Nuclear Energy: A Snapshot of Today And The Outlook for Tomorrow

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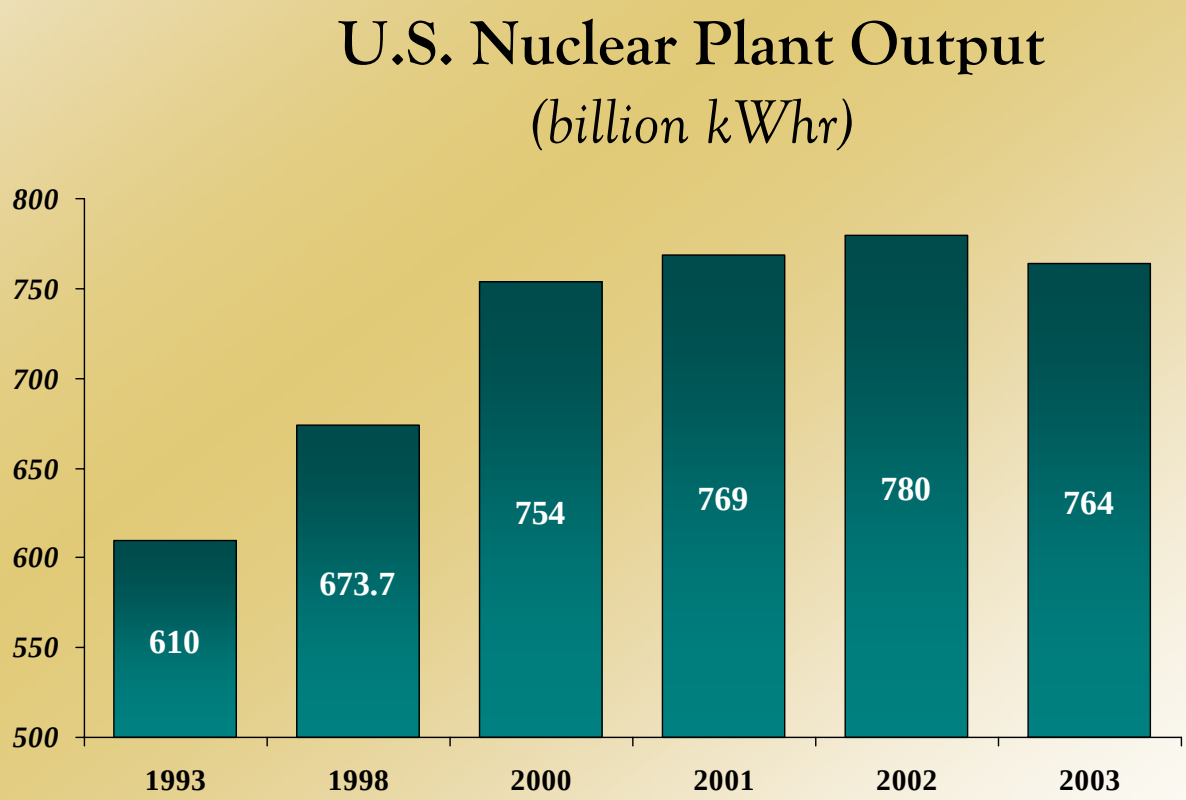
Key Trends in Nuclear Business

