ISO New England Testimony to:

Joint Committee on Environment, Natural Resources and Agriculture
Joint Committee on Public Health
Joint Committee on Public Safety and Homeland Security
Joint Committee on Telecommunications, Utilities and Energy

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ISO New England

About ISO New England

- **Not-for-profit corporation created in 1997 to oversee New England's restructured electric power system**
  - Regulated by the Federal Energy Regulatory Commission (FERC)

- **Independent System Operator**
  - Independent of companies doing business in the market
  - No financial interest in companies participating in the market
  - Neutral as to resource fuel type

New England's Electric Power Grid

A tightly integrated regional power system

- 6.5 million households and businesses; population 14 million
- More than 300 generators
- Over 8,000 miles of high-voltage transmission lines
- 13 interconnections to electricity systems in New York and Canada
- Approx. 32,000 megawatts of total supply and 2,500 megawatts of demand resources
- All-time peak demand of 28,130 megawatts, set on August 2, 2006
- More than 400 participants in the marketplace
- $5-11 billion annual energy market value

ISO's Major Responsibilities

1. **Operate the Power System**
   - Maintain minute-to-minute reliable operation of region's power gird
   - Perform centralized dispatch of the lowest-priced resources
   - Coordinate operations with neighboring power systems

2. **Administer Wholesale Electricity Markets**
   - Oversee region's wholesale electricity marketplace for energy, capacity and reserves
   - Internal and External Market Monitoring

ISO's Major Responsibilities, cont.

3. Power System Planning

- Administer requests for interconnection of generation, merchant transmission, and regional transmission system access
- Conduct periodic transmission system needs assessments
- Develop 10-year transmission plan to ensure a reliable and efficient power system if market responses do not fully address system needs

ISO New England's Responsibilities Are Defined and Guided by Rules and Standards

FERC
FEDERAL ENERGY REGULATORY COMMISSION

Defines ISO's authority and the services it provides. ISO responsibilities are guided by rules approved or mandated by FERC.

NERC coordinates its activities with eight regional entities. NPCC develops, implements, and enforces criteria for the design and operation of the interconnected power systems in the Northeast.

Rules and standards give industry certainty of purpose and provide clear goals for maintaining reliable electricity service at competitive prices.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Develops and ensures compliance with mandatory standards for planning and operating power systems in North America. Can levy fines of $1,000 to $1 million per day for violations.

Develops and follows procedures to meet the numerous, stringent reliability standards.

ISO new england

Overview

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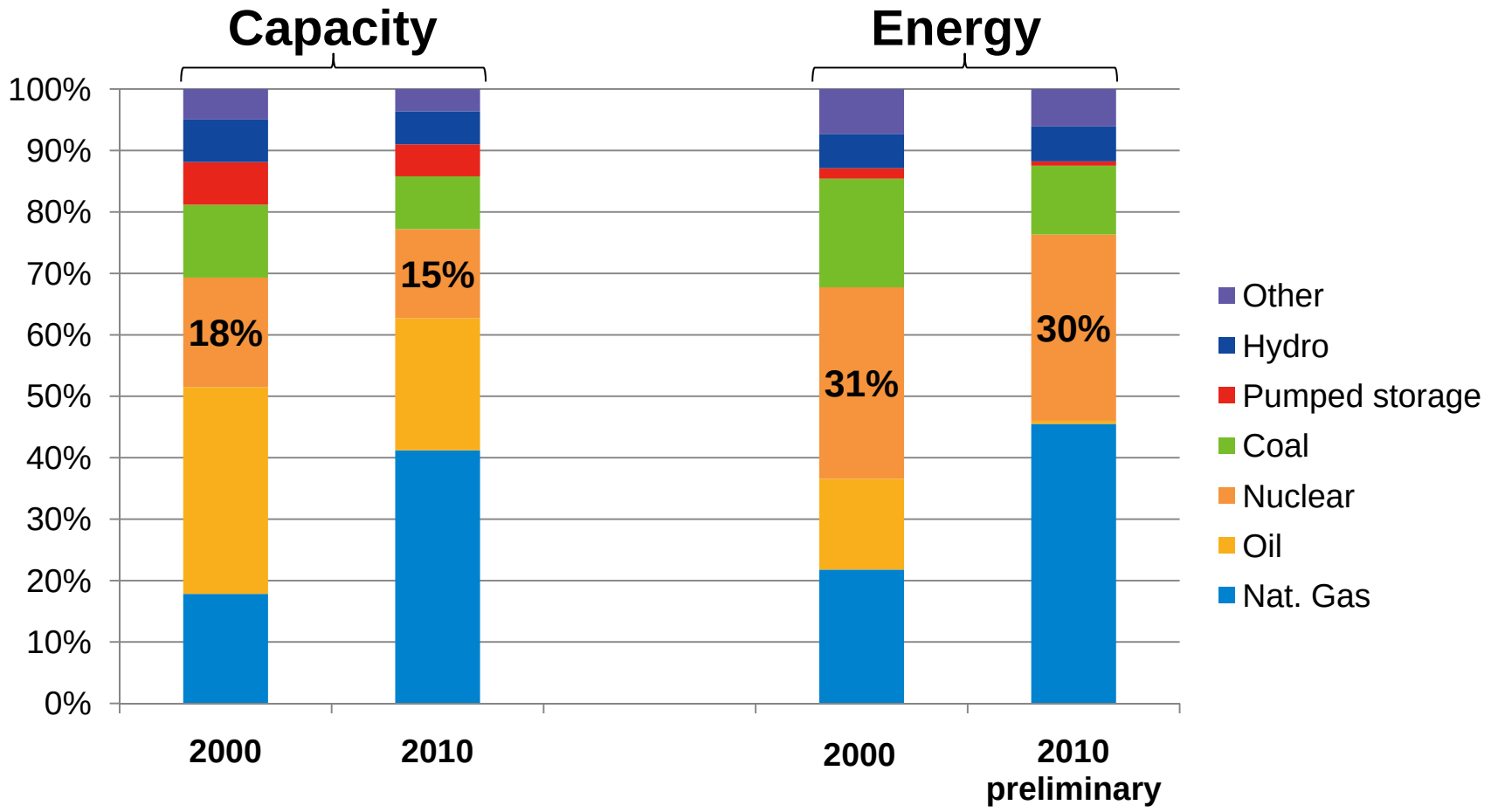
Features of Nuclear Power in New England

