

NUCLEAR ENERGY RENAISSANCE IN THE USA

2010 LAS-ANS SYMPOSIUM

Rio de Janeiro-Brazil

June 2010

Joe F. Colvin

President, ANS



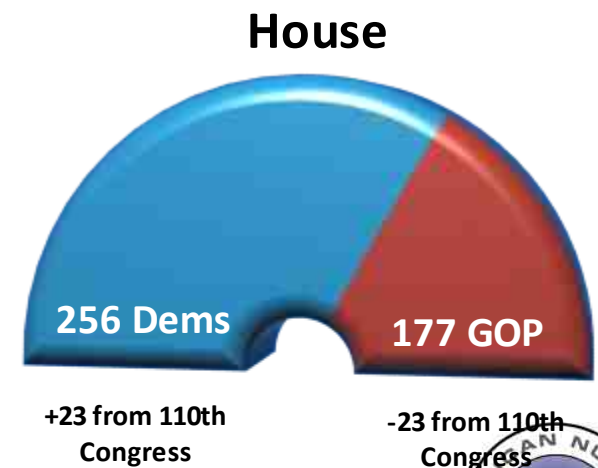
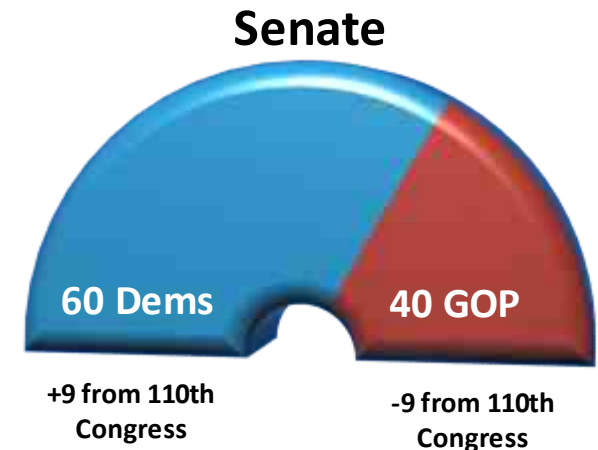
Outline

- The new politics of nuclear energy
- New nuclear plants: Progress and expectations
- Performance of operating nuclear plants
- Conclusions



For Nuclear Energy, Large Political Uncertainty At the Beginning of 2009

- Increased Democratic control of House and Senate
- Lost a number of pro-nuclear champions (Sen. Pete Domenici, Congressman John Dingell)
- Obama: Terminate Yucca Mountain project



Energy Legislation in 2009: How Would Nuclear Be Treated?

- Economic stimulus legislation
 - Large increase in loan guarantees for renewables, transmission but no additional for nuclear
- Energy/climate legislation passed House in June
- Energy/climate legislation stalled in Senate



As 2009 Unfolded, Bipartisan Support For Nuclear Energy Increased

- Strong support for nuclear energy in Congress among Republicans, conservative Democrats, progressive Democrats
- House, Senate legislation included strong nuclear provisions
- Strong nuclear build a prerequisite for energy/climate legislation

The Washington Post

Nuclear power regains support

**TOOL AGAINST
CLIMATE CHANGE**

*Even green groups see it
as 'part of the answer'*

Washington Post, November 24, 2009



Unlikely Allies Find Common Ground In Nuclear Energy



Sen. John Kerry
(D-Mass.)



Sen. Lindsey Graham
(R-S.C.)

“[W]hile we invest in renewable energy sources like wind and solar, we must also take advantage of nuclear power, our single largest contributor of emissions-free power. Nuclear power needs to be a core component of electricity generation if we are to meet our emission reduction targets.”

“Yes We Can (Pass Climate Change Legislation)”
by John Kerry and Lindsey Graham
Op-ed in New York Times, October 11, 2009



The American Power Act

- Introduced May 12, 2010
- Major nuclear provisions
 - Increased nuclear loan guarantee program to \$54 Billion
 - Expedited procedures for issuing combined-operating license
 - Increased regulatory risk insurance for first 12 plants vice 6 plants
 - Required DOE to designate a National Lab as center for spent fuel recycling and development excellence
- Nuclear tax provisions
 - Allows, tax-free municipal bonds, 5-year accelerated depreciation, 10% investment tax credit for some expenditures



Obama Administration Actions That Support Nuclear Energy Expansion

- Fixed rule governing loan guarantee program
- \$36 billion increase in loan volume in 2011 budget
- Supported more liberal rules for nuclear financing under OECD protocols
- \$73.8 million for clean energy manufacturing tax credits awarded to manufacturers of nuclear components
- Confirmed three new commissioners for the U.S. Nuclear Regulatory Commission



Administration's View on Nuclear

“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.”

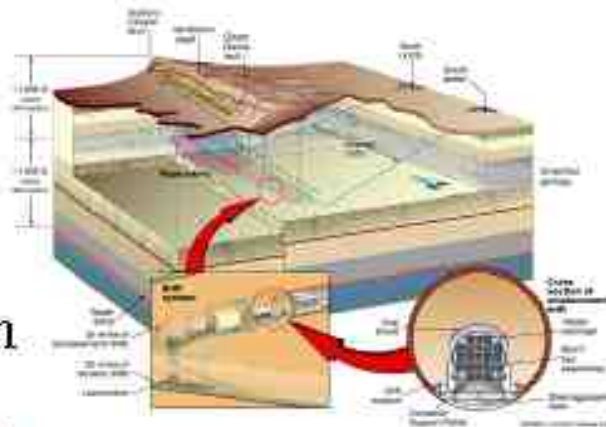
– President Barack Obama
State of the Union
January 27, 2010



High Level Waste Management



Long-Term
Storage
Yucca
Mountain



Ultimate Options:

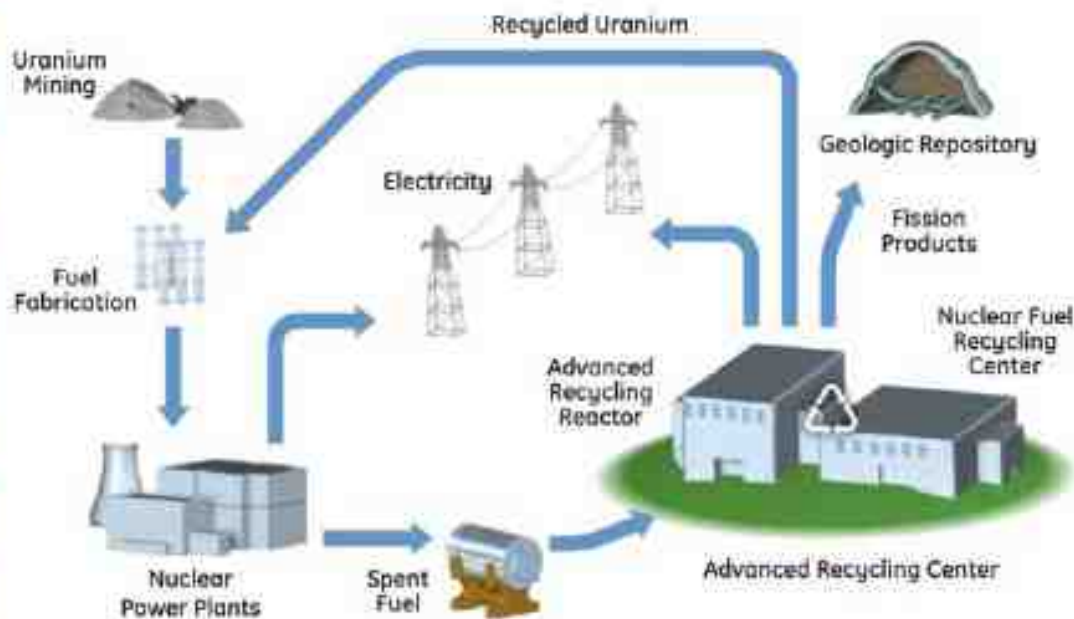
- Fuel Reprocessing
 - Recycle Fissile Material
 - Transmute High Level Waste
 - Vitrify Residual Waste
- As demonstrated currently in France, UK, Russia, Japan, and previously in USA



Reference: ANS Position Statement #80, "Licensing of Yucca Mtn..." see May/June *ANS News*



Close The Nuclear Fuel Cycle



- Re-establish reprocessing
- Establish recycling (MOX with or without advanced reactors)
- Define HLW forms
- Establish geologic repository



See ANS Position Statement #45, "Nuclear Fuel Recycling"



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



Blue Ribbon Commission on America's Nuclear Future

- Conduct comprehensive review of policies for managing the back-end of the nuclear fuel cycle
- Include alternatives for the storage, processing and disposal of civilian and defense used nuclear fuel, high-level waste and related materials
- Evaluate existing fuel cycle technologies and R & D programs
- Draft report within 18 months, final report within 24 months
- Yucca Mountain not to be considered



WIPP Has Operated for 10 Years



“The Salado Salt Formation (WIPP) can take as much nuclear waste of any type from anywhere for the next ten thousand years.”