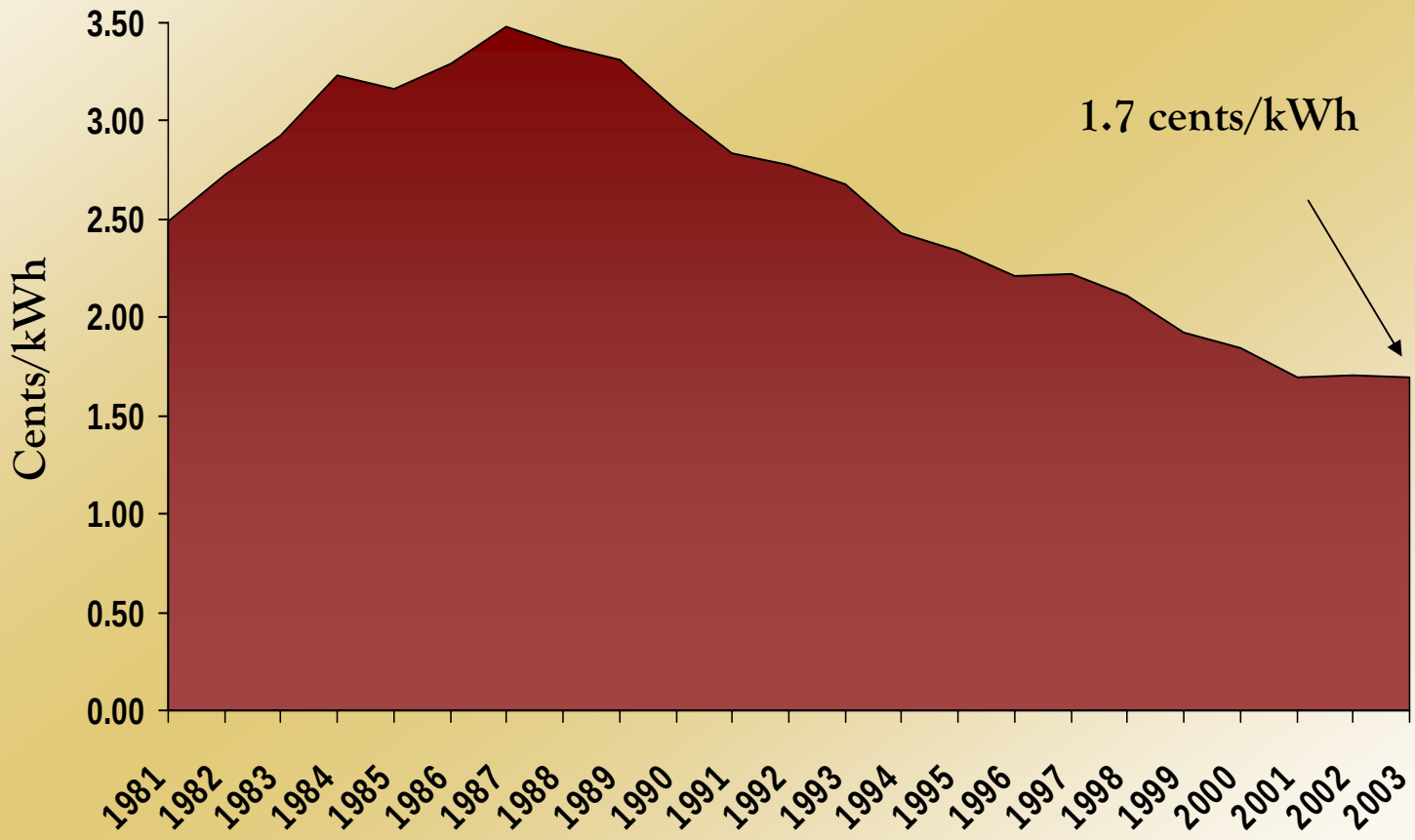
1) Consolidation of ownership, operating responsibility

2) Improved performance: equivalent to output of 19 1,000-MW



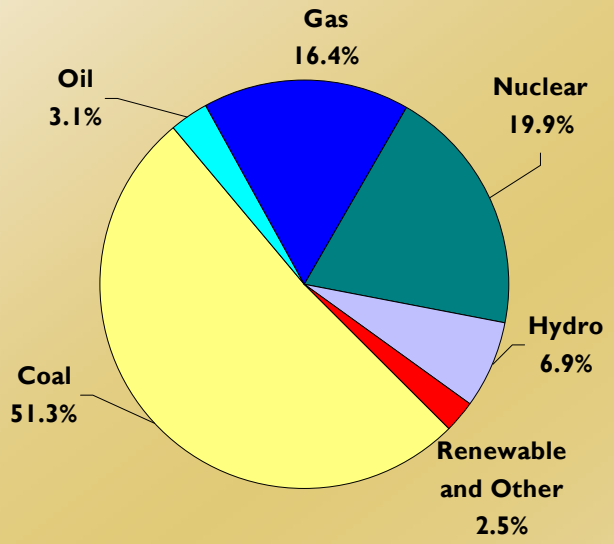
Key Trends in Nuclear Business

U.S. Nuclear Plant Production Costs (O&M + Fuel)

