

Nuclear: A Critical Role in Our 21st Century Energy Portfolio

38th Annual PURC Conference

Paul H. Genoa

Director, Policy Development

Nuclear Energy Institute



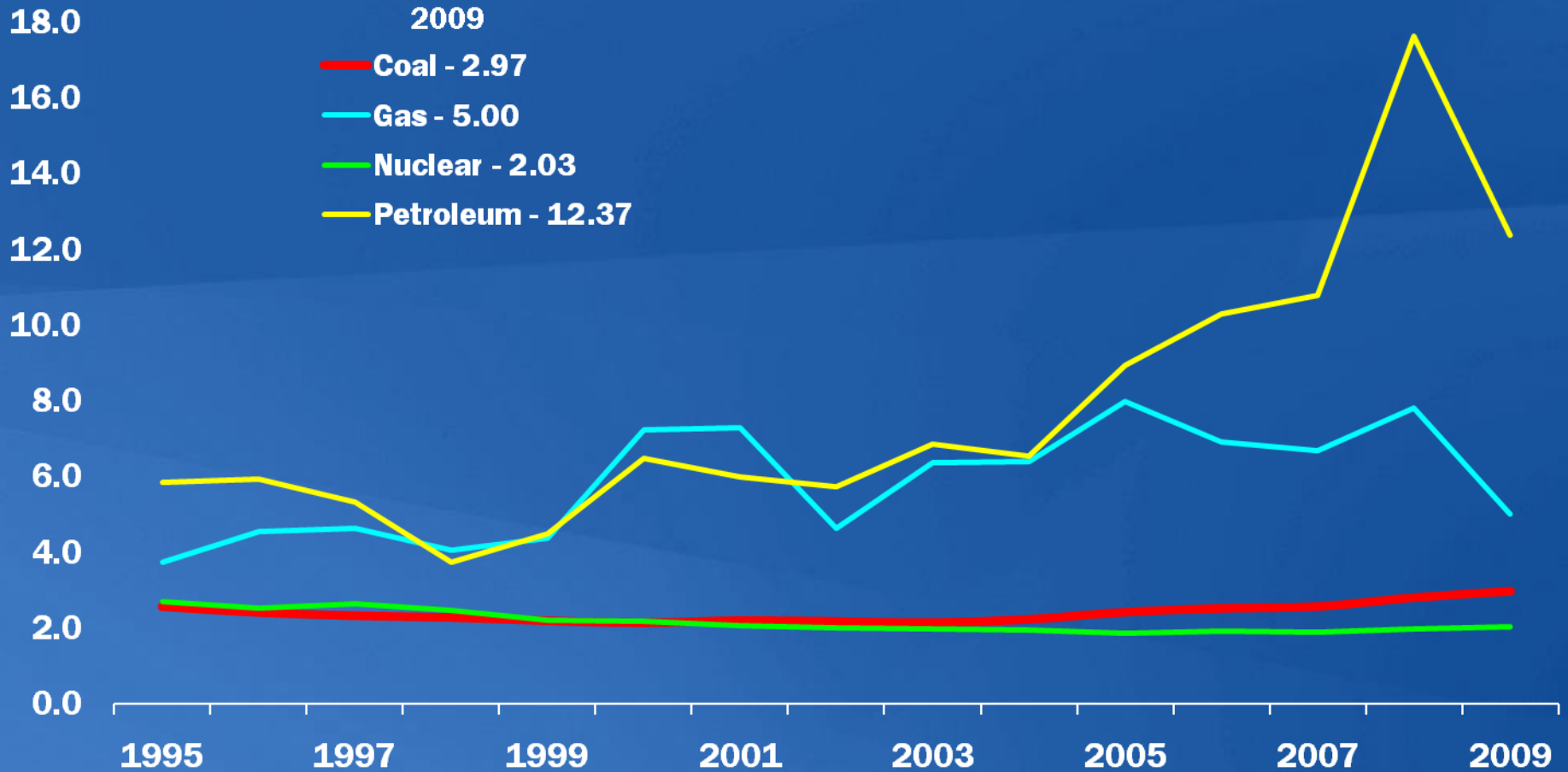
NUCLEAR
ENERGY
INSTITUTE

Overview

- **Nuclear Plant performance**
- **License Renewal /Long-Term Operation**
- **Used Fuel Management/Blue Ribbon Com.**
- **Recognition of Environmental Benefits**
- **Public Opinion**
- **Status of New Plant Developments**
- **Current Political Support**

U.S. Electricity Production Costs

1995-2009, *In 2009 cents per kilowatt-hour*



Production Costs = Operations and Maintenance Costs + Fuel Costs. Production costs do not include indirect costs and are based on FERC Form 1 filings submitted by regulated utilities. Production costs are modeled for utilities that are not regulated.



Source: Ventyx Velocity Suite
Updated: 5/10

U.S. Capacity Factors by Fuel Type

2009

Fuel Type	Average Capacity Factors (%)
Nuclear	90.5
Geothermal	71.5
Biomass	66.0
Coal (Steam Turbine)	63.1
Gas (Combined Cycle)	44.7
Hydro	29.4
Wind	27.8
Solar	23.5
Gas (Steam Turbine)	13.3
Oil (Steam Turbine)	7.4



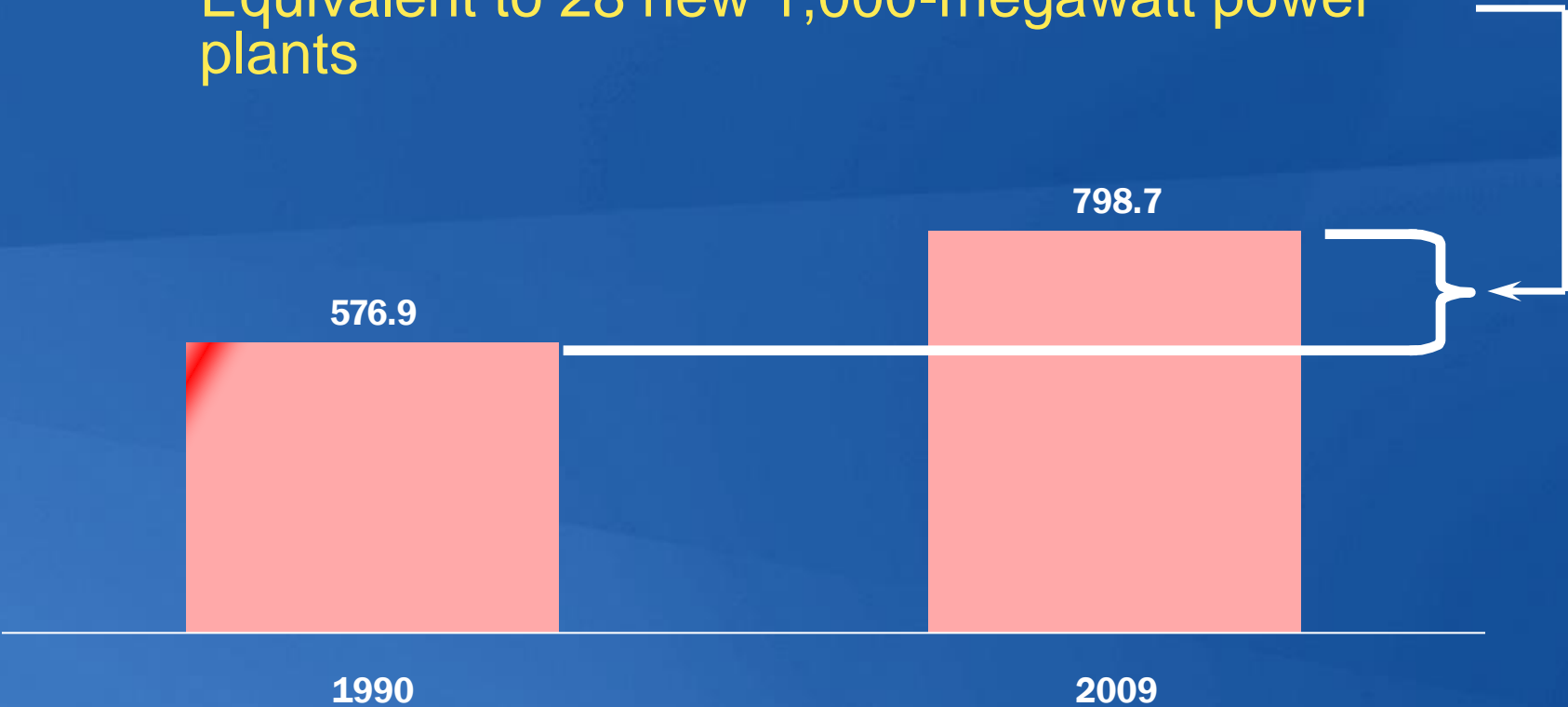
Source: Ventyx Velocity Suite / Energy Information Administration

