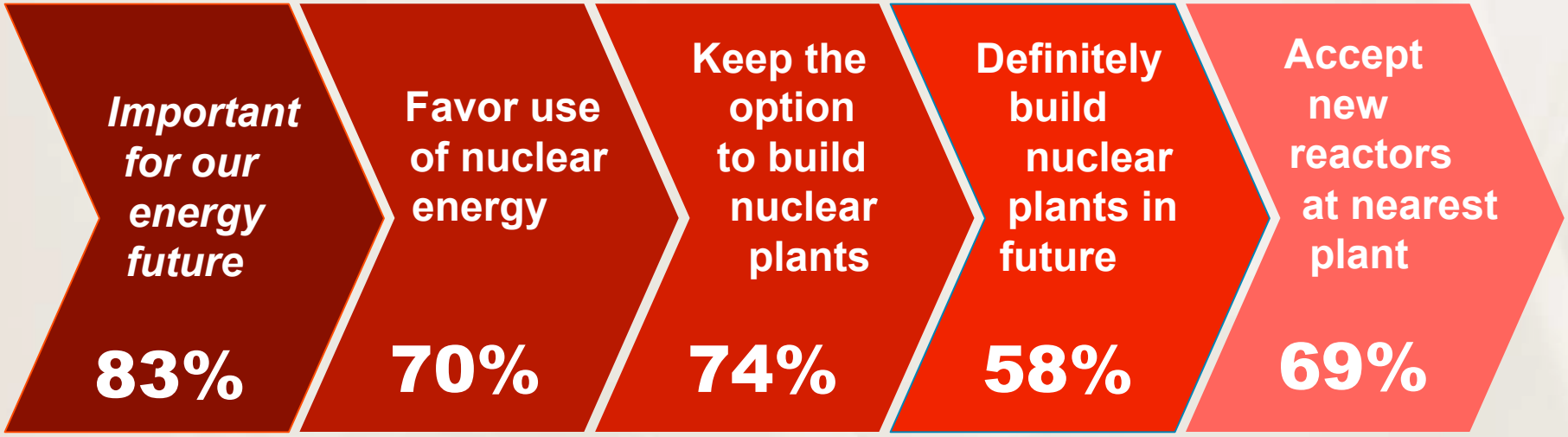
- **Browns Ferry #1 restart**
  - Tennessee Valley Authority
    - 1,280 MWe
    - Applied for 20-year license renewal
    - 100% power June 2007
    - on budget

Evidence of U.S. Nuclear Revival—
License Renewals



Evidence of U.S. Nuclear Revival

Increasing Public Support



Source: Bisconti Research Inc.

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.

U.S. Nuclear Industry—First Movers

Existing or Expected ESP / COL Applications in the U.S.

Reactor Type	Number
AP1000 (Westinghouse)	11
EPR (AREVA)	5
ABWR & ESBWR (GE)	7
TBA	10
Total	33

Source: Nuclear News, January, 2007

Challenges

1. Financial markets
2. Continued Safe Operation
3. Lack of agility (construction time, licensing risk)
4. Infrastructure (workforce, lack of momentum, equipment suppliers)
5. Waste / transport
6. Safety culture tuning and the never-ending challenges (DB, TEPCO, Tokaimura)
7. Public perceptions (safety, security, terrorism, proliferation)

Current Top Issues

1. Accelerating the opening of Yucca Mountain.
2. Creating interim storage sites for spent commercial nuclear fuel.
3. Accelerating R&D and construction funding of prototype advanced reactors.
4. Testing the new licensing procedure.
5. Committing to deployment of a closed fuel cycle, as outlined in the administration's GNEP proposal.
6. Expanding federal funding to train the next generation nuclear workforce.
7. Rebuilding the nation’s infrastructure to manufacture large reactor components.

Questions?

You can't turn back the clock,

but you can wind it up again.

Bonnie Prudden