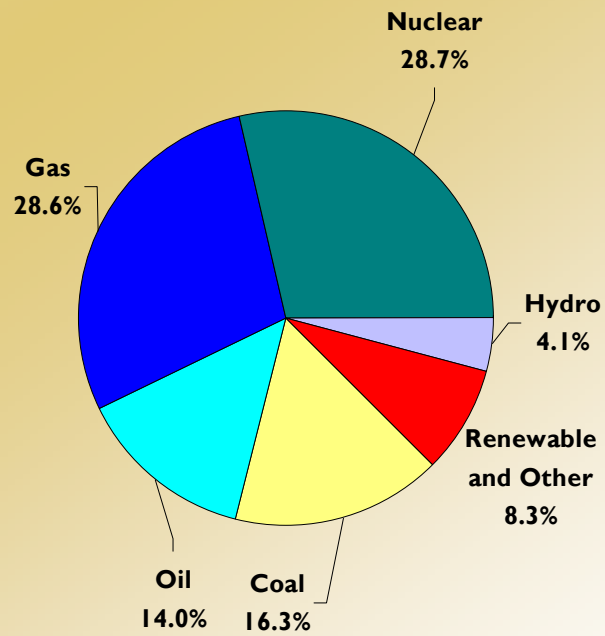


Current Electric Generation

U.S. Electric Generation by Fuel Source (2003)



New England Generation by Fuel Source (2002)



Source: EIA Updated 10/04

New England Nuclear Plants

	Capacity (MW)	Generation 2003 (MWh)	License Expiration Date
Millstone 2	869	6,328,000	Nov, 2015
Millstone 3	1,136	9,750,000	Jul, 2025
Pilgrim	690	4,978,000	Jun, 2012
Seabrook	1,161	9,276,000	Oct, 2026
Vermont Yankee	506	4,444,000	Mar, 2012

NOx, SO_2, and CO_2 Emissions Avoided by U.S. Nuclear Power Plants

Year	SO_2 *(thousand short tons)*	*NOx (thousand short tons)*	CO_2 *(million metric tons)*
New England 2003	80	23	23
United States 2003	3,360	1,240	680
Emissions reduced at U.S. fossil generating plants 1990-2001 as a result of 1990 Clean Air Act amendments	5,100	1,970	***CO_2 emissions not regulated by Clean Air Act***

SO_2 emissions for the electric power sector in 1990 were 15.73 million tons; by 2001, emissions had been reduced to 10.63 million tons, a 5.1-million-ton reduction. NOx emissions from the power sector in 1990 were 6.66 million tons; by 2001, NOx emissions had been reduced to 4.69 million tons, a 1.97-million-ton reduction.

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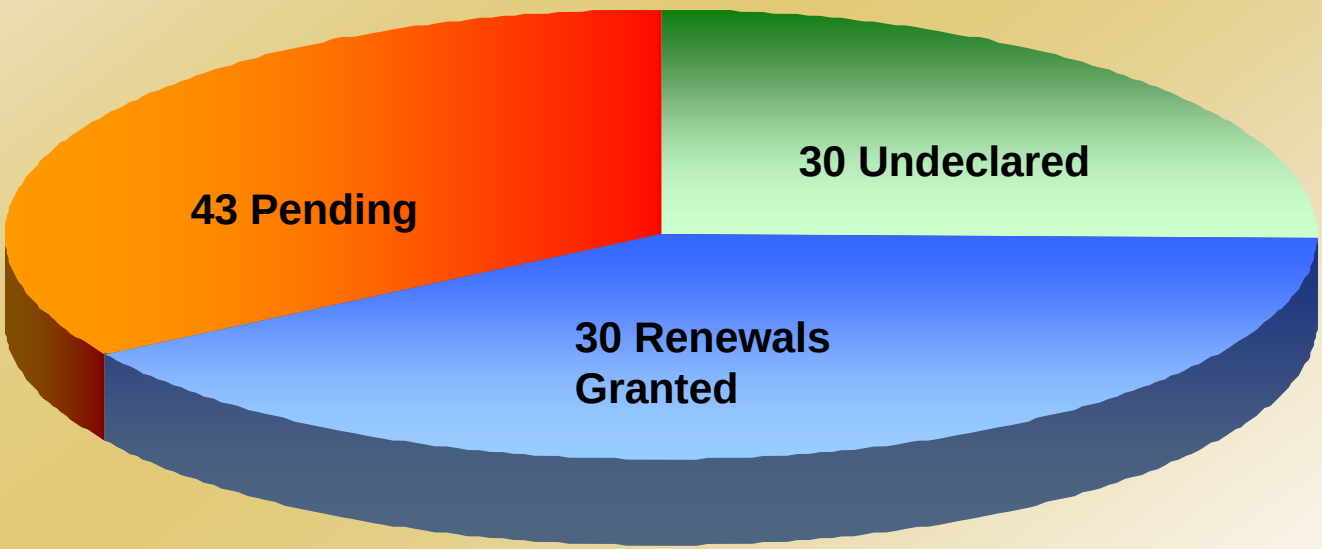
License Renewal of Current Fleet of Nuclear Plants

