

Nuclear Energy One Option in a Diversified Energy Portfolio

Minnesota Legislative Energy Commission

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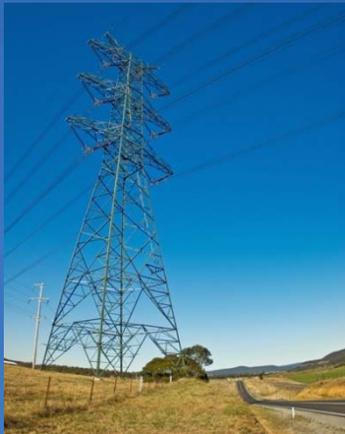
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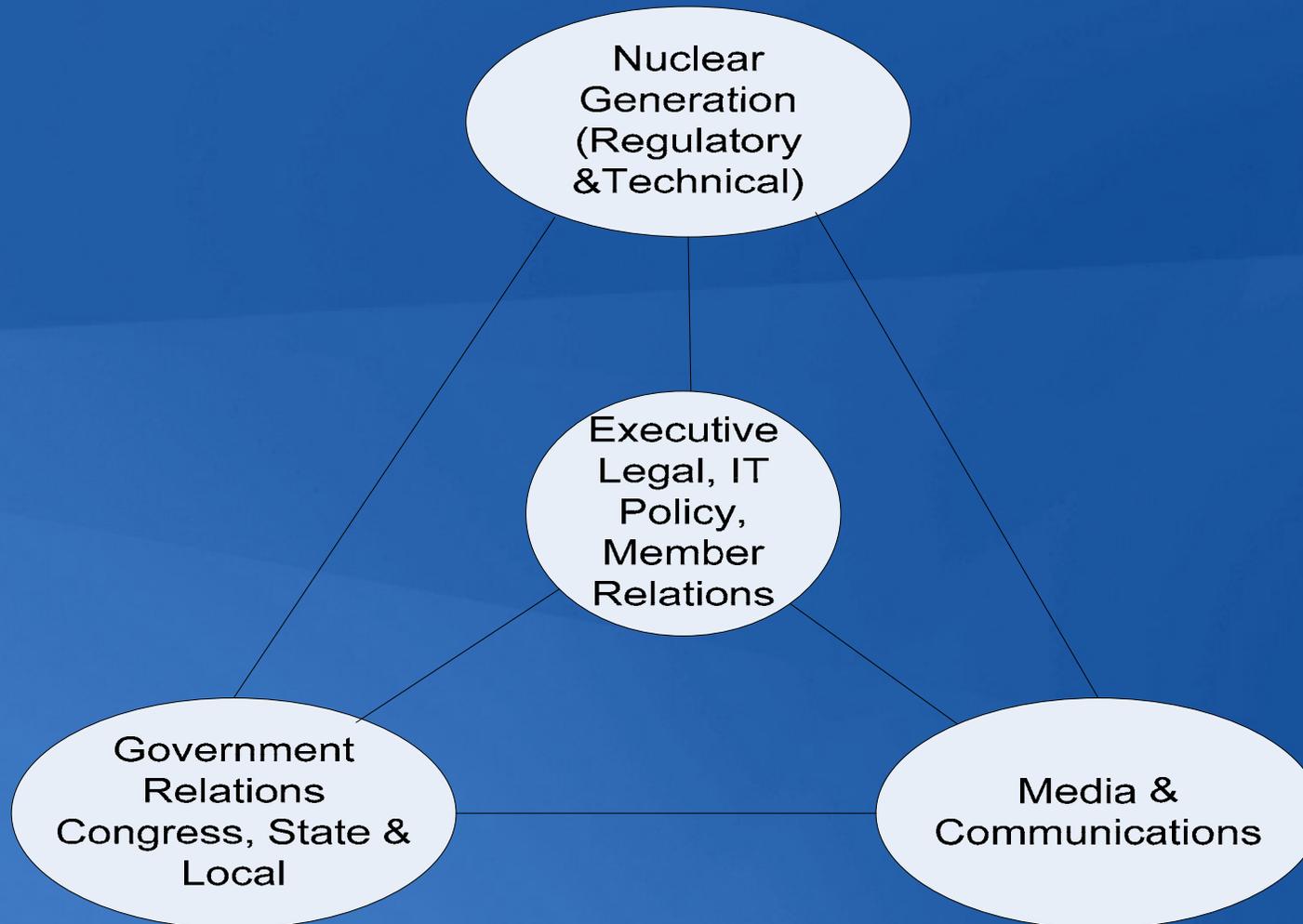
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Today's Briefing

- **Status of Operating Reactors**
- **New Nuclear Plants**
- **Used Fuel Management – The Way Ahead**