Updated: 5/10

U.S. Nuclear Plant Output Growth

Billion kWh

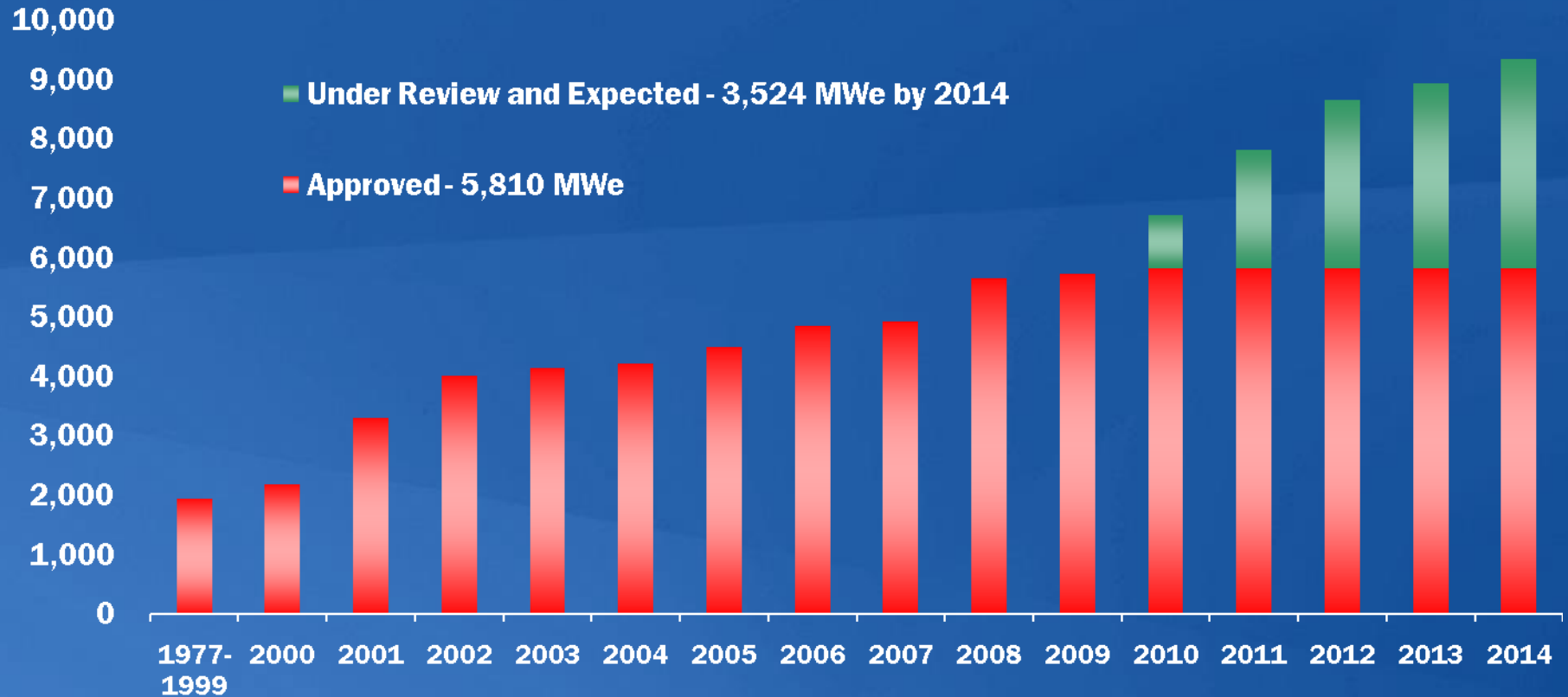
Equivalent to 28 new 1,000-megawatt power plants



Source: Energy Information Administration

Updated: 4/10

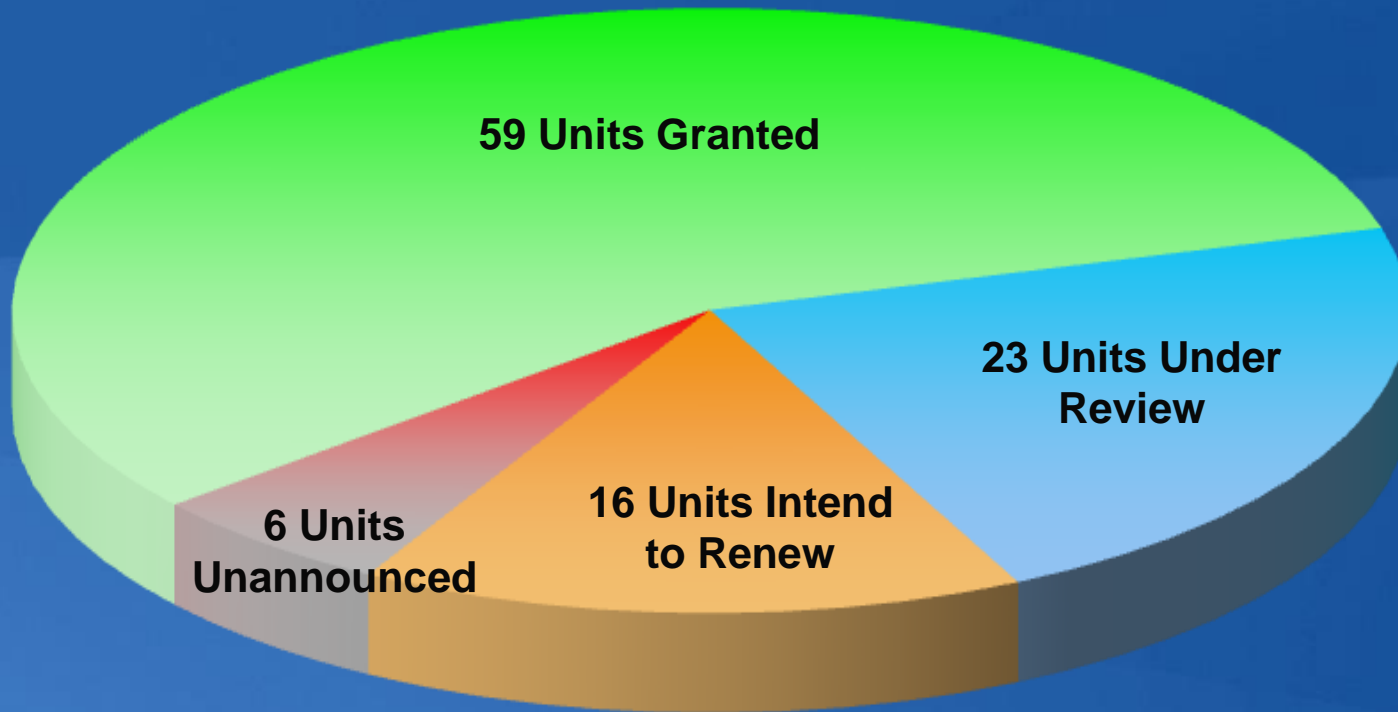
Cumulative Capacity Additions at U.S. Nuclear Facilities 1977-2014