**James Conca
UNM**



Uranium Recycling

- Worldwide expansion of nuclear energy likely will increase recycling for fuel supply and waste management
- Other countries recycle used nuclear fuel:
 - Russia; United Kingdom; Japan (soon); France
 - China and India have active development programs
- Develop advanced used fuel recycling systems
 - New fuel types and improved waste forms
 - New reactor designs
 - Support advanced fuel cycle R&D
 - Support international safeguards regimes

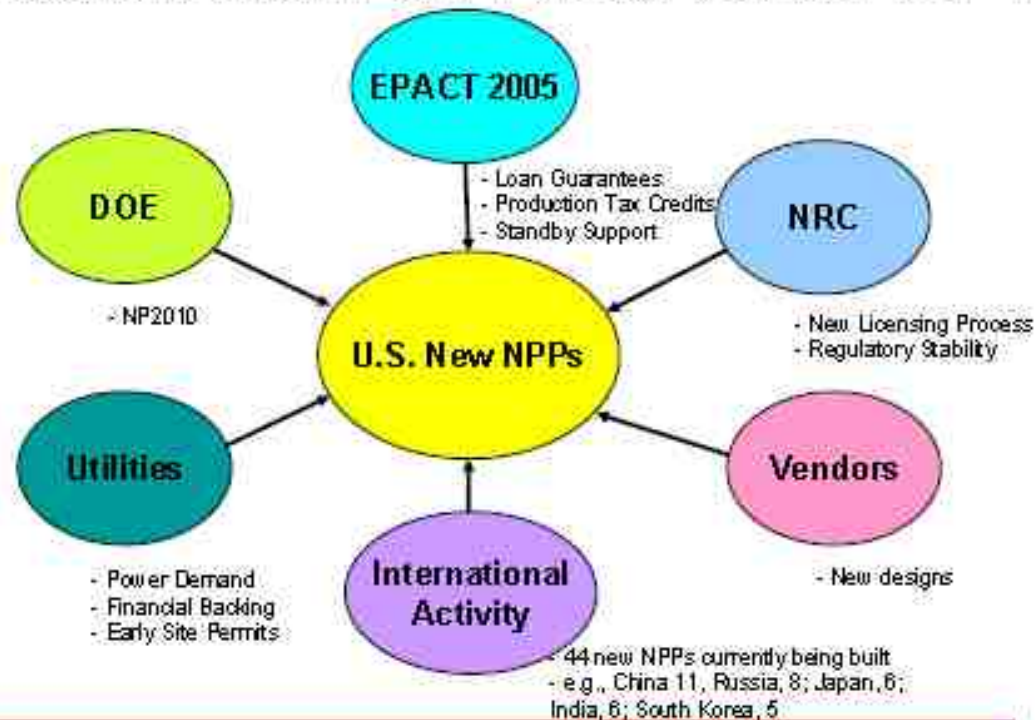


New Nuclear Plants: Progress and Expectations

The Nuclear Renaissance at Work



Factors Which Influence Consideration of New U.S. NPPs



Many factors have converged!

**THE BIGGEST MAY BE
PUBLIC CONCERN OVER
POTENTIAL CLIMATE CHANGE**



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

- North American electricity demand will likely 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
- Regional areas most in need for power not likely to build nuclear



Our Challenge: Reasonable Expectations for New Nuclear Build

- Positive
 - Significant growth in public support
 - Growing bi-partisan support in Congress
 - Recognition of nuclear growth needed to reduce greenhouse gases
 - Nuclear competitive
- Negative
 - New build dependent on power needs not political desires
 - Slower build could result in reduced support



Snapshot of New Plant Development

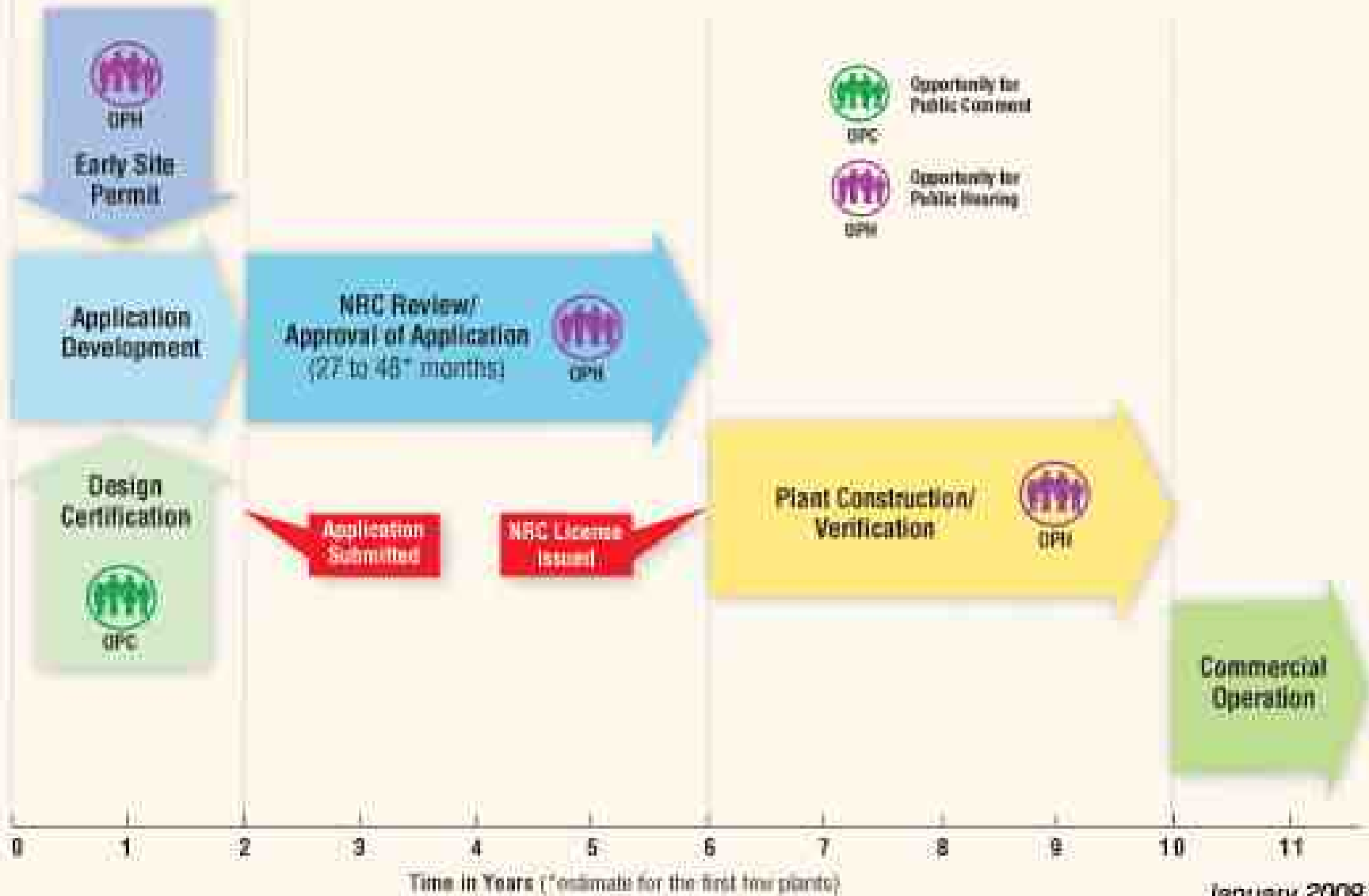
- 13 license applications (22 reactors) under active review at NRC-First licenses late 2011, early 2012
- Design certification
 - Three design certifications in progress, two previously certified designs being updated
- First movers have started site preparation, ordered long-lead components
- Southern Company's Vogtle Units 3 & 4 and SCANA Units 2 & 3 received NRC Early Site Permit and Limited Work Authorizations
- Licensing plants for initial 60 year life, may go to 80 years
- Expect four reactors in commercial operation 2016-2017





*Review Suspended

Key Licensing Steps in Building First New Reactors



The NRC's new licensing process offers multiple opportunities for public input.