Nuclear Energy Institute



Sustained Reliability and Productivity

U.S. Nuclear Capacity Factor, Percent



* NEI Estimate

Source: Ventyx Velocity Suite / Energy Information Administration

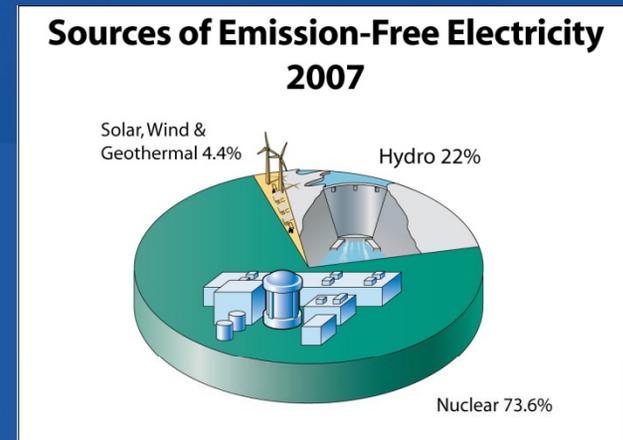
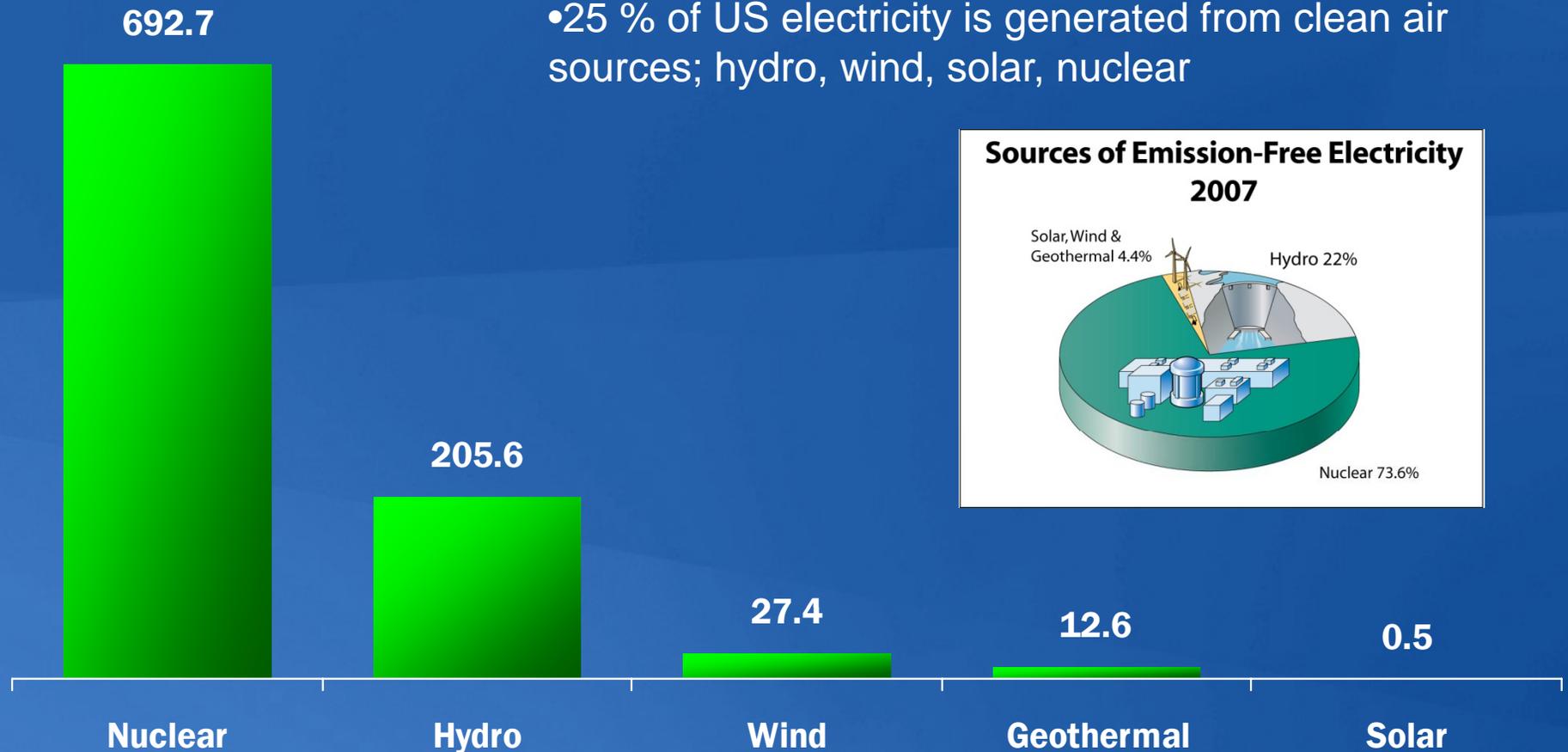
Updated: 1/09



U.S. Electric Power Industry CO₂ Avoided

Million Metric Tons, 2007

•25 % of US electricity is generated from clean air sources; hydro, wind, solar, nuclear