U.S. Nuclear Plant License Renewal Status

(as of November, 2004)



Expanding Capacity of The Current Fleet of Nuclear Plants

- **Power Uprates: with capital investment, existing plants can increase capacity. NRC must approve these license amendments.**

United States:

- Approximately 2,000 MWe added 2000-2003
- Approximately 2,000 MWe under review at NRC
- There is likely 2,500 MWe potential uprate capacity beyond

New England:

- Approximately 20 MWe added 2000-2003
- Approximately 180 MWe under review at NRC
- There is likely 170 MWe potential uprate capacity beyond

Update on Used Fuel Disposal
Continuing Progress

- Congressional approval for siting repository at Yucca Mountain in 2002
- DOE and industry working with Nevada to address concerns and resolve issues
- Action needed on Nuclear Waste Fund and congressional appropriations
  - Nuclear Waste Fund has collected $23 billion since 1982; $14 billion remains unspent
- License application to be submitted to the NRC December, 2004
- Anticipate first fuel delivered to repository 2010

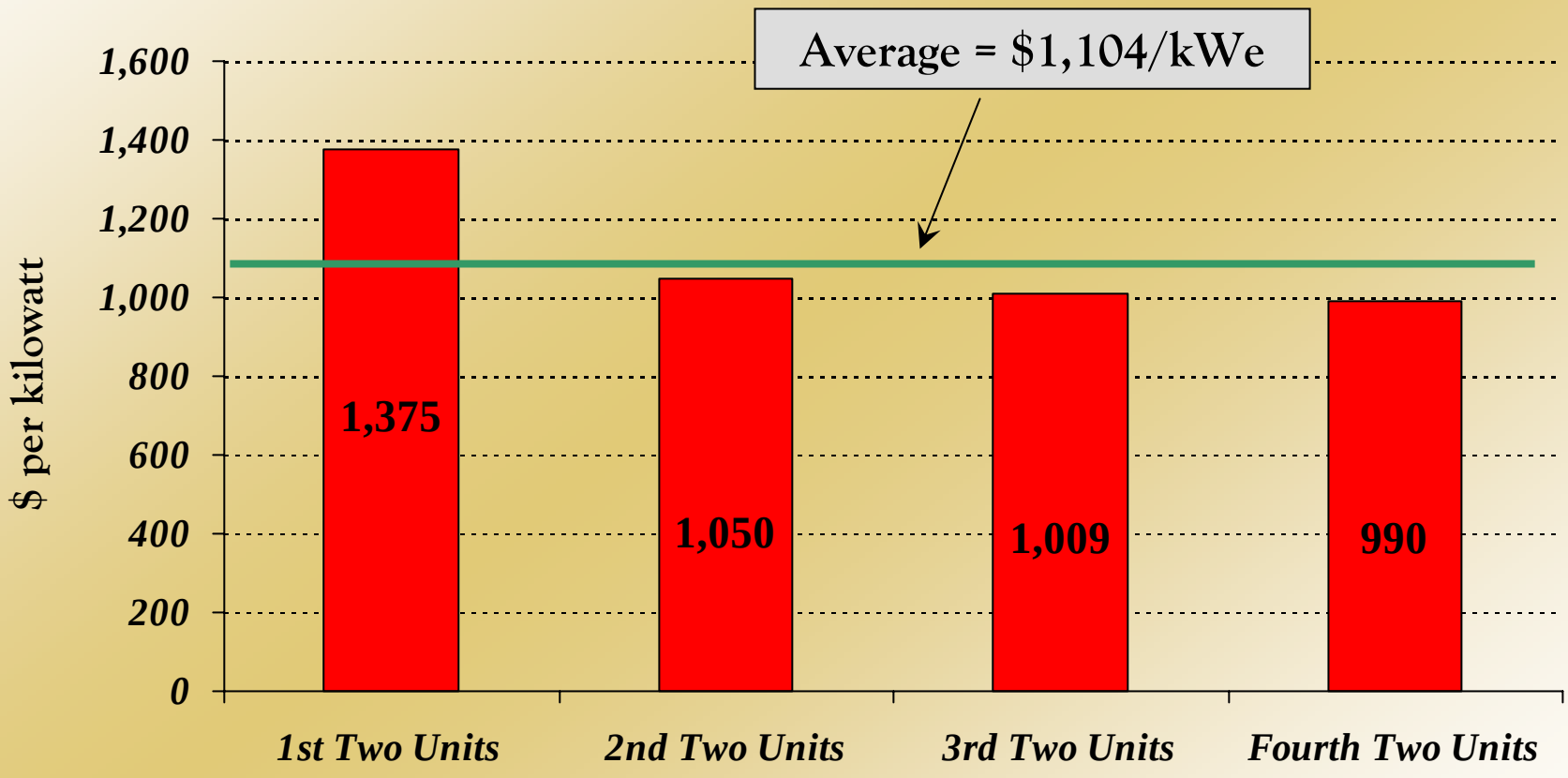
New Nuclear Power Plants: The Business Case