Source: Nuclear Regulatory Commission

Updated: 10/10

Applications for License Renewal



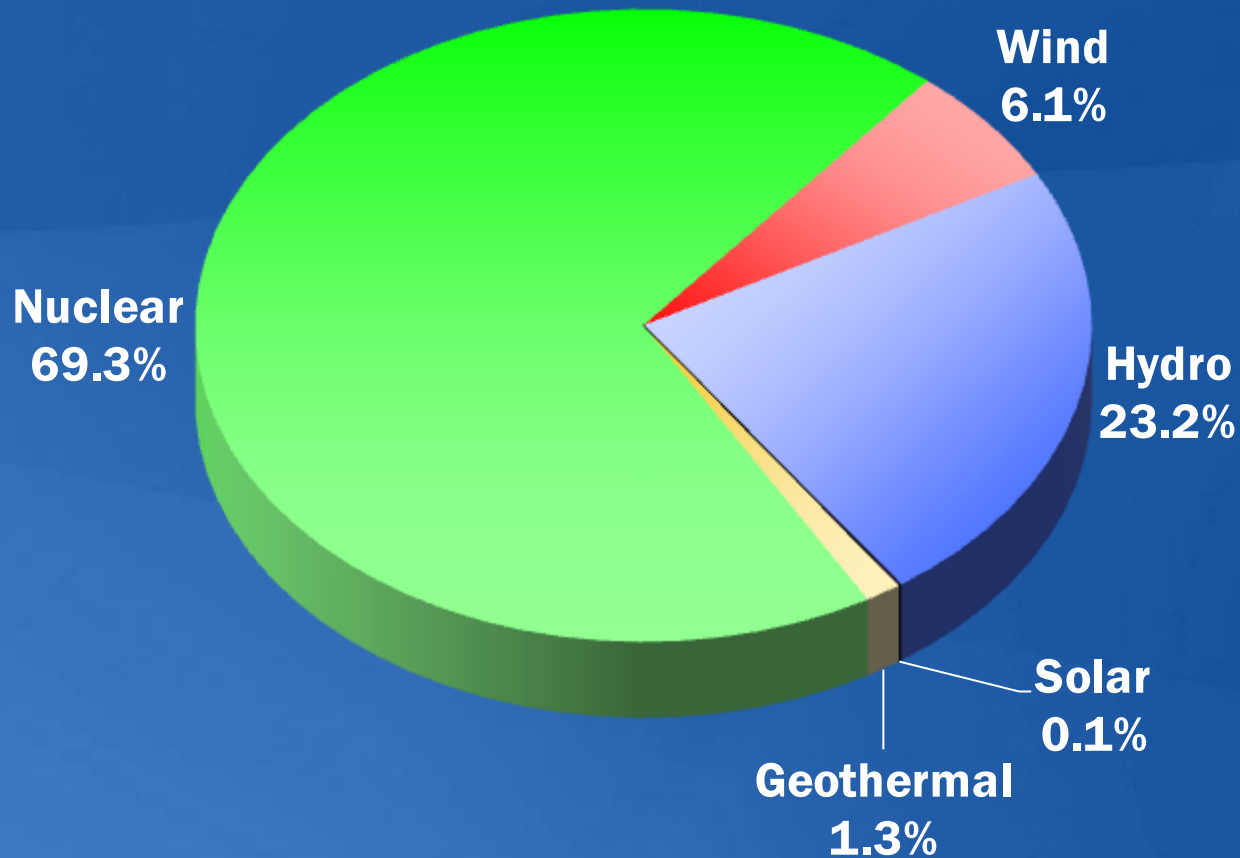
Source: Nuclear Regulatory Commission

Updated: 11/10

Environmental

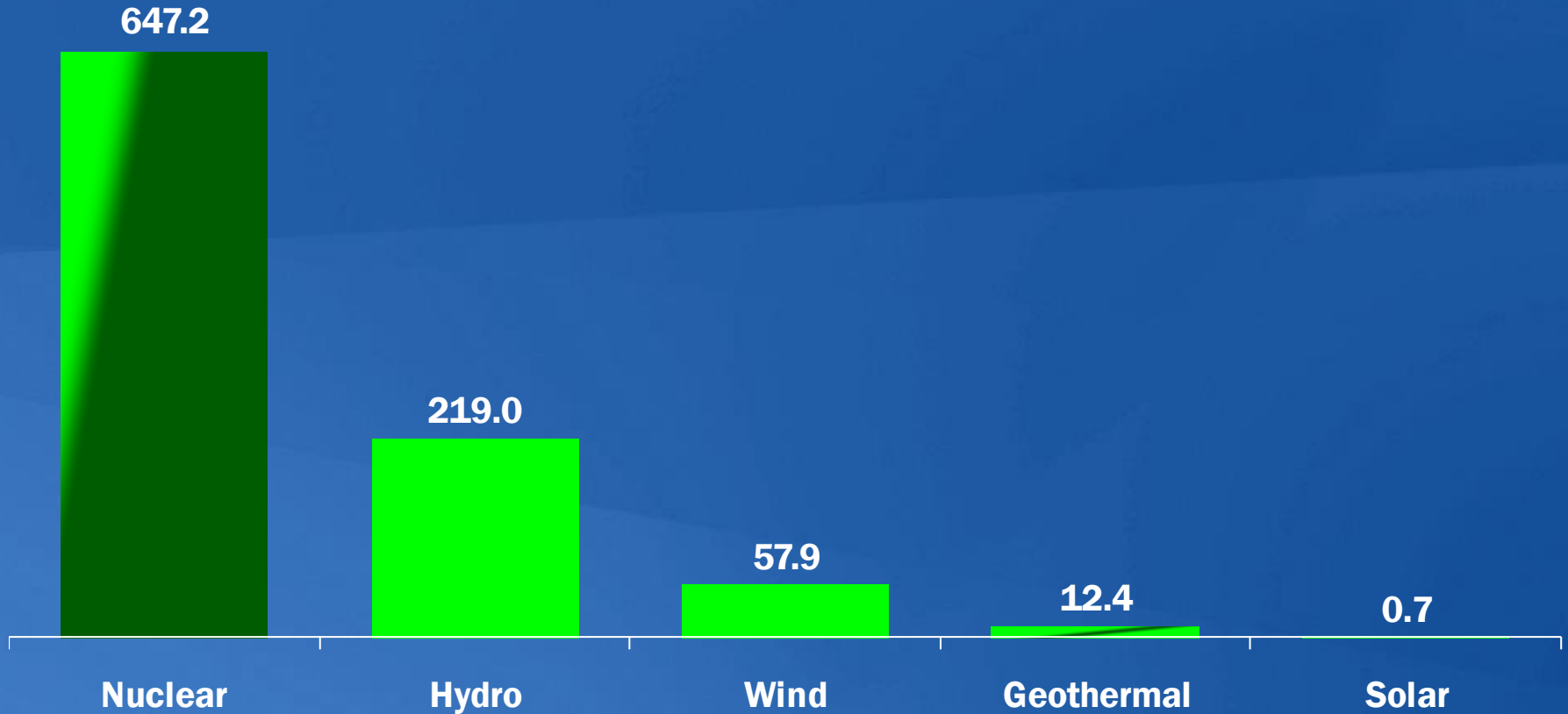
U.S. Electricity Sources Which Do Not Emit Greenhouse Gases During Operation

2009



U.S. Electric Power Industry CO₂ Avoided

Million Metric Tons, 2009

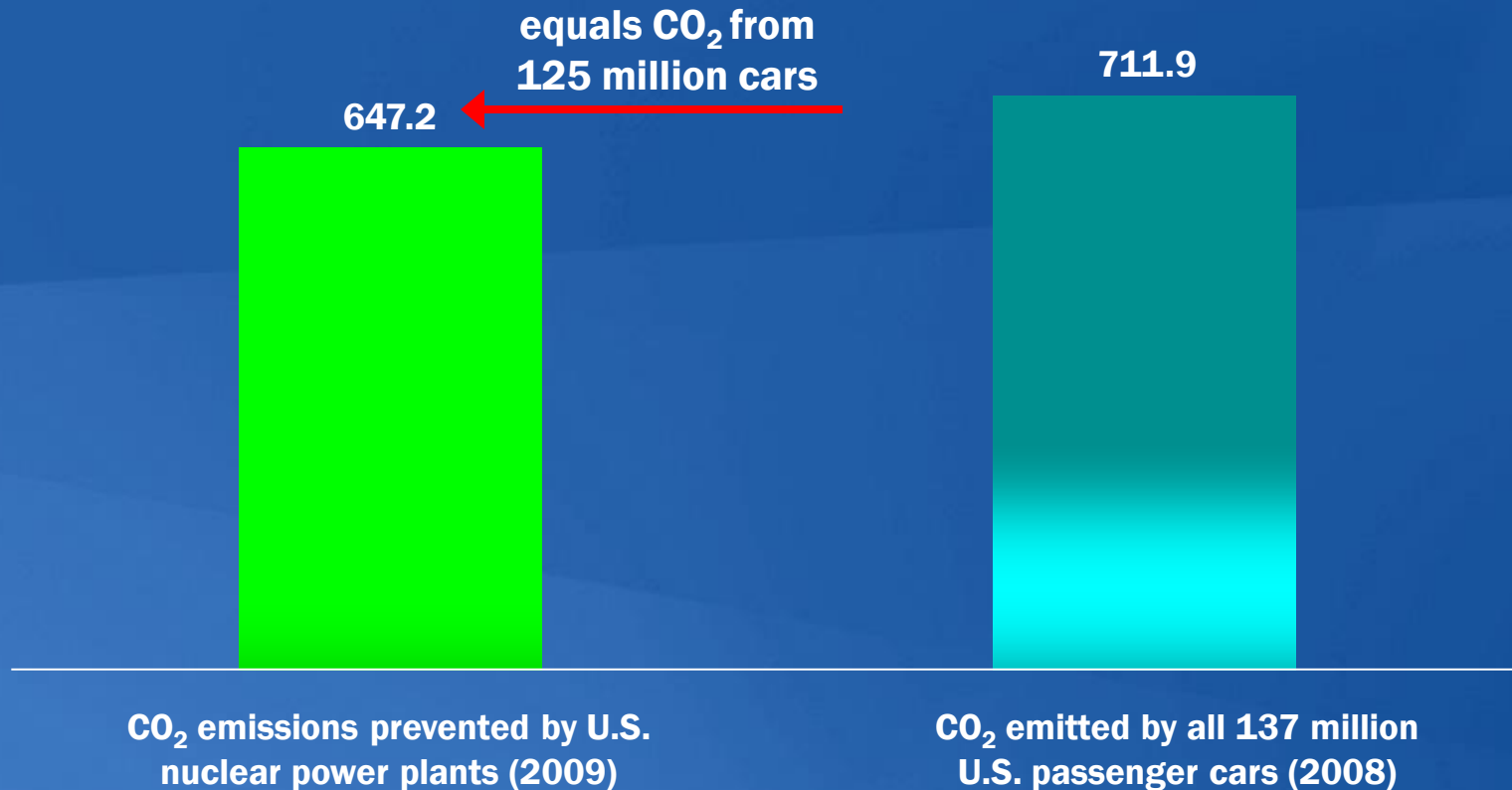


Source: Emissions avoided are calculated using regional and national fossil fuel emissions rates from the Environmental Protection Agency and plant generation data from the Energy Information Administration.