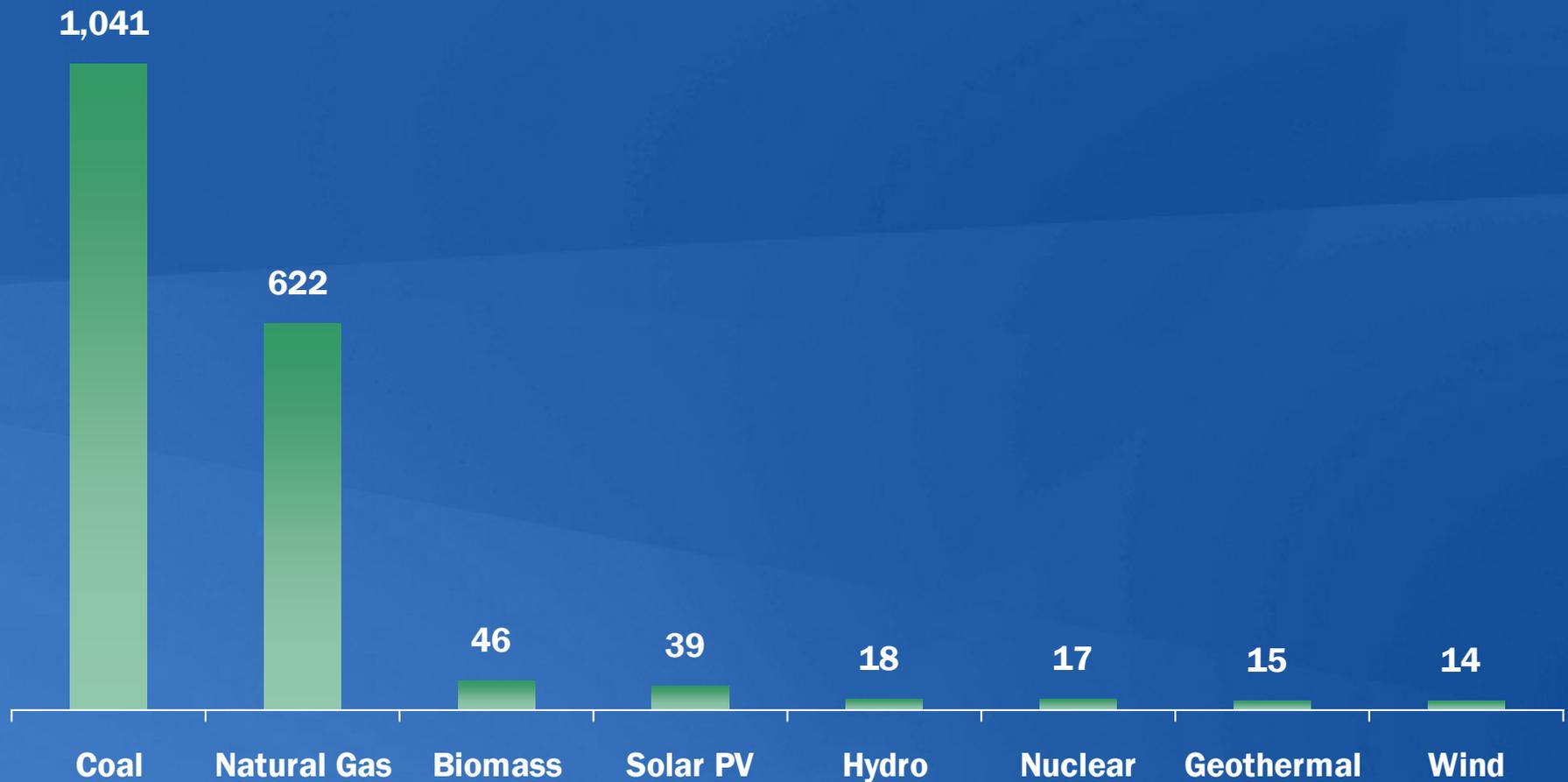


Source: Emissions avoided are calculated using regional and national fossil fuel emissions rates from the Environmental Protection Agency and plant generation data from the Energy Information Administration.