New 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 using combined license occurred for LES' National Enrichment Facility in Eunice, NM

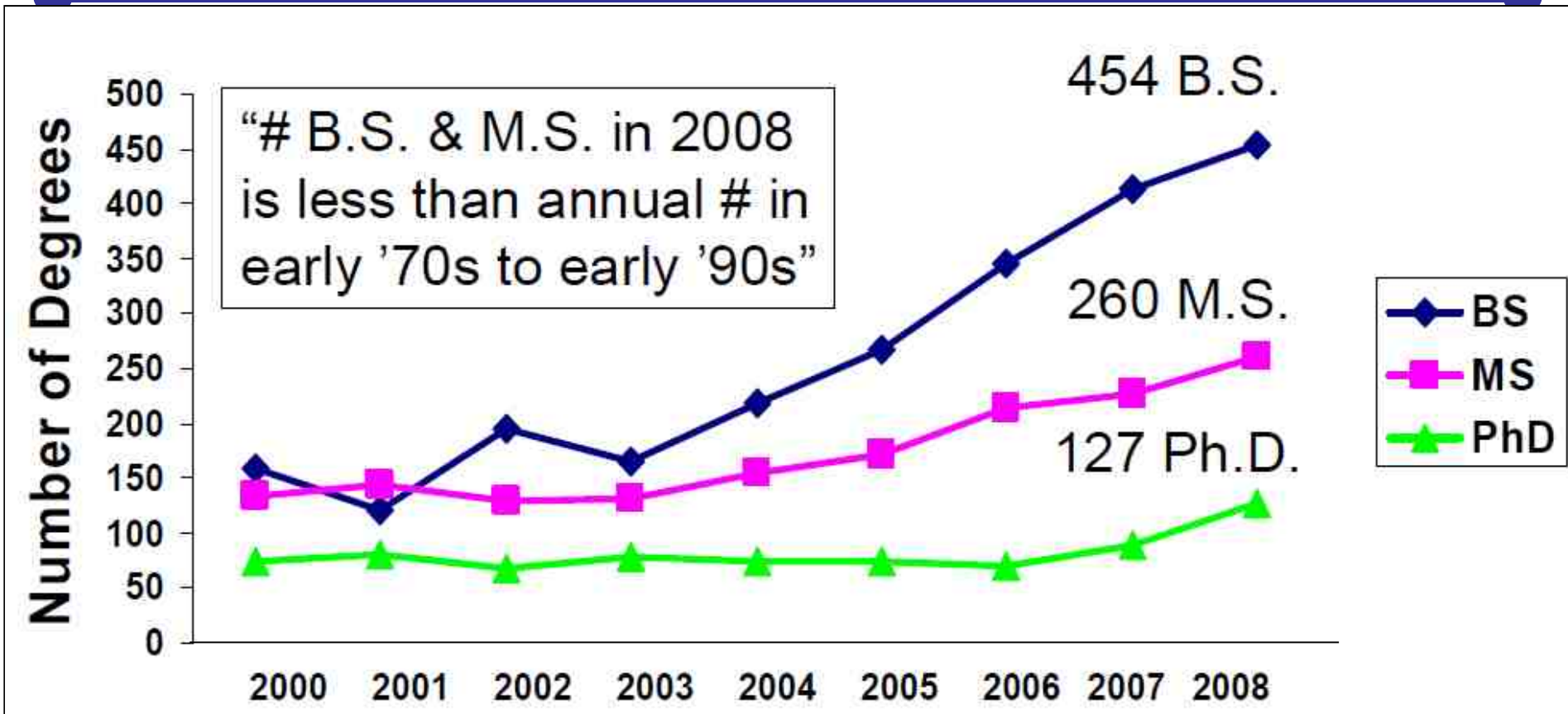


Major New U.S. Nuclear Facilities

- 1 Heavy Components Fabrication Facility
 - Areva Newport News (JV with Northrup-Gruman) in Virginia
- 1 MOX Fabrication Facility
 - Areva at Savannah River Site in South Carolina
- 4 New Enrichment Facilities
 - Areva in Idaho
 - General Electric in North Carolina
 - Louisiana Energy Services in New Mexico (COLA approved by NRC July 06)
 - US Enrichment Corp in Ohio
- 3 Reprocessing Facilities (letters of intent to NRC)
 - Areva
 - Louisiana Energy Services
 - Proprietary submittal
- 1 Waste Vitrification Demo Facility
 - DOE Hanford in State of Washington



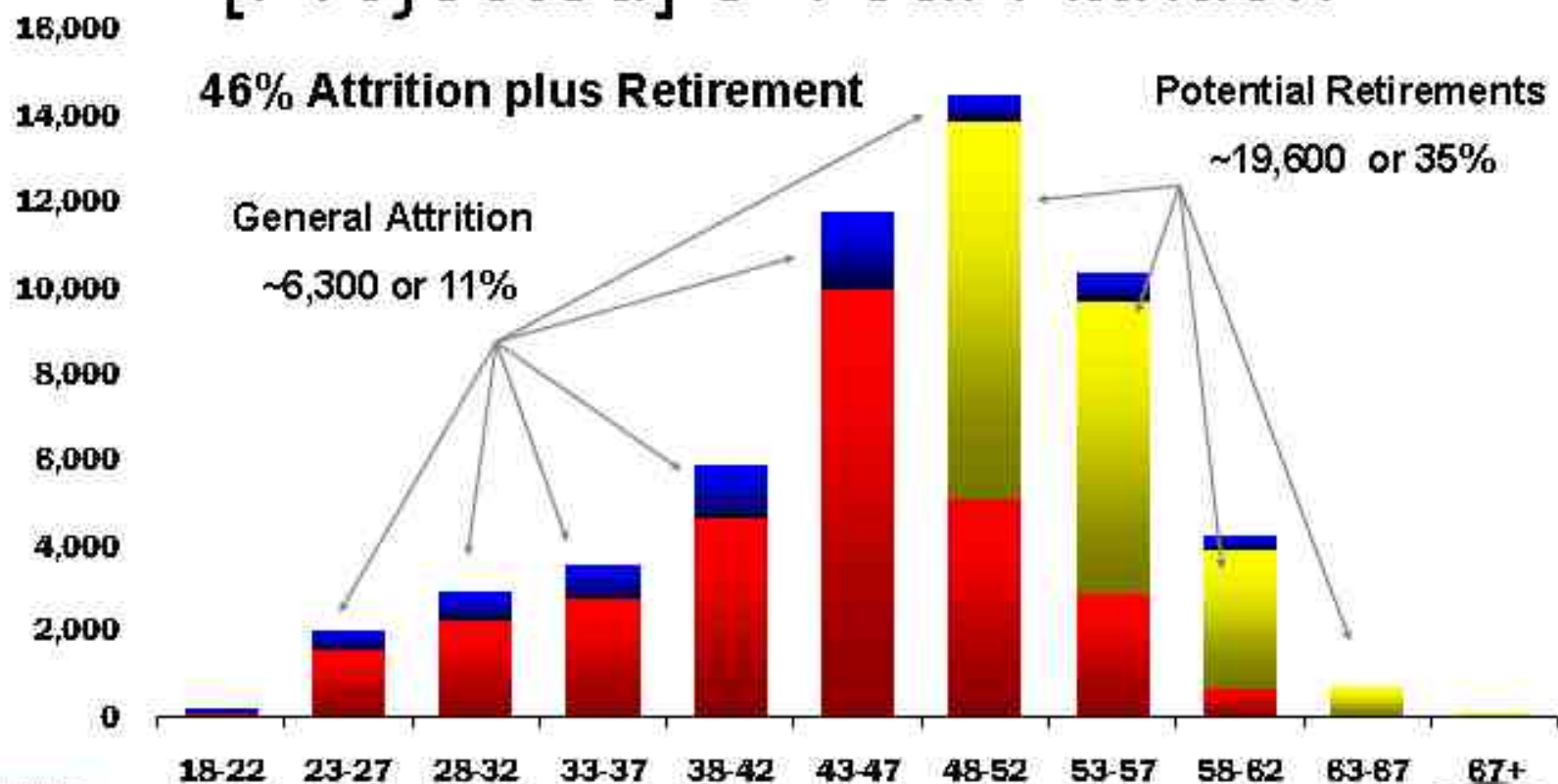
Nuclear Engineering Graduation Numbers are Increasing



Source: “Nuclear Engineering Enrollments and Degrees Survey,” 2008 Data, Oak Ridge Institute for Science and Education



Nuclear Generation Worker [Projected] 5-Year Attrition



Potential Retirees are defined as employees that will be older than 53 with 25+ years of service, or older than 63 with 20 years of service, or older than 67 within the next five years.