Updated: 5/10

Perspective on CO₂ Emissions Prevented By U.S. Nuclear Plants

Million Metric Tons, 2009

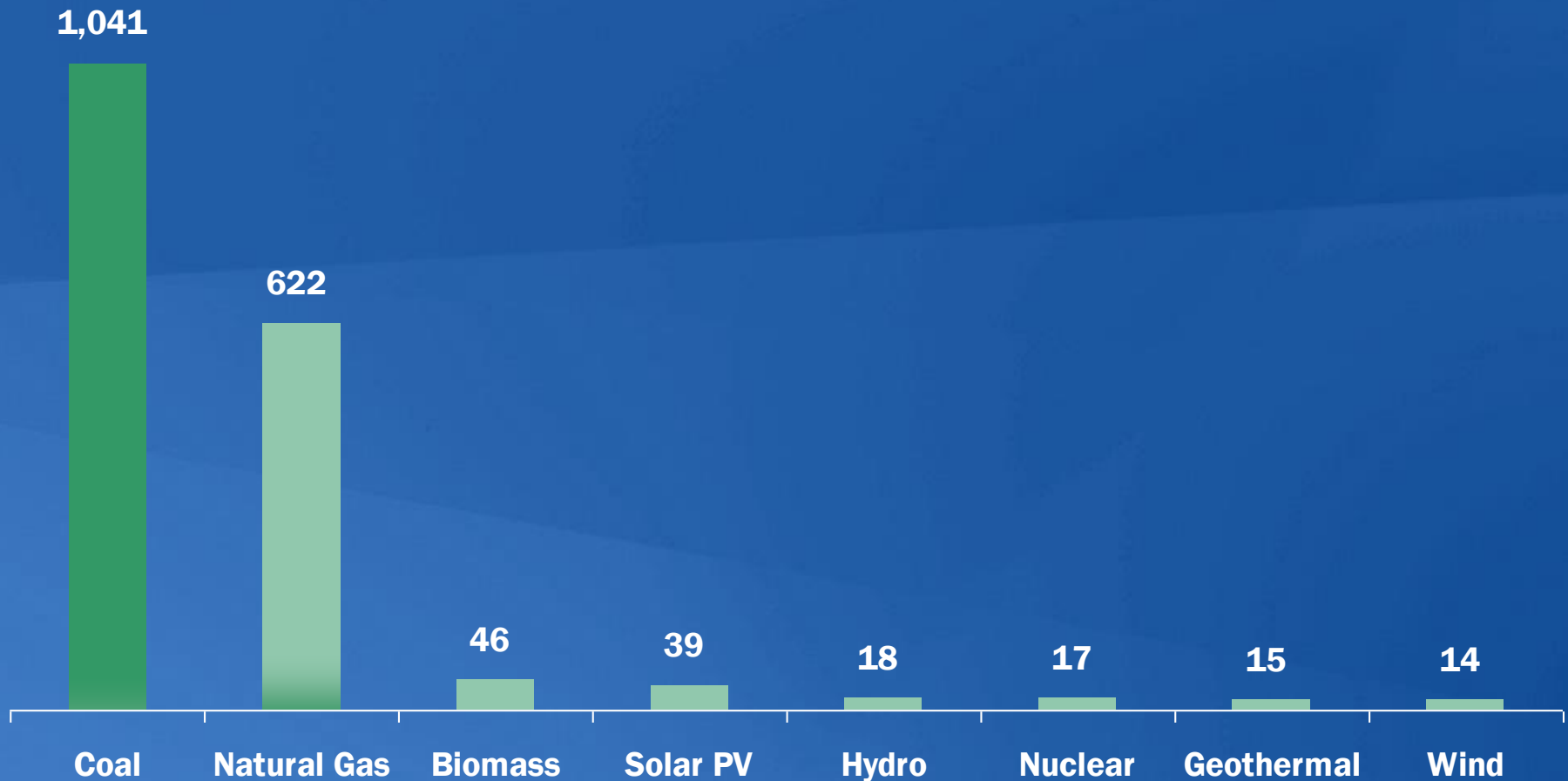


Source: Emissions avoided by nuclear power are calculated using regional fossil fuel emission rates from the Environmental Protection Agency and plant generation data from the Energy Information Administration. Car emissions from EPA, Office of Transportation and Air Quality Emissions Facts (April 2000).

Updated: 5/10

Comparison of Life-Cycle Emissions

Tons of Carbon Dioxide Equivalent per Gigawatt-Hour



Source: "Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis," Paul J. Meier, University of Wisconsin-Madison, August 2002.

Summary of Studies on Climate Change Mitigation

New Nuclear Generation Capacity Required

Source	Study /Analysis	Number of new reactors*	Gigawatts	Timeframe
Energy Information Administration	<i>Annual Energy Outlook 2010</i>	6	8	2035
	Kerry/Lieberman, American Power Act (2010)	52	72	2035
	Waxman/Markey (2009)	69	96	2030
	Lieberman/Warner (2008)	191	268	2030
Environmental Protection Agency	Kerry/Lieberman, American Power Act (2010)	181	253	2050
	Waxman/Markey (2009)	187	262	2050
	Lieberman/Warner (2008)	179	250	2050
National Academy of Sciences	America's Energy Future: Technology and Transformation (2009)	77	108	2035
Electric Power Research Institute	Prism/Merge Analyses: 2009 Update	46	64	2030
McKinsey & Company	U.S. Greenhouse Gas Abatement Mapping Initiative - Mid-Range Case (2007)	18	25	2030



*Based on a 1,400 MW average nuclear plant.

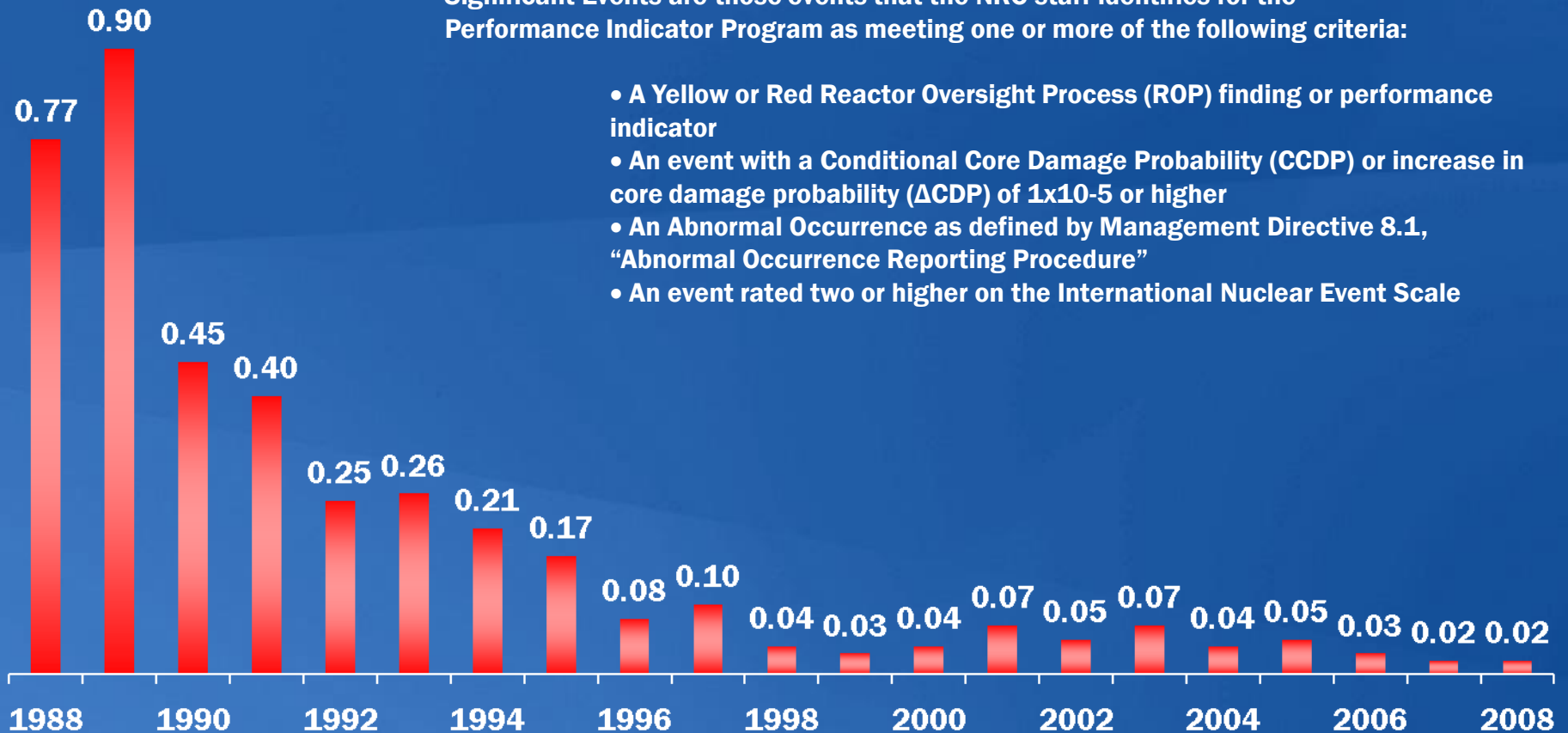
Safety

Significant Events at U.S. Nuclear Plants:

Annual Industry Average, Fiscal Year 1988-2008

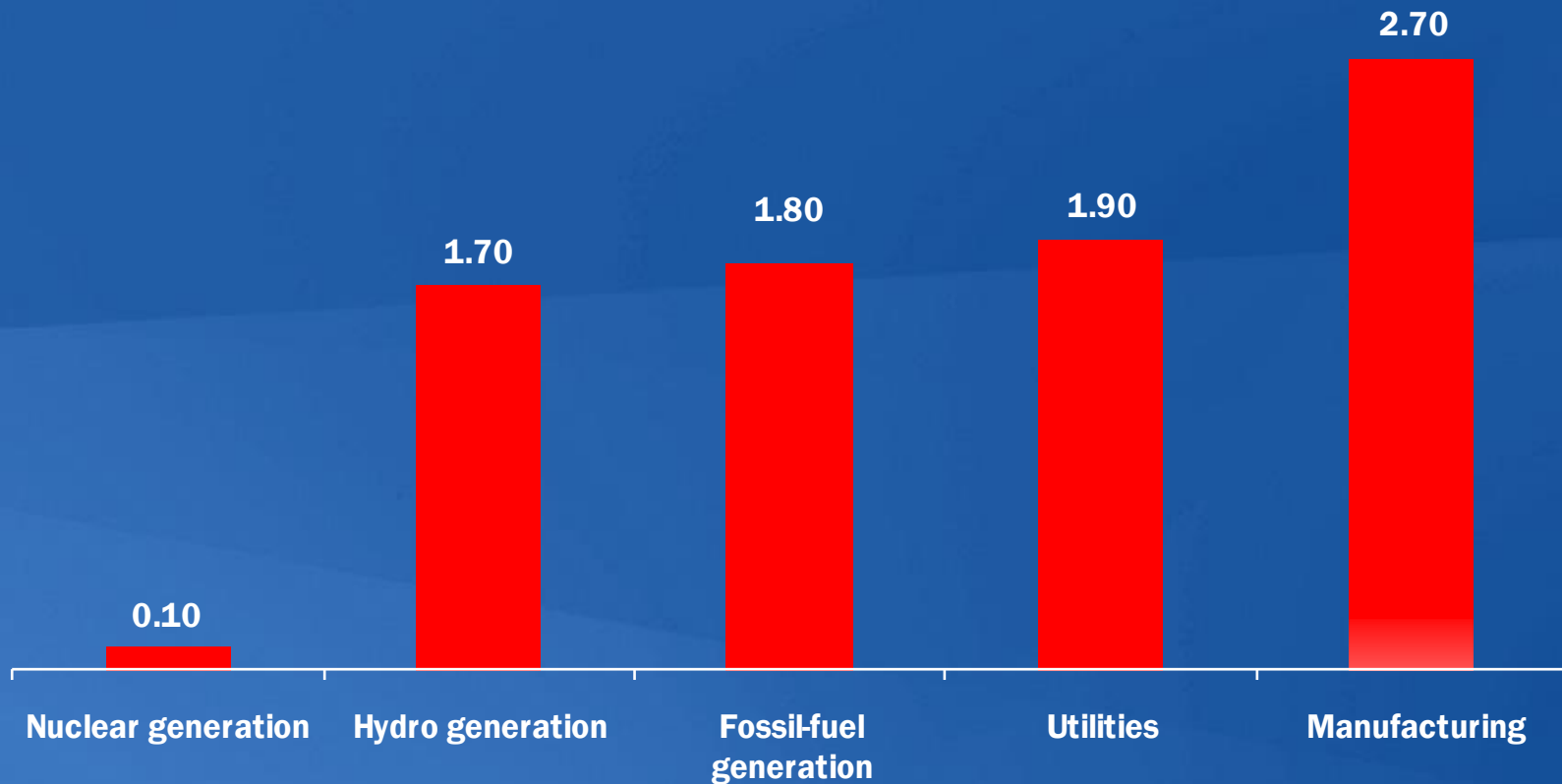
Significant Events are those events that the NRC staff identifies for the Performance Indicator Program as meeting one or more of the following criteria:

- A Yellow or Red Reactor Oversight Process (ROP) finding or performance indicator
- An event with a Conditional Core Damage Probability (CCDP) or increase in core damage probability (Δ CCDP) of 1×10^{-5} or higher
- An Abnormal Occurrence as defined by Management Directive 8.1, "Abnormal Occurrence Reporting Procedure"
- An event rated two or higher on the International Nuclear Event Scale



Source: NRC Information Digest, 1988 is the earliest year data is available.
Updated: 4/10

U.S. Industrial Safety Accident Rate 2009



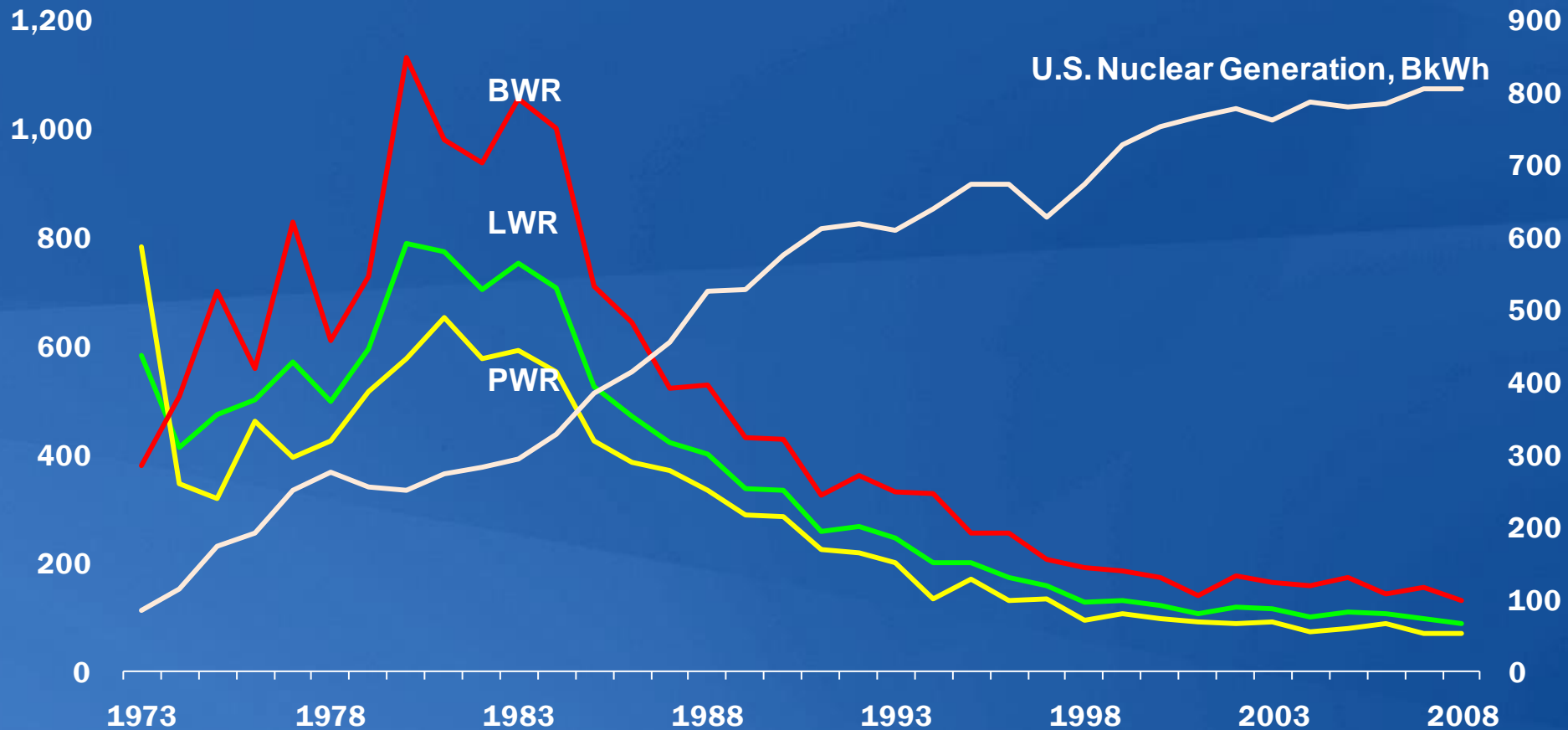
ISAR = Number of accidents resulting in lost work, restricted work, or fatalities per 200,000 worker hours. Hydro, fossil-fuel, utilities and manufacturing data do not include fatalities.



Sources: Nuclear (World Association of Nuclear Operators), 2008 data for all others (U.S. Bureau of Labor Statistics).
Updated: 6/10

Average Collective Dose Per Reactor

1973-2008, Person-rem



Source: Nuclear Regulatory Commission - Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, Energy Information Administration

Updated: 6/10



Used Nuclear Fuel

Used Nuclear Fuel: The New Reality

- Administration terminating the Yucca Mountain project
 - Blue ribbon commission to develop recommendations on used fuel management
- Interim storage safe, secure for indefinite period of time
- Used fuel issues not an impediment to operating reactors or new plant development



Dry cask storage for used fuel at the Surry station in Virginia

Recognition of Environmental Benefits

Yvo de Boer - Executive Secretary, UNFCCC



“I have never seen a credible scenario for reducing emissions that did not include nuclear energy”

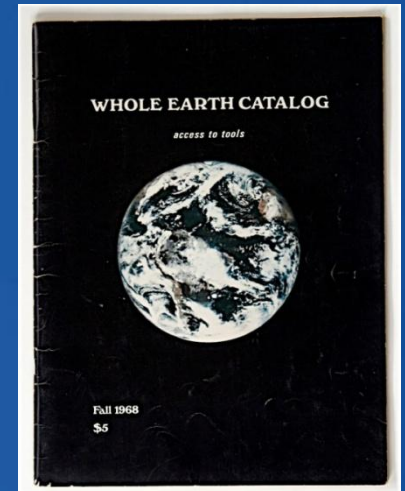
June 2007

Stewart Brand



“[I]f we encourage it in the right way, nuclear energy growing well . . . minimizes humanity’s carbon-loading of the atmosphere . . . collaborates well with other carbon-free or superefficient energy forms . . . helps generate other Green services such as desalination or hydrogen . . . helps eliminate nuclear weapons . . . securely energizes cities and thereby helps to reduce world poverty . . .”

**Stewart Brand
*Whole Earth Discipline,
an Ecopragmatist Manifesto*
October 2009**



Dr. James Hansen, NASA



“I think that next-generation, safe nuclear power is an option which we need to develop. And it is being developed in many countries around the world. So if the United States declines to do that, we're just going to suffer economically because other countries will take the lead in that technology.”