Updated: 4/07

Comparison of Life-Cycle Emissions

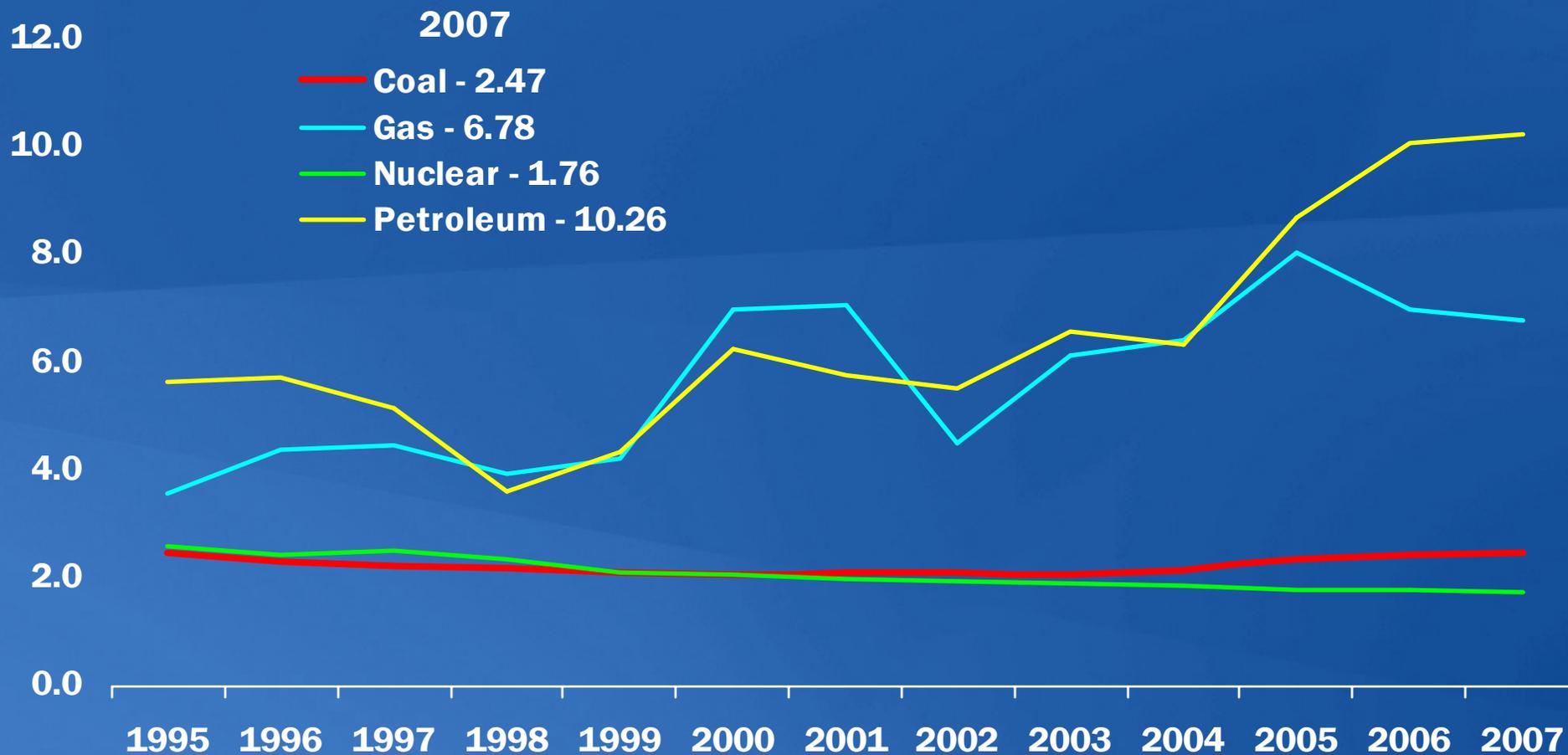
Tons of Carbon Dioxide Equivalent per Gigawatt-Hour



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

U.S. Electricity Production Costs

1995-2007, *In 2007 cents per kilowatt-hour*



Production Costs = Operations and Maintenance Costs + Fuel Costs



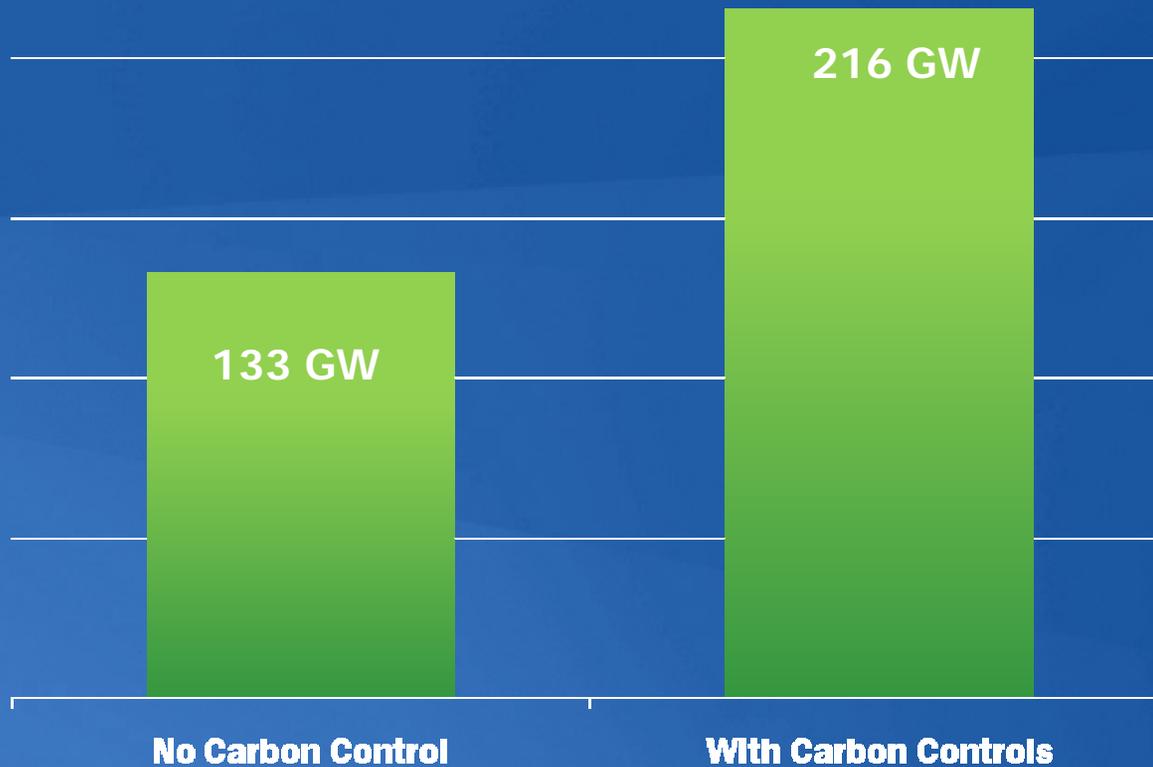
Source: Global Energy Decisions
Updated: 5/08