Source: "NEI Work Force Report," Nuclear Energy Institute, December, 2007



Work Force: Training the Industry's Next Generation

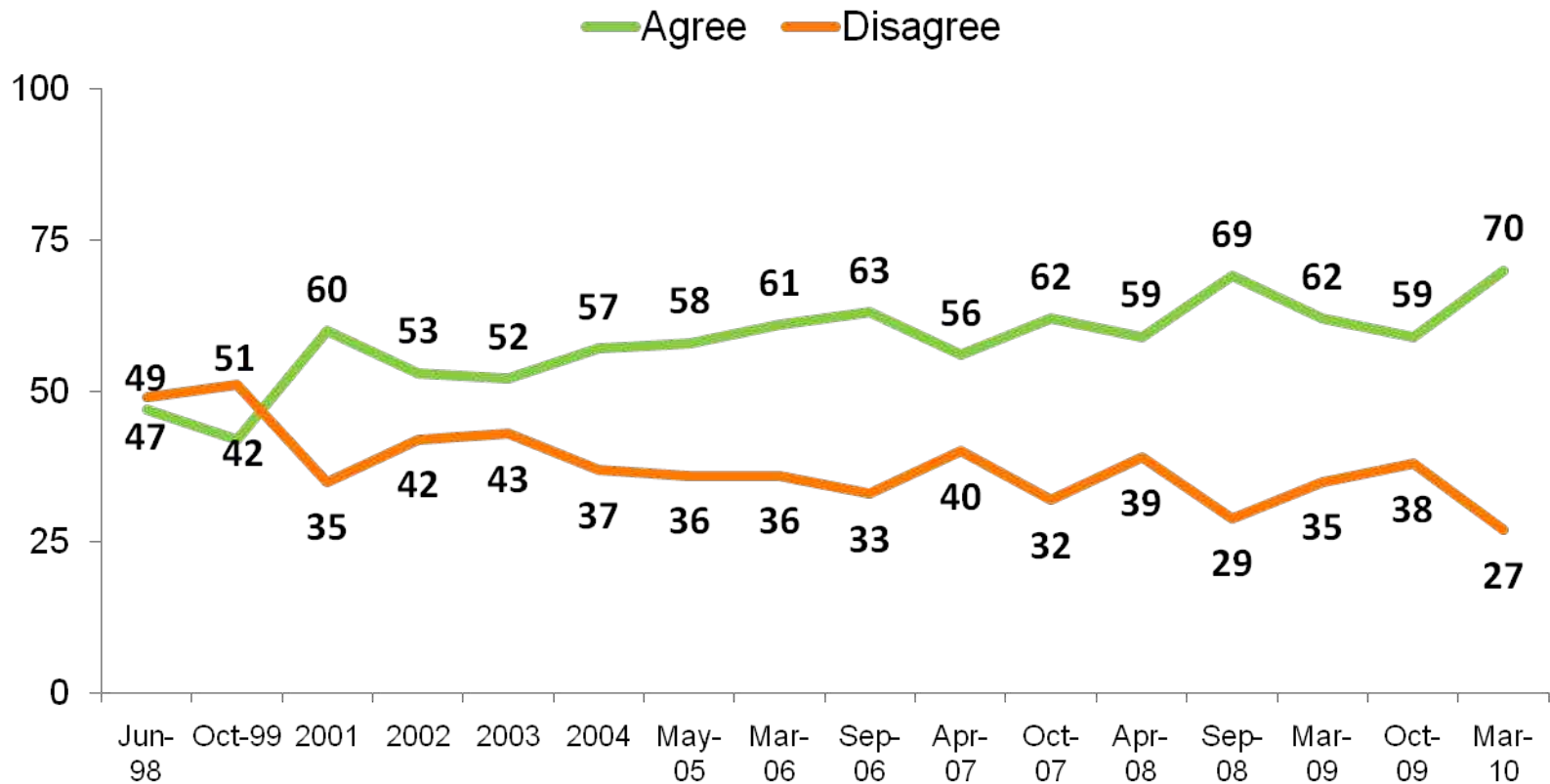


- 52 community college nuclear partnership programs
- 28 state energy work force consortia
- More than \$90 million in federal grants to support nuclear career and work force development activities



Agreement with Definitely Building More Nuclear Power Plants

Percentages



Bisconti Research, Inc. surveys of nationally representative samples of 1,000 U.S. adults; margin of error plus or minus 3 percentage points



New Nuclear is Competitive

Levelized cost of electricity (2007 cents per Kw)

- Nuclear 6-13
- Combined Cycle 4-16
- Combined Cycle-CCS 7-21
- Coal 5-9
- Coal-CCS 9-15
- Wind 4-18
- Solar 14-30
- Biopower 8-10



Site Preparations Are Underway

Vogtle Units 3 and 4



Photo Courtesy Southern Company



Today China, Tomorrow America



Photos Courtesy Shaw Group



Performance of Operating Plants

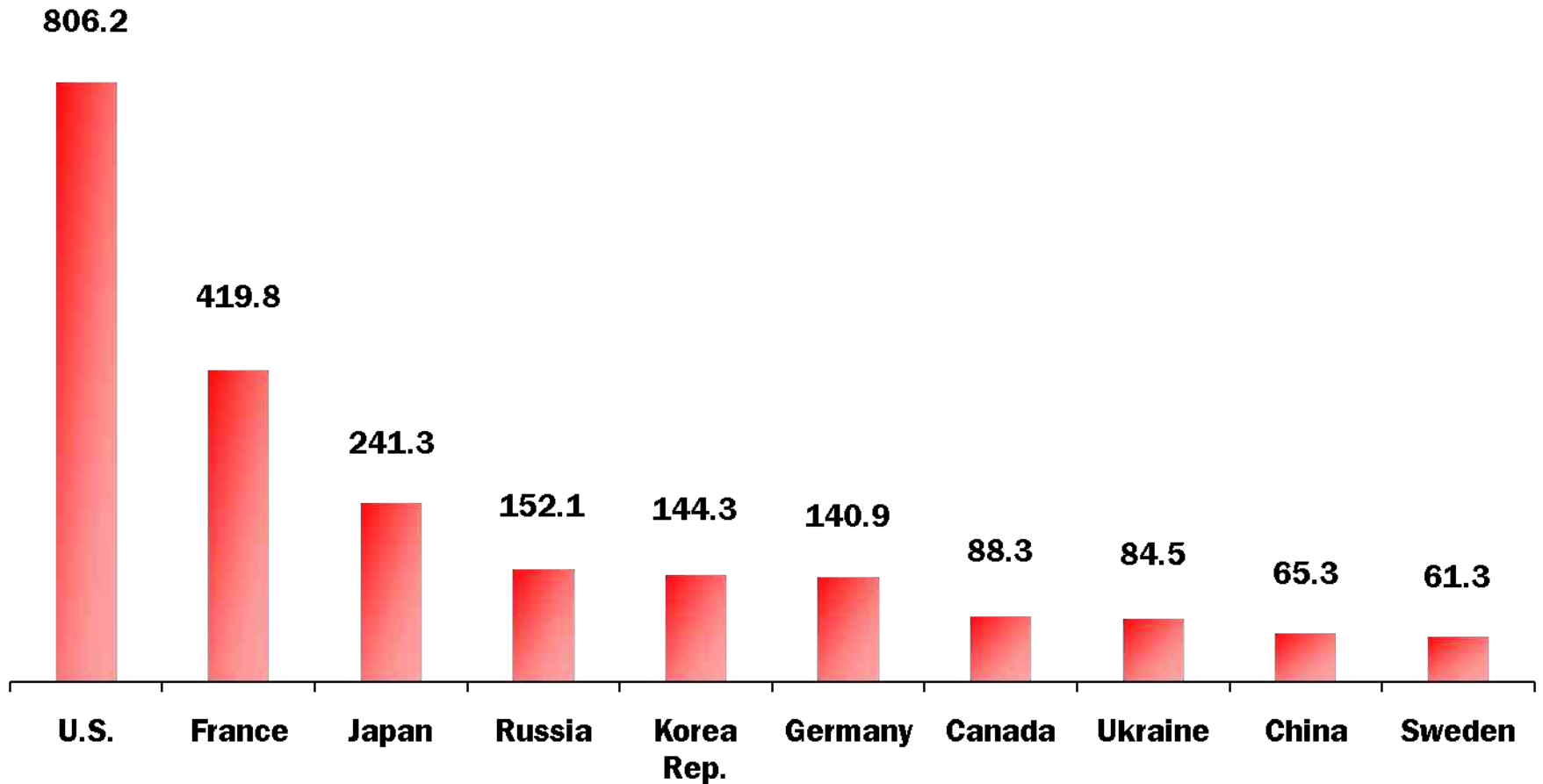
The Renaissance Continues

Prerequisites for new plants= continued safety
and reliability of existing plants