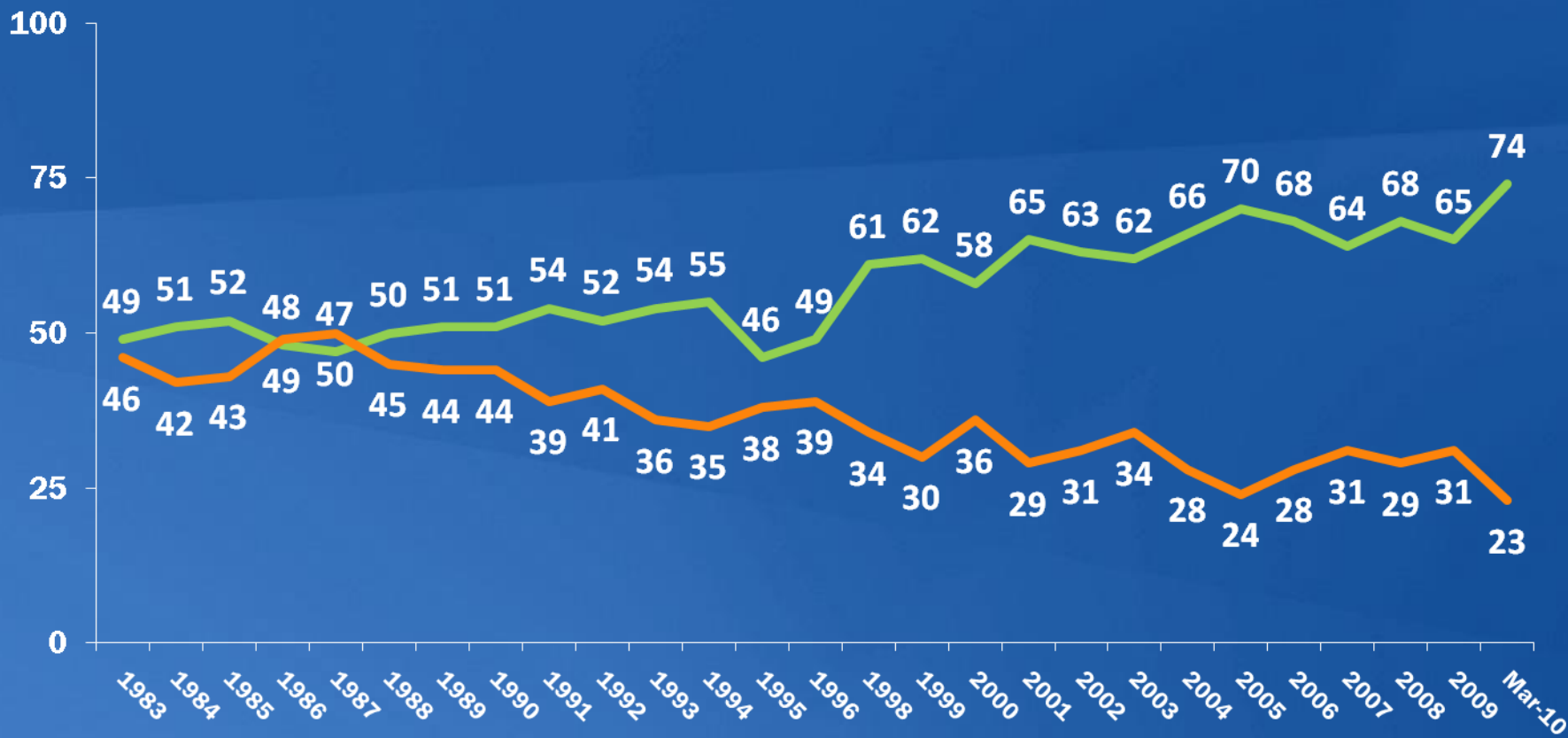
**Dr. James E. Hansen, Director
NASA Goddard Institute for Space Studies
January 26, 2010**

Public Opinion

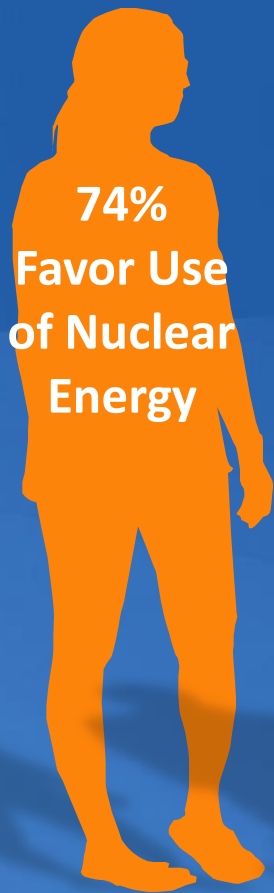
U.S. Public Opinion 1983 – 2010: Favorability to the Use of Nuclear Energy for Electricity