New Generating Capacity Needed

Assumes 0.7% Annual Growth in Peak Load

Average Electricity Growth Rate 2000 to date: 1.5%/yr

Average Electricity Growth Rate in 1990s: 1.8%



Source: The Brattle Group, "Transforming America's Power Industry: The Investment Challenge 2010-2030," November 2008



New Nuclear Power Plants Will Be Competitive

- Need for baseload generation
- FP&L: Nuclear superior in 8 of 9 scenarios
- Progress: Nuclear “better than Atmospheric Fluidized Bed Combustion (AFBC), pulverized coal and coal gasification”
- Brattle Group analysis:

Technology	Nuclear	SCPC w/CCS	IGCC w/CCS	Gas CC w/CCS
Capital Cost (\$/kWe)	4,038	4,037	3,387	1,558
Levelized Cost (\$/MWh)	83.40	141.90	124.50	103.10

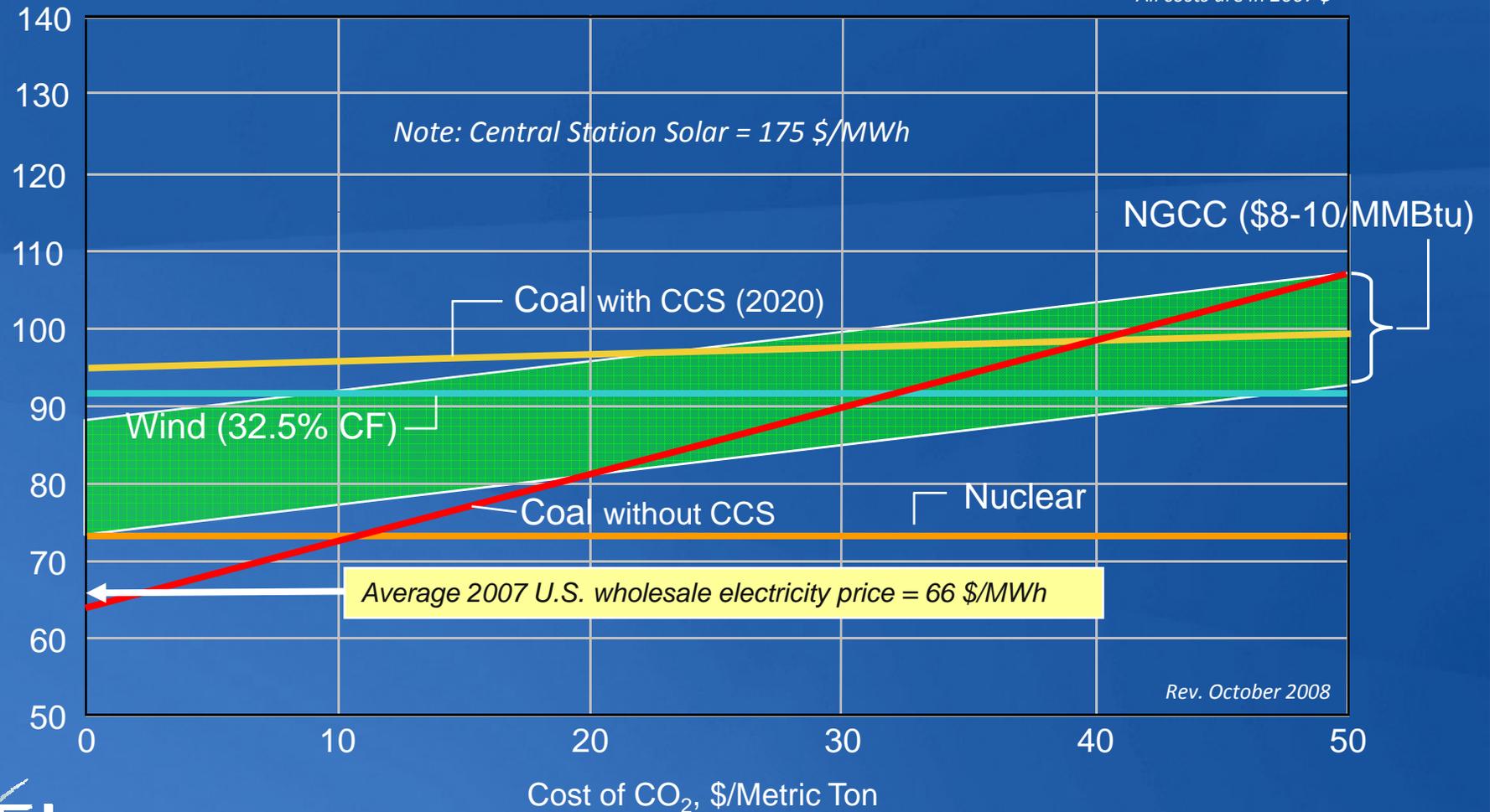


Source: “Integrated Resource Plan for Connecticut,” The Brattle Group, January 2008