- Industry believes new nuclear capacity can be built at an overnight capital cost of $1,000-1,200 per kilowatt
- Competitive with gas-fired combined cycle plants at $600 per kilowatt with gas delivered at $4-5 per million Btu
- Competitive with new baseload coal-fired capacity
  - *Conventional pulverized coal with full environmental controls ($1,000-1,200 per kW)*
  - *"Clean coal" technologies ($1,200-1,500 per kW)*

Validating the Licensing Process

- New licensing process created in 1992 Energy Policy Act:
  - All regulatory approvals up front
    - Early site permits
    - Design certifications
    - Combined construction/operating license (COL)
- Dominion, Exelon, Entergy seeking early site permits
- Two consortia (NuStart Energy, Dominion) have responded to Department of Energy solicitation for proposals to demonstrate process for obtaining COL (including first-of-a-kind design and engineering)
- TVA: feasibility study at Bellefonte

The Capital Cost Challenge



New Nuclear Power Plants: Market Potential by 2020

- At $1,250/kWe = 23 GW
- At $1,125/kWe = 62 GW
- Carbon tax of $5/metric ton in 2011, rising to $50/metric ton by 2020 = 108 GW[1]

1. For reference, carbon allowance price under McCain-Lieberman estimated at $79 per metric ton in 2010, $221 per metric ton in 2025 (EIA analysis of S.139)

Source: Electric Power Research Institute, 2002, using EIA NEMS forecasting model

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New Nuclear Plants Under McCain-Lieberman Legislation

(2010-2016 GHG emissions capped at 2000 level)

- By 2020 = 17 GW
- By 2025 = 49 GW
- McCain-Lieberman plus high natural gas prices = 65 GW by 2025
- No new nuclear sensitivity case = significantly (34%) higher carbon allowance prices in 2025
- Nuclear capital cost assumptions: $2,118/kW ⇨ $1,660/kW in 2020

Source: Energy Information Administration analysis of S. 139

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The Energy/Carbon Challenge

- To cap global CO_2 concentrations at no more than 550 ppm*, must achieve average emission rate < 0.2kgC/kWh
- Today's best technology:
  - *0.9kgC/kWh for coal-based systems*
  - *0.4 kgC/kWh for natural gas*
- This suggests need for massive deployment of zero-carbon technologies

* Today's level ~ 375 ppm

Source: EPRI Electricity Technology Roadmap

Conclusions

- Continued operation of existing nuclear power plants is vital for:
  - electric price stability
  - future success of emission reduction programs
- More capacity from current fleet (uprates) available, but limited
- Fuel diversity is desirable for price stabilization and reliability
- U.S. and worldwide: cannot achieve significant reductions in greenhouse gas emissions without additional nuclear power
- Policy makers should be supportive of various types of generation to maintain fuel diversity