U.S. Is Global Leader in Nuclear Energy

(Billion kilowatt-hours of electricity)



Source: International Atomic Energy Agency, U.S. is from Energy Information Administration. Updated: 9/09



Comparison of Production Costs and Capacity Factors

- **2009 Production Costs**

- Nuclear: 2.03 c/KW
- Coal: 2.97 c/KW
- Gas: 5.00 c/KW
- Oil: 12.37 c/KW

- **2009 Capacity Factors**

- Nuclear: 90.5%
- Geothermal: 71.5%
- Biomass: 66.0%
- Coal (steam): 63.1%
- Gas CC: 44.7%
- Hydro: 29.4%
- Wind: 27.8%
- Solar: 23.5%
- Gas (steam): 13.3%
- Oil (steam): 7.4%

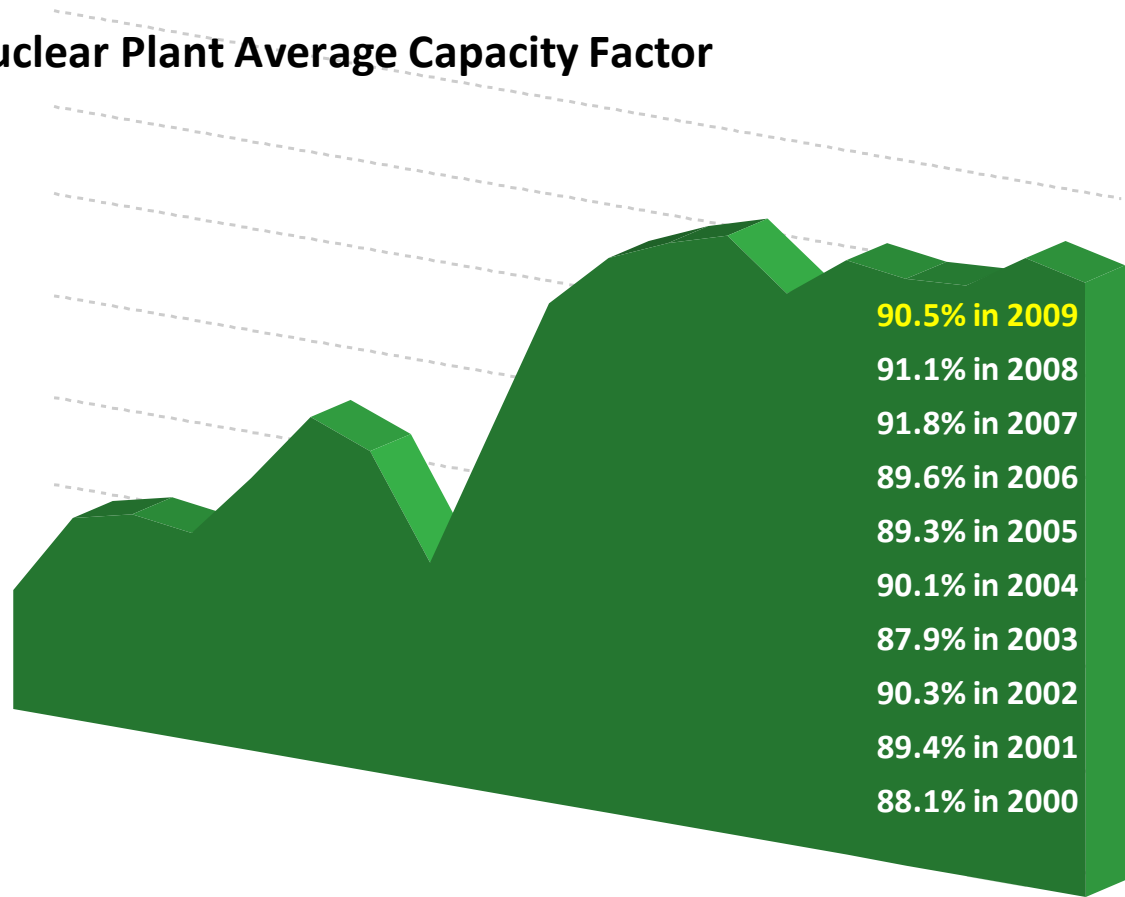


Decade of Sustained Reliability

U.S. Nuclear Plant Average Capacity Factor

Highlights

- Refueling outages: 66 in 2009, 66 in 2008
- Average refueling outage duration: 38.2 days in 2009, 37.6 days in 2008



Sources: U.S. Energy Information Administration, NEI estimate for 2009

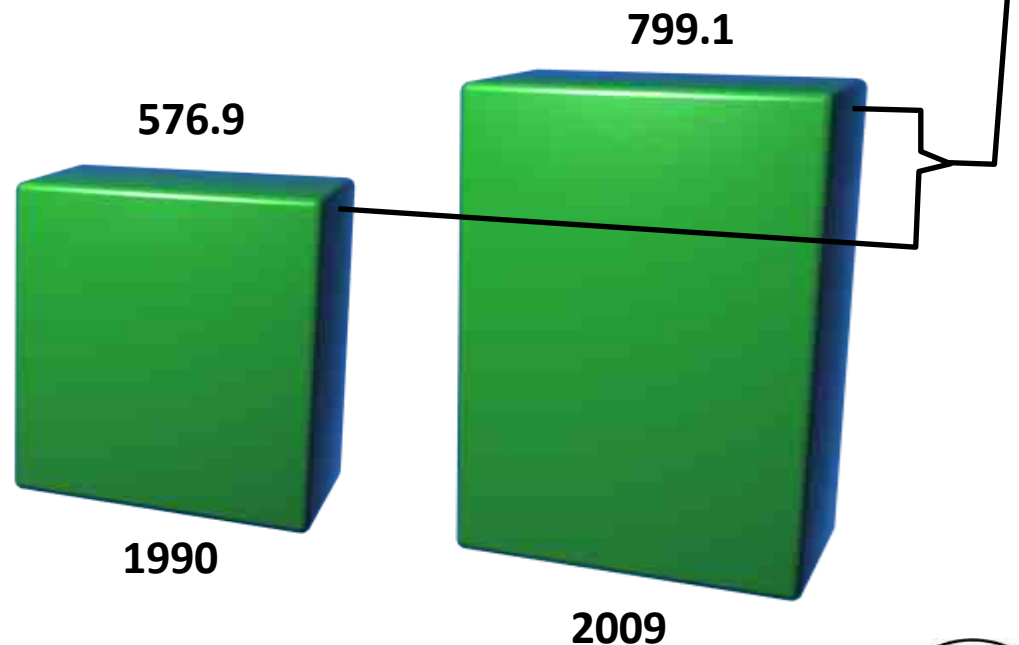


Operating Plant Productivity

Highlights

- 5,200 MW of power uprates approved since 1990
- 935 MW of uprates under review
- 2,629 MW of uprates expected by 2014