Comparative Costs of New Generation Options: 2015-2020

Levelized Cost of Electricity, \$/MWh

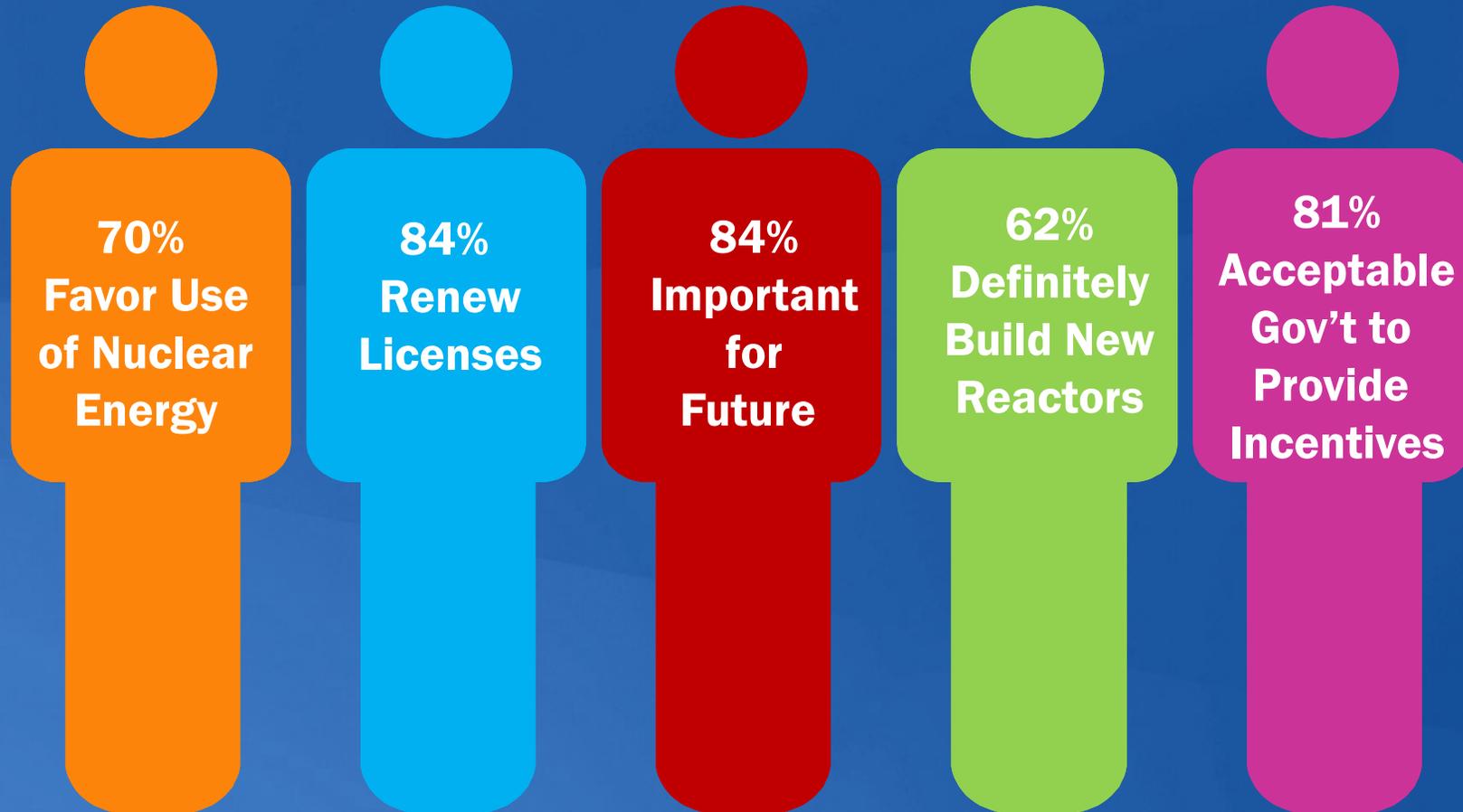
All costs are in 2007 \$



Source: "Integrated Generation Technology Options, EPRI Report 1018329



Strong Public Support Continues



Source: Biscoti Research Inc.