Annual Averages Until 2010, Percentages

— Favor — Oppose

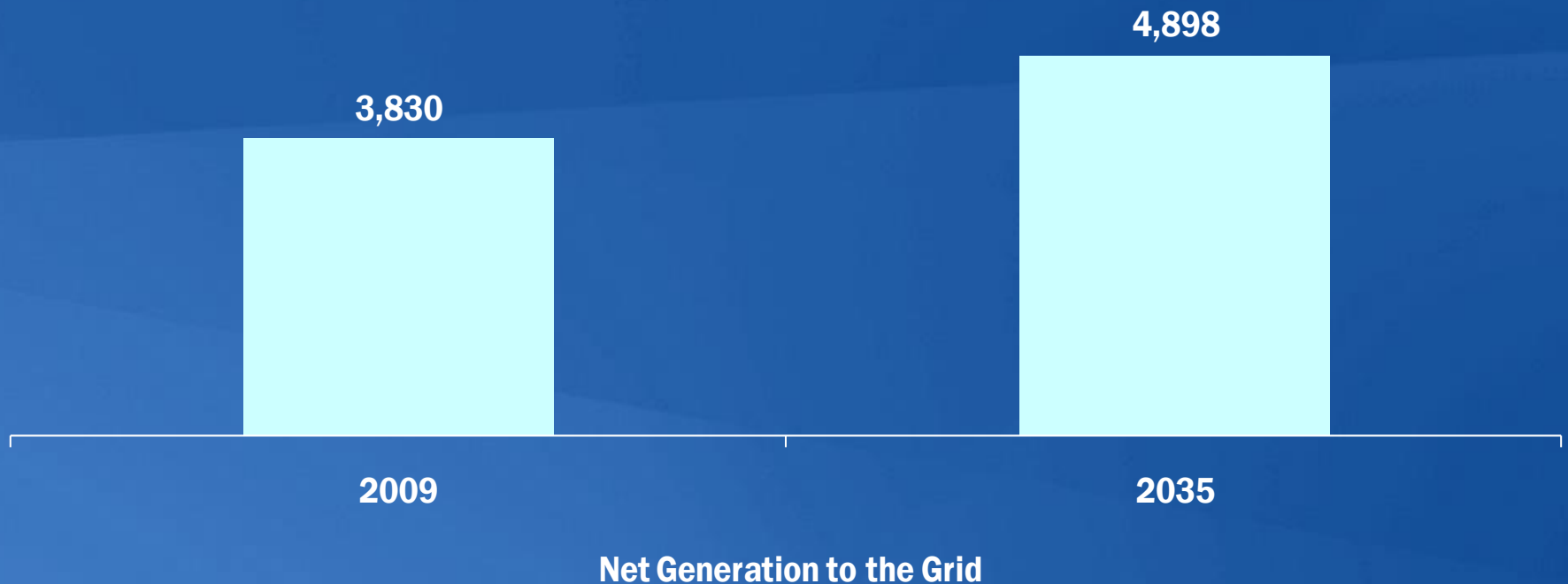


Strong Public Support Continues



New Plant Information

U.S. Needs 28 Percent More Electricity by 2035 BkWh

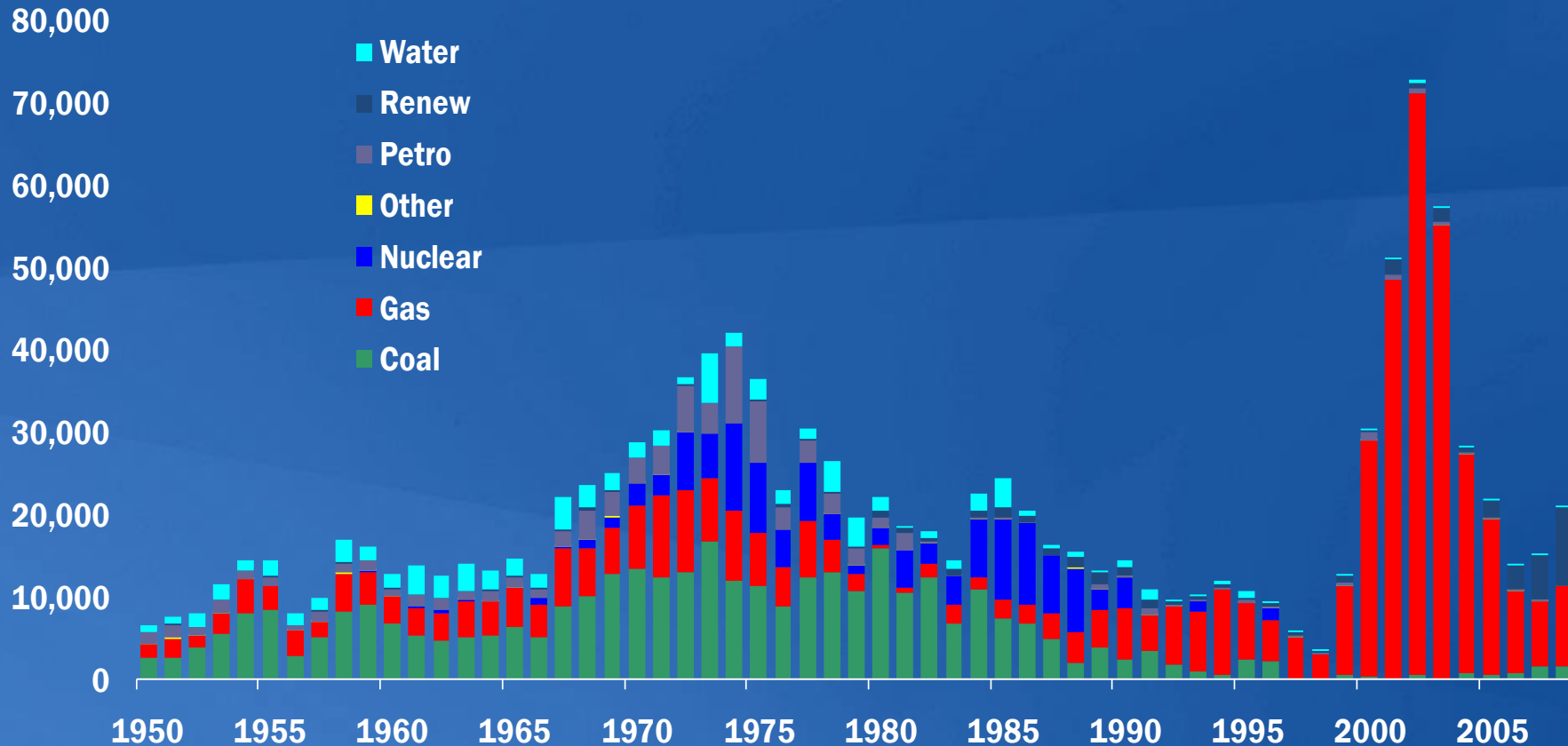


Source: Energy Information Administration's Annual Energy Outlook 2010

Updated: 2/10

Capacity Brought Online by Fuel Type

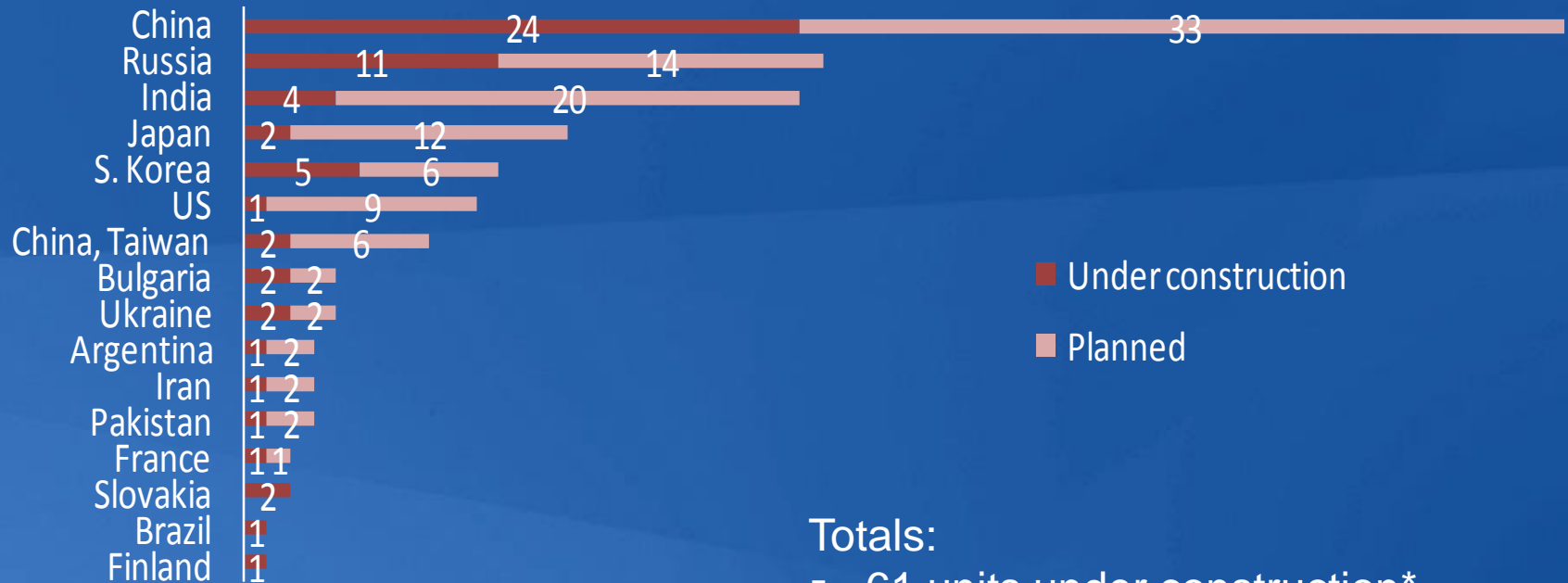
1950-2009 (Nameplate Capacity, MW)



Source: Ventyx Velocity Suite

Updated: 2/10

Nuclear Units Under Construction and Planned Worldwide



Totals:

- 61 units under construction*
- 149 units on order or planned**

Sources: International Atomic Energy Agency for units under construction and World Nuclear Association for units on order or planned.

*Chart includes only countries with units under construction. **Countries planning new units are not all included in the chart.

Planned units = Approvals, funding or major commitment in place, mostly expected in operation within 8-10 years.

Updated: 10/10



Near-Term Fundamentals Negative, Long-Term Fundamentals Have Not Changed

- **North American electricity demand will not recover to pre-recession levels until 2012 or so**
- **Most regional power markets likely to remain oversupplied for at least the next five years**
- **Spot power prices projected to remain soft in 2010-2011 at least**
- **Low natural gas prices likely to persist in near term**

Part 52 Licensing Process Working as Planned

- **Technical questions are being addressed *before* construction begins**
 - **Process is transparent and readily available to the public**
 - **Hearing process is proceeding as scheduled where applicable**
- **Construction inspection in progress**
- **First facility start-up for combined license will occur in 2010 for LES' National Enrichment Facility**