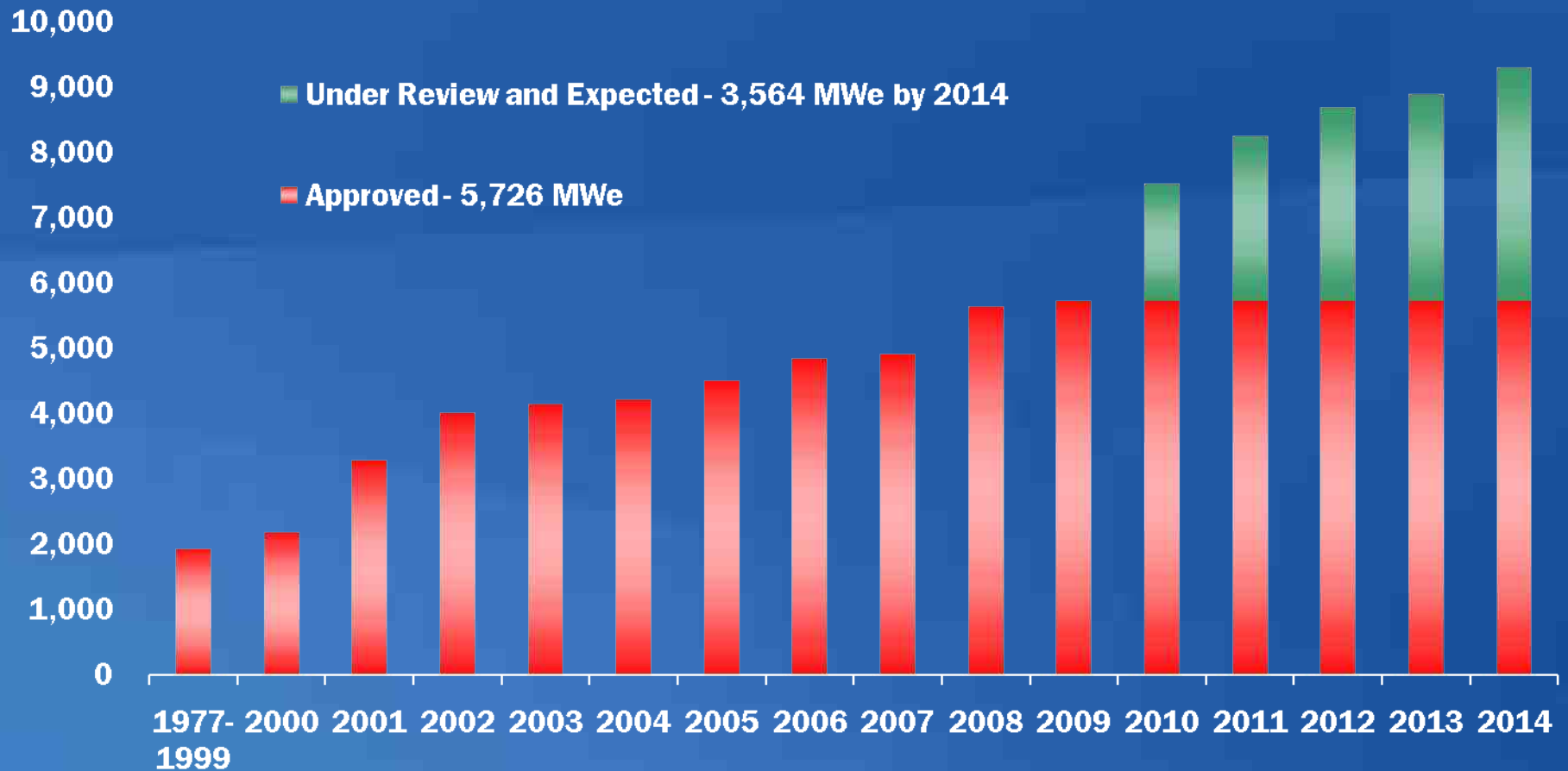
U.S. Nuclear Generation (billion kilowatt-hours)
Equivalent to 28 1,000-megawatt power plants



Sources: U.S. Energy Information Administration,
U.S. Nuclear Regulatory Commission, NEI estimate for 2009



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

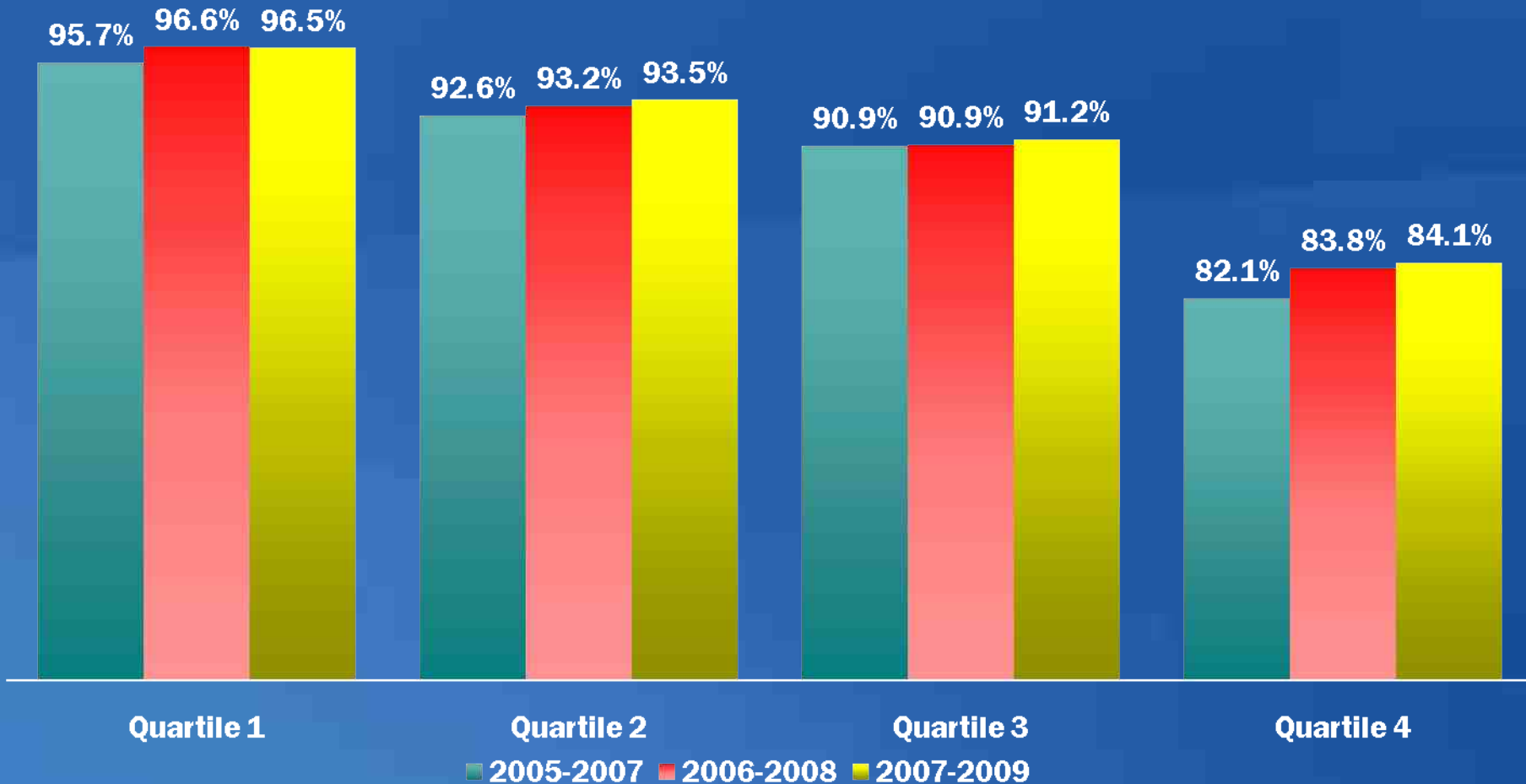


Source: Nuclear Regulatory Commission

Updated: 1/2010

U.S. Nuclear Industry Capacity Factors by Quartile

3-year rolling average

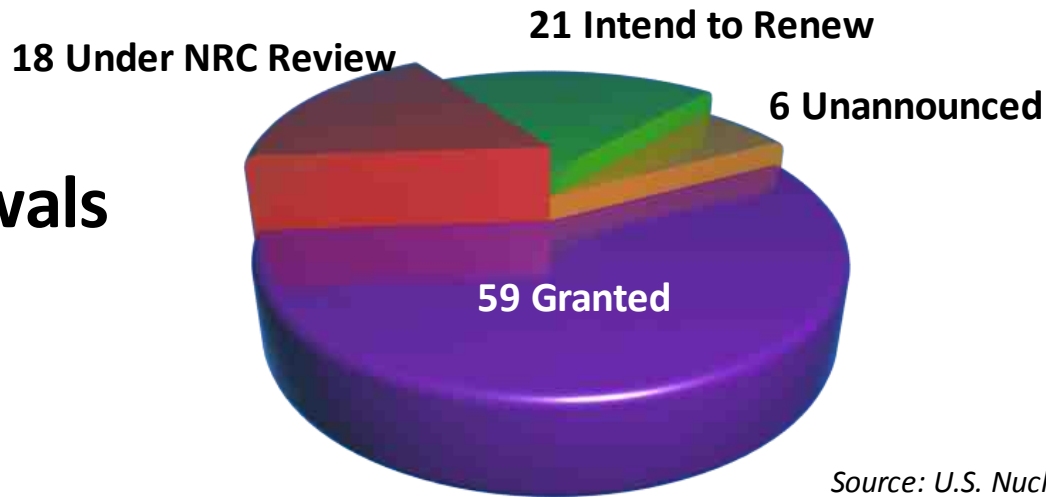


Source: Energy Information Administration

Updated: 5/10

Preparing for Longer-Term Operation

License Renewals Continue ...