March 2009 poll of 1,000 U.S. adults; margin of error is +/- 3%

Construction & Licensing Then and Now

THEN	NOW
Design as you build	Plant designed before major construction begins
No design standardization	Standard NRC-certified designs – 70+% Standard
Inefficient construction management practices	Lessons learned from overseas projects; Increased planning; Modular construction
Changing regulatory standards and requirements	More stable process: NRC approves site, design, construction & operation before construction begins and significant capital is placed “at risk”
Main opportunity for public intervention when plant is essentially complete	More opportunities to intervene at well-defined points in process. Intervention at the end of the process must be based on objective evidence that acceptance criteria, defined in the license, have not been, and will not be met

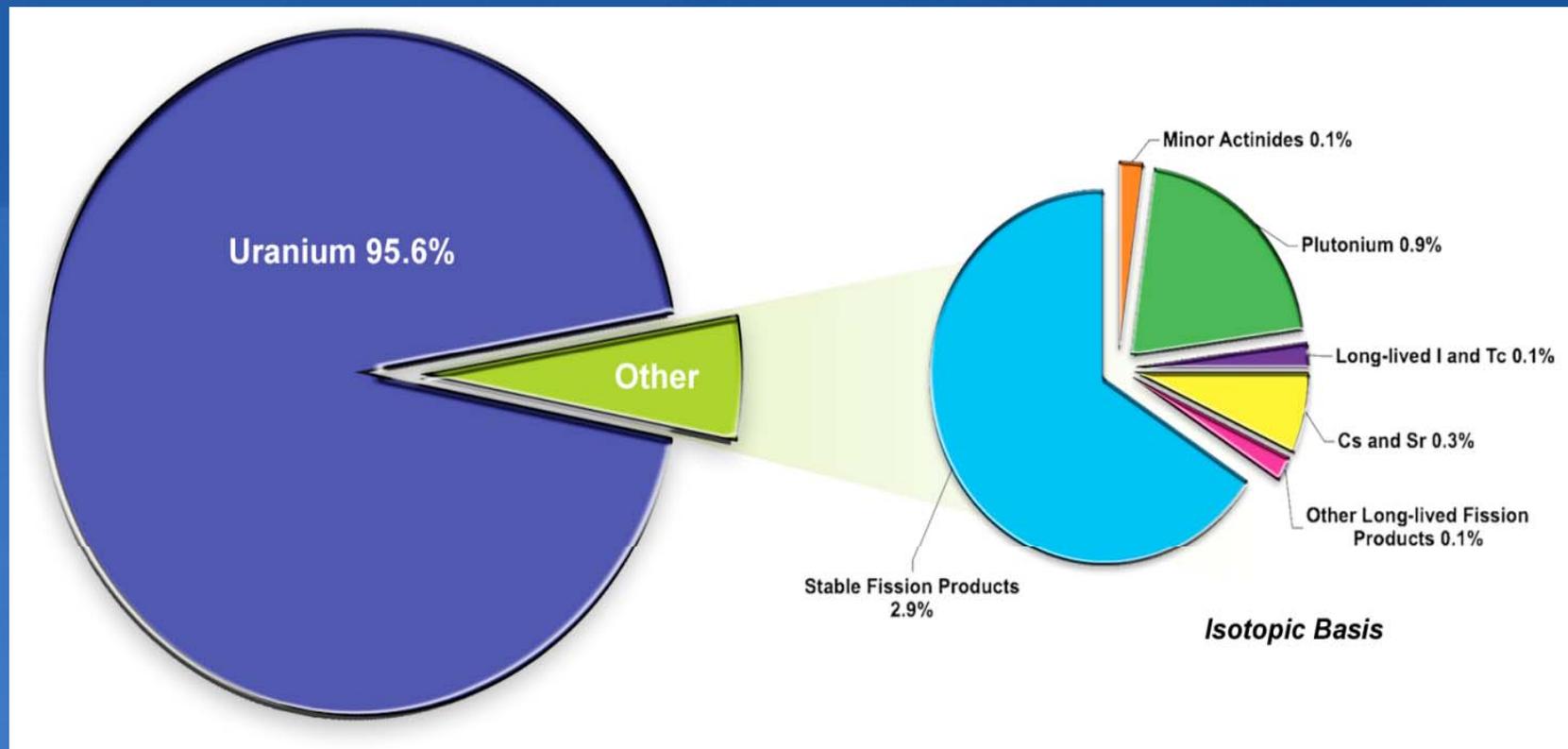
Benefits of Nuclear Generation

- Does not emit greenhouse gas while generating
- Stable, low-cost electricity
- Jobs & tax revenue
 - Three generations
- \$20 million/yr in state & local taxes
- Value to the economy -- \$430+ million/yr

Future Designs

- **Small Light-Water Reactors, Gas-Cooled High Temperature Reactors & Fast Reactors**
- **Generation and process heat**
- **Small generating reactors for remote areas of N America & overseas developing countries**
- **Process heat – industrial applications**
 - **Replace natural gas as heat source**
 - **Petro-chemical industry**
 - **Hydrogen manufacture**
 - **Coal/gas to liquid fuels**
 - **Water purification, desalination, fertilizers ...**