Photo courtesy Louisiana Energy Services

Review Status

DESIGN
CERTIFICATIONS

AP1000
ABWR
ESBWR

USAPWR
EPR

2010

2011

2012

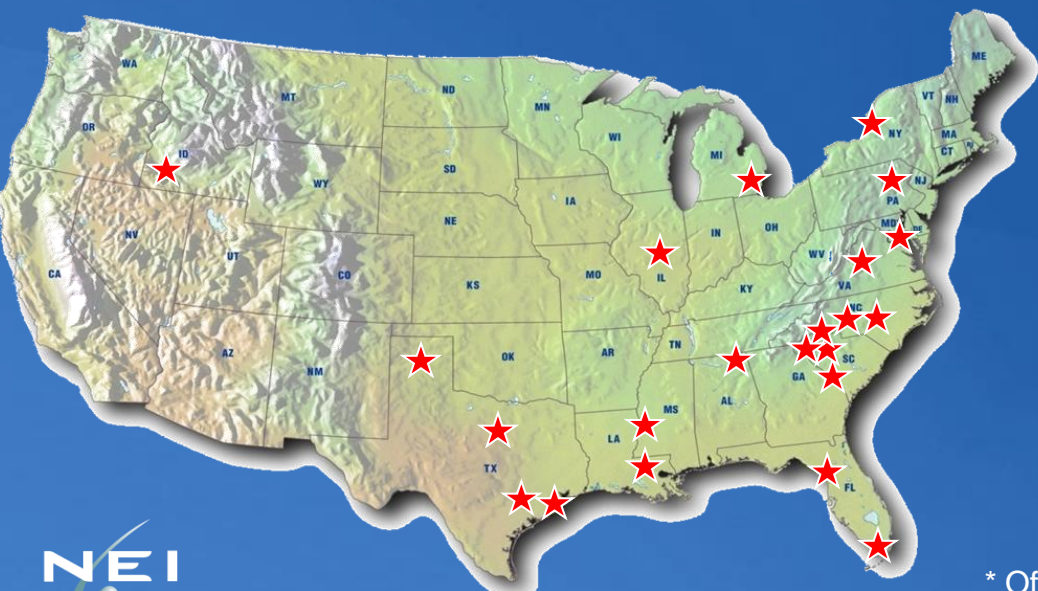
2013

COMBINED OPERATING
LICENSES

Vogtle

Comanche Peak
North Anna
Bellefonte
Summer
Harris
Levy
STP

Turkey Point*
Calvert Cliffs
Bell Bend
Fermi
Lee



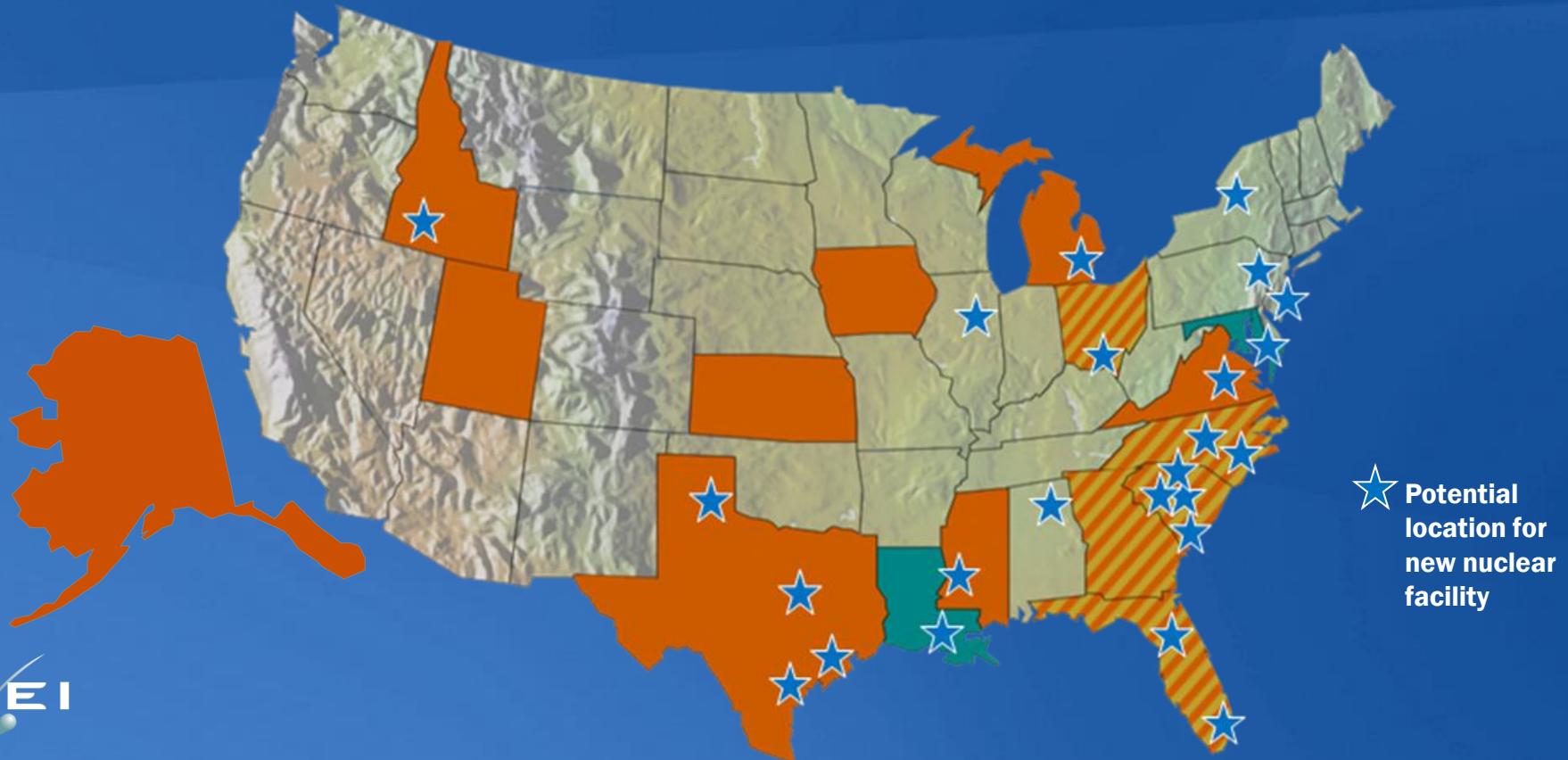
* Official review schedule not issued by the NRC yet.

State Policies Supporting New Nuclear

■ Legislation

■ Regulation

■ Both legislation and regulation



Site Preparations Are Underway

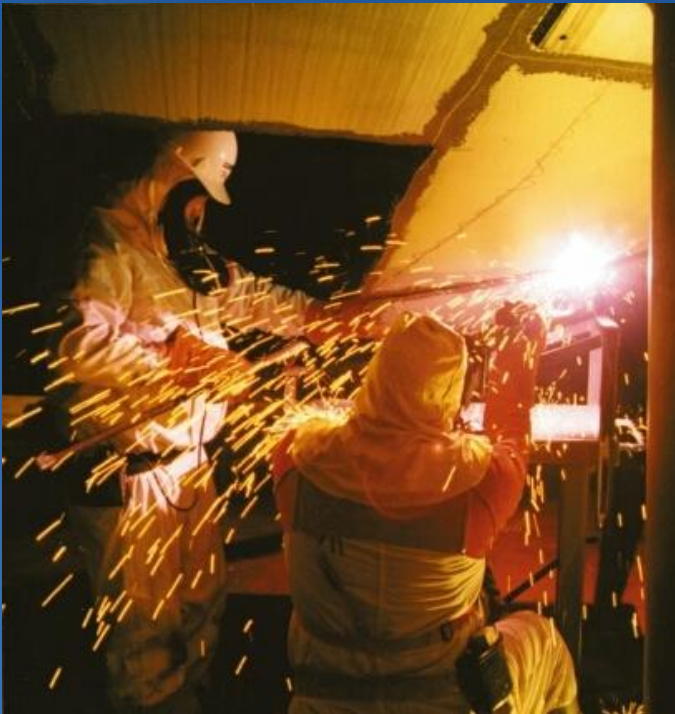
Vogtle Units 3 and 4



South Carolina Electric & Gas V. C. Summer Units 2 & 3



Work Force: Training the Industry's Next Generation



- 52 community college nuclear partnership programs
- 28 state energy work force consortia
- More than \$90 million in federal grants to support nuclear career and work force development activities

Growth in Nuclear Supply Chain Continues

- Shaw Group near completion of new nuclear component manufacturing facility in Lake Charles, La.
- Global Laser Enrichment started test loop in Wilmington, N.C., in July 2009
- AREVA and Northrop Grumman broke ground in July 2009 in Newport News, Va., on nuclear components manufacturing facility
- 10 percent increase in number of domestic “N-stamps”



Groundbreaking for AREVA-Northrop
Grumman manufacturing facility

Economic Benefits of Nuclear Power

Job Creation

- 1,400 – 1,800 jobs during construction, peak employment up to 2,400 jobs
- 700 permanent operating jobs: These jobs pay 36% more than average local salaries
- 700 equivalent additional jobs in local area to support the plant workforce & families

Suppliers

- 400,000 cubic yards of concrete—five times as much the 100-story Sears Tower
- 66,000 tons of steel
- 44 miles of piping and 300 miles of electric wiring
- 130,000 electrical components.

Local Economy

- \$430 million a year in total output for the local community
- \$40 million per year in total labor income.
- Every \$1 spent by the average nuclear plant results in the creation of \$1.07 in the local community.
- \$20 million per year in state and local taxes. These tax payments support schools, roads and other state and local infrastructure.
- \$75 million per year in federal taxes



New Nuclear Will Be Competitive

Levelized Cost of Electricity (2007 cents per kilowatt-hour)

Combined cycle (low gas price)	4-7
Wind (onshore)	4-10
Coal	5-9
Wind (offshore)	5-18
Nuclear	6-13
Combined cycle with CCS (low gas price)	7-10
Biopower	8-10
Solar CSP	8-20
Coal with CCS	9-15
Geothermal	10
Combined cycle (high gas price)	10-16
Combined cycle with CCS (high gas price)	14-21
Solar PV	14-30



Source: National Research Council of the National Academies,
America's Energy Future: Technology and Transformation

Current Political Support

President Obama

State of the Union

“But to create more of these clean energy jobs, we need more production, more efficiency, more incentives. And that means building a new generation of safe, clean nuclear power plants in this country.”



President Barack Obama
State of the Union
January 27, 2010

President Obama

Announcing Clean Energy Loan Guarantee



“We're going to have to build a new generation of safe, clean nuclear power plants in America. This is only the beginning. My budget proposes tripling the loan guarantees we provide to help finance safe, clean nuclear facilities.”

**President Barack Obama
Lanham, Maryland
February 16, 2010**

President Obama



“There's been discussion about how we can restart our nuclear industry as a means of reducing our dependence on foreign oil and reducing greenhouse gases.”

**President Barack Obama
White House press conference
November 3, 2010**

Secretary of Energy

Dr. Steven Chu



“investing in nuclear energy will position America to lead in a growing industry. If we are serious about cutting carbon pollution then nuclear power must be part of the solution.”

**Dr. Steven Chu
Wall Street Journal
March 3, 2010**

President Obama

State of the Union

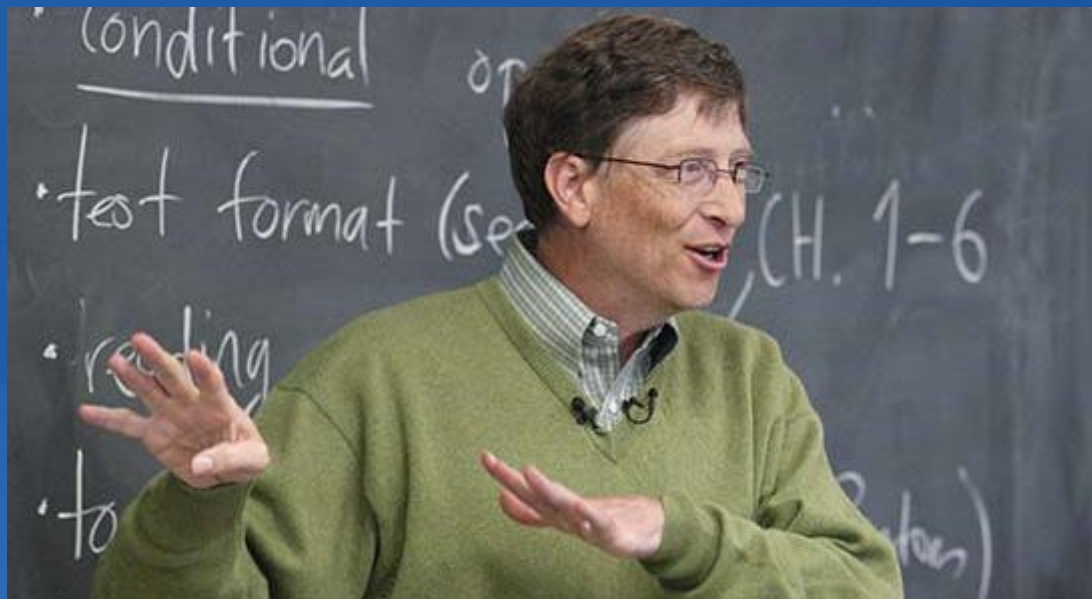
- **“So tonight, I challenge you to join me in setting a new goal: By 2035, 80 percent of America’s electricity will come from clean energy sources.”**
- **“Some folks want wind and solar. Others want nuclear, clean coal and natural gas. To meet this goal, we will need them all.”**



President Barack Obama
State of the Union
January 25, 2011

One More Perspective Just for Fun!

Bill Gates



“I love nuclear.”

**Bill Gates
Remarks at MIT
April 21, 2010**