Source: U.S. Nuclear Regulatory Commission

- Extends license from 40 to 60 years
- Industry investing in extended operation through replacements, upgrades and uprates for up to 80 years
- EIA's 2010 Annual Energy Outlook reference case assumes 41 nuclear units will operate beyond 60 years

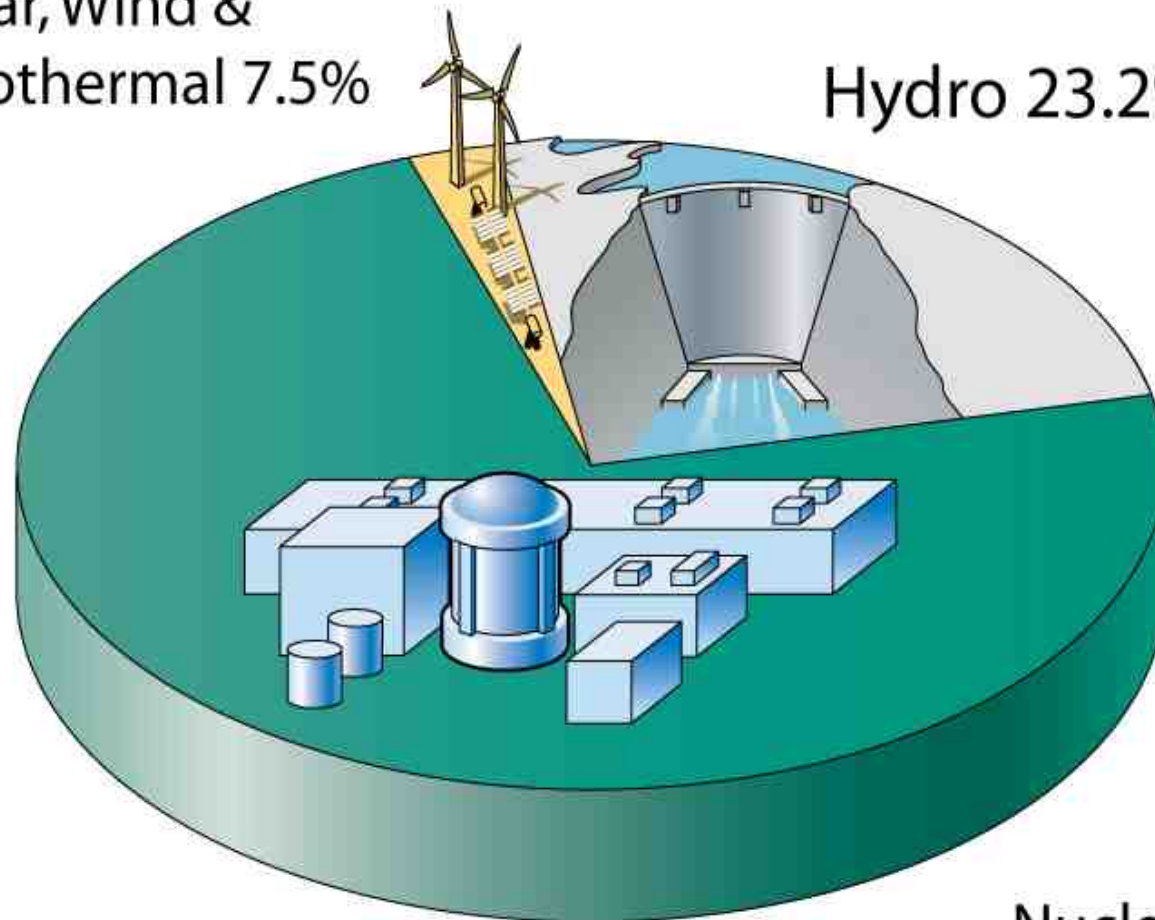


Sources of Emission-Free Electricity

2009

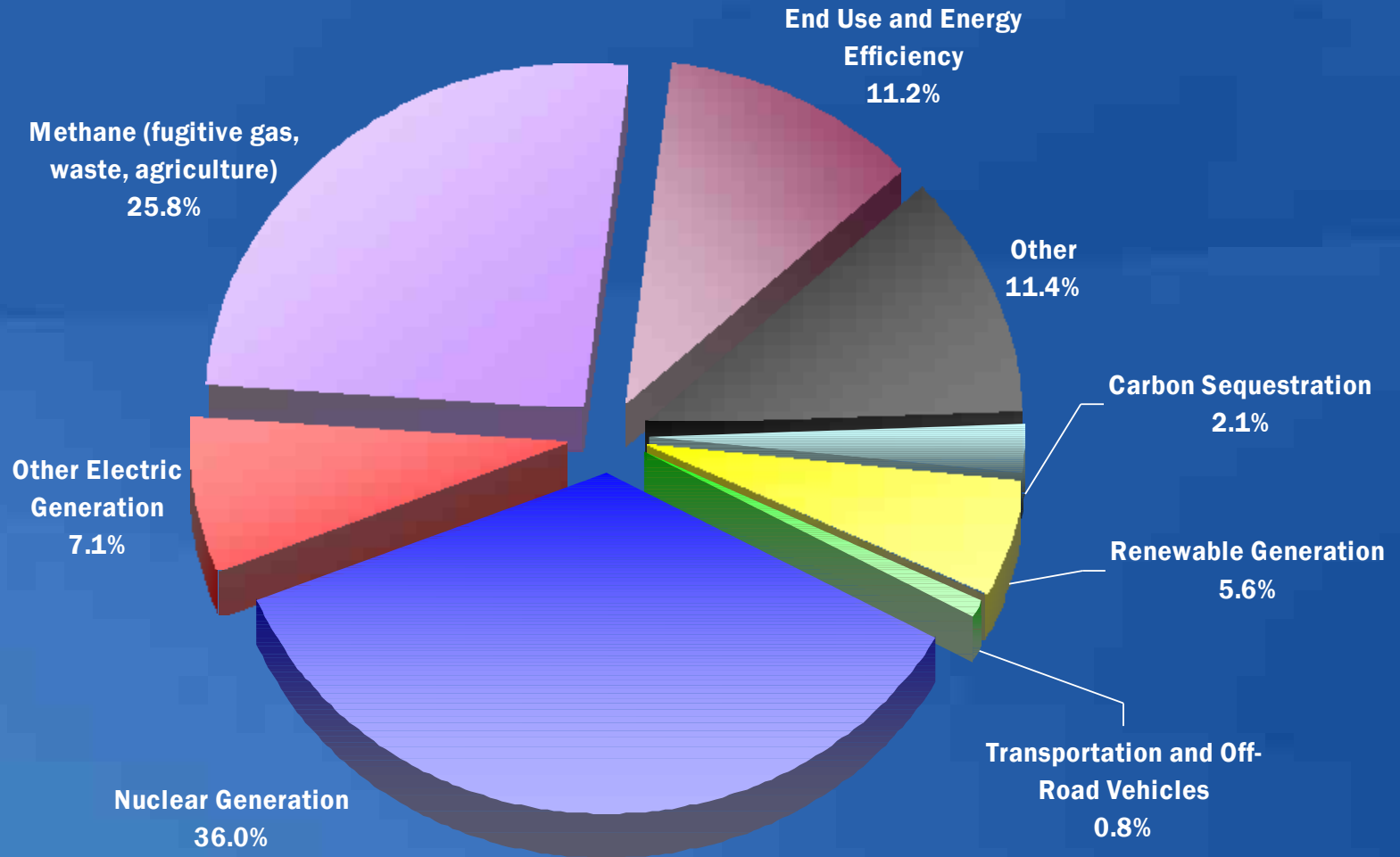
Solar, Wind &
Geothermal 7.5%

Hydro 23.2%



Nuclear 69.3%

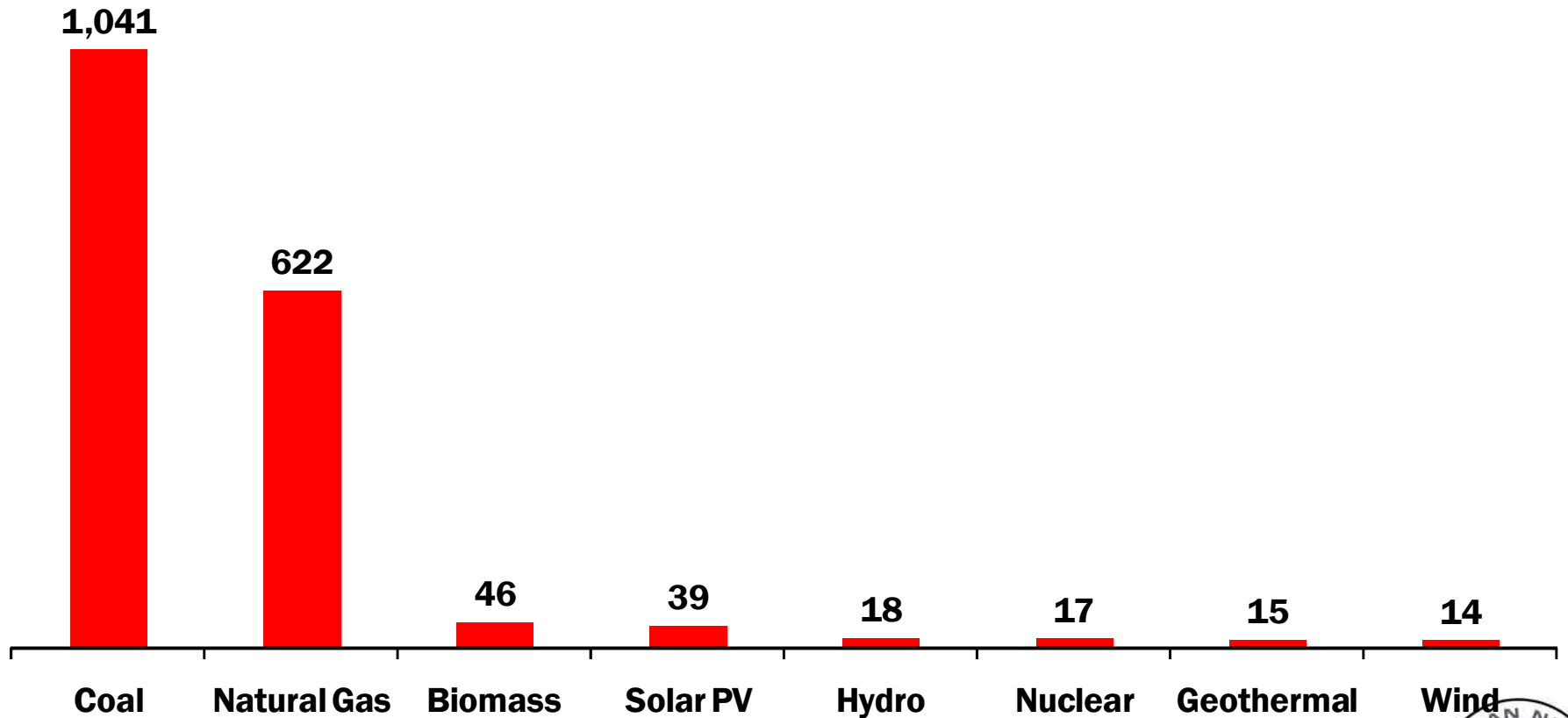
U.S. Voluntary CO₂ Reductions 2005



Source: Energy Information Administration Voluntary Reporting of Greenhouse Gases 2005
Updated: 2/07

Comparison of Life-Cycle Emissions

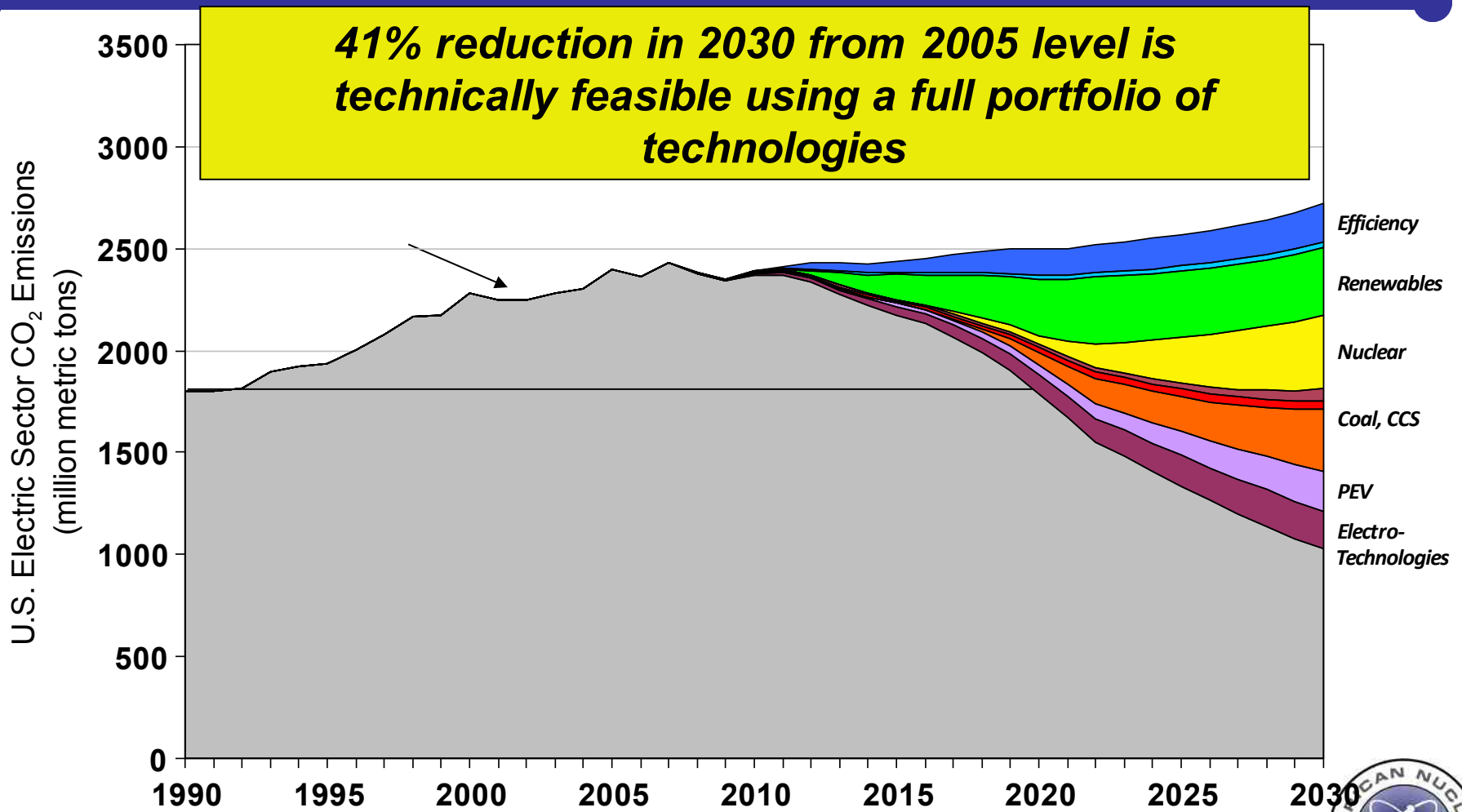
Tons of Carbon Dioxide Equivalent per Gigawatt-Hour



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



Portfolio Approach Can Meet Carbon Reductions



Source: Electric Power Research Institute PRISM 2009



The Priorities for 2010 and Beyond

- **Operating plants:** Safety, reliability is top priority
- **New plants:** Risk management is highest priority
 - Disciplined project management essential
 - Ensure certainty, predictability in the licensing process
 - Firm up financing plans
 - Sustain programs to grow nuclear work force
 - Provide investment stimulus to expand nuclear supply chain
- Industry's major opportunity: Reinforcing and strengthening the new political mandate



Conclusions

- The nuclear renaissance in the USA is real and making great progress
- Public concerns over greenhouse gases have increased support for new nuclear build
- The Obama administration is strongly behind new nuclear build due to climate concerns