Used Fuel Management What's Used – What's Left



Used Fuel Management Status

- **Worldwide expansion of nuclear energy prompting renewed interest in “closing” the nuclear fuel cycle**
- **Opportunity for a more effective and energy efficient approach**
- **Long-term goal has not changed**
 - **Need deep geological isolation needed even with a closed fuel cycle**
- **Industry four-part integrated fuel management program**

Strategic Direction

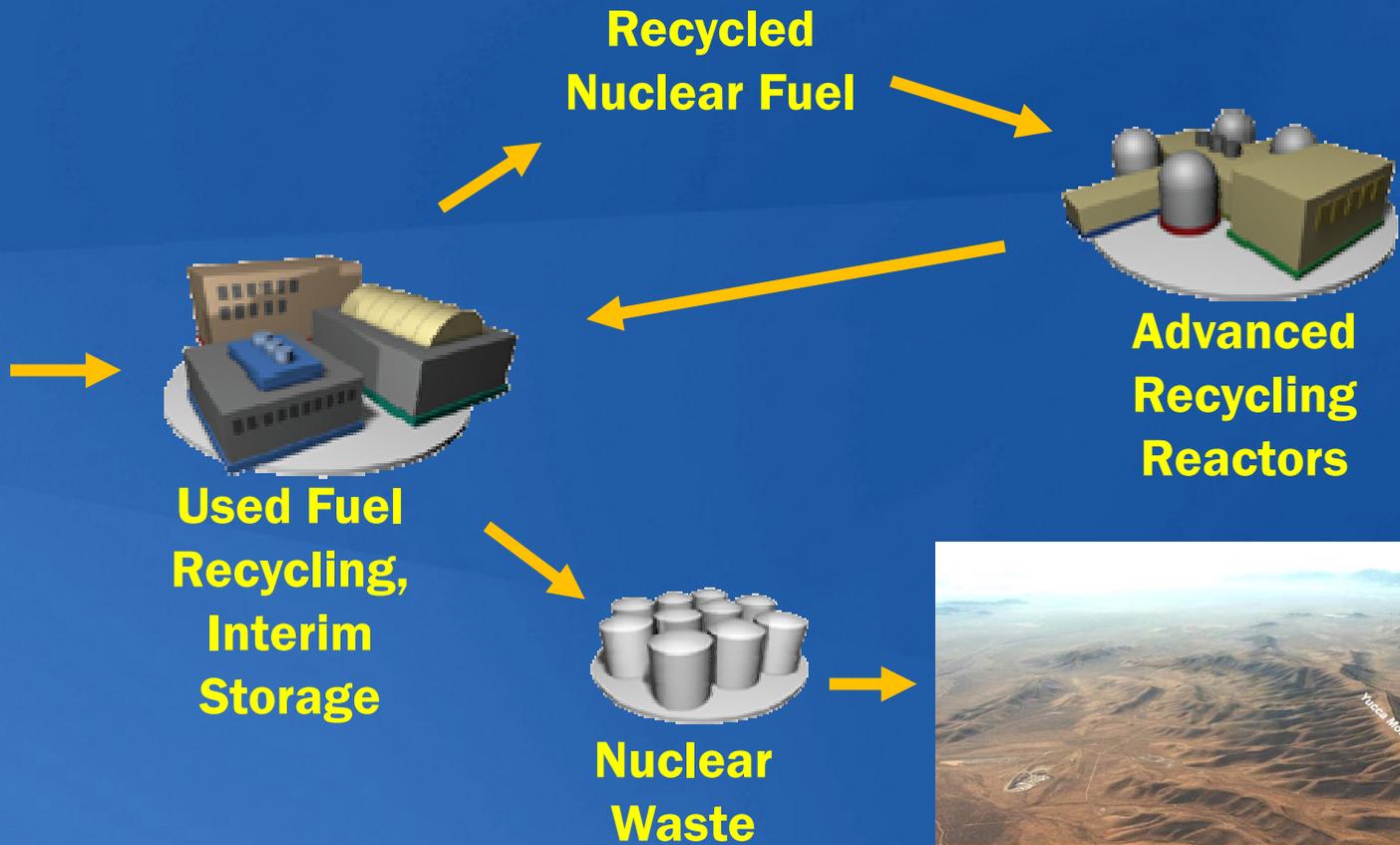
Four-Part Integrated Program

- **Form a Executive Commission to assess options while continuing the Yucca Mtn license review**
 - Adjust fee structure to fund only licensing while options being considered
- **Establish R&D centers to develop advanced, more economic, proliferation resistant process**
- **Move used fuel to interim storage locations & recycle the used fuel--reduce toxicity, heat load & volume**
- **Isolate waste product in a geologic facility**

Used Fuel Management



Used Fuel



Yucca Mountain

Clean Generating Options are Beneficial & Need to be Deployed

- **Providing for options is sound government and company policy in uncertain times**
 - **Uncertainty over impact on electricity from carbon controls, economy, terrorism,...**
- **Electricity is essential & demand will grow**
- **Need all low-emitting generating options to provide US consumers with clean, low-cost, reliable and stable electricity**