- New England's 345 kV transmission system was originally designed around the development of nuclear plants
  - Fast-start pumped-storage-hydro facilities developed to back up nuclear
- The largest contingency is typically a nuclear plant
  - ISO is required to carry Ten-Minute Reserve equal to 100% of the largest supply source in the region
- Unlike other generators on the system, nuclear power plants bid as non-dispatchable resources
  - Units self-schedule in the energy market
  - Units operate as baseload resources with high availability
  - Outages closely coordinated with ISO
- Nuclear capacity has increased in recent years through "uprates"

Nuclear Power Provides 15% of New England's Total System Capacity and 30% of Total Energy

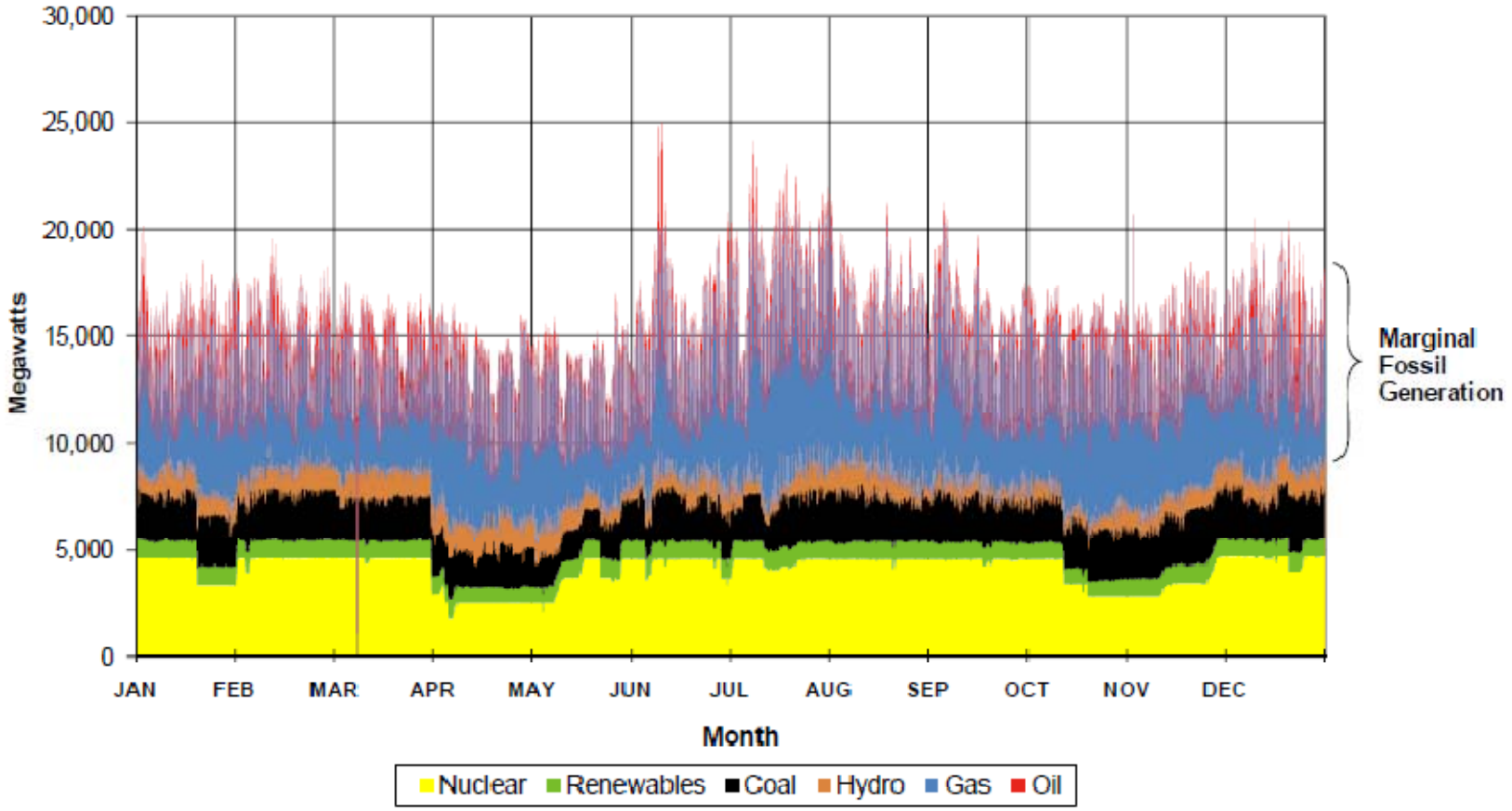
Nuclear power represents 20% of total U.S. generating capacity



Source: 2010 Regional System Plan;"Other" includes landfill gas, other biomass gas, refuse, wood and wood waste, wind, and misc. fuels.

Nuclear Power Plants Run Continuously

Nuclear provides a significant source of baseload power



Source: *2008 New England Electric Generator Air Emissions Report*, ISO New England, August 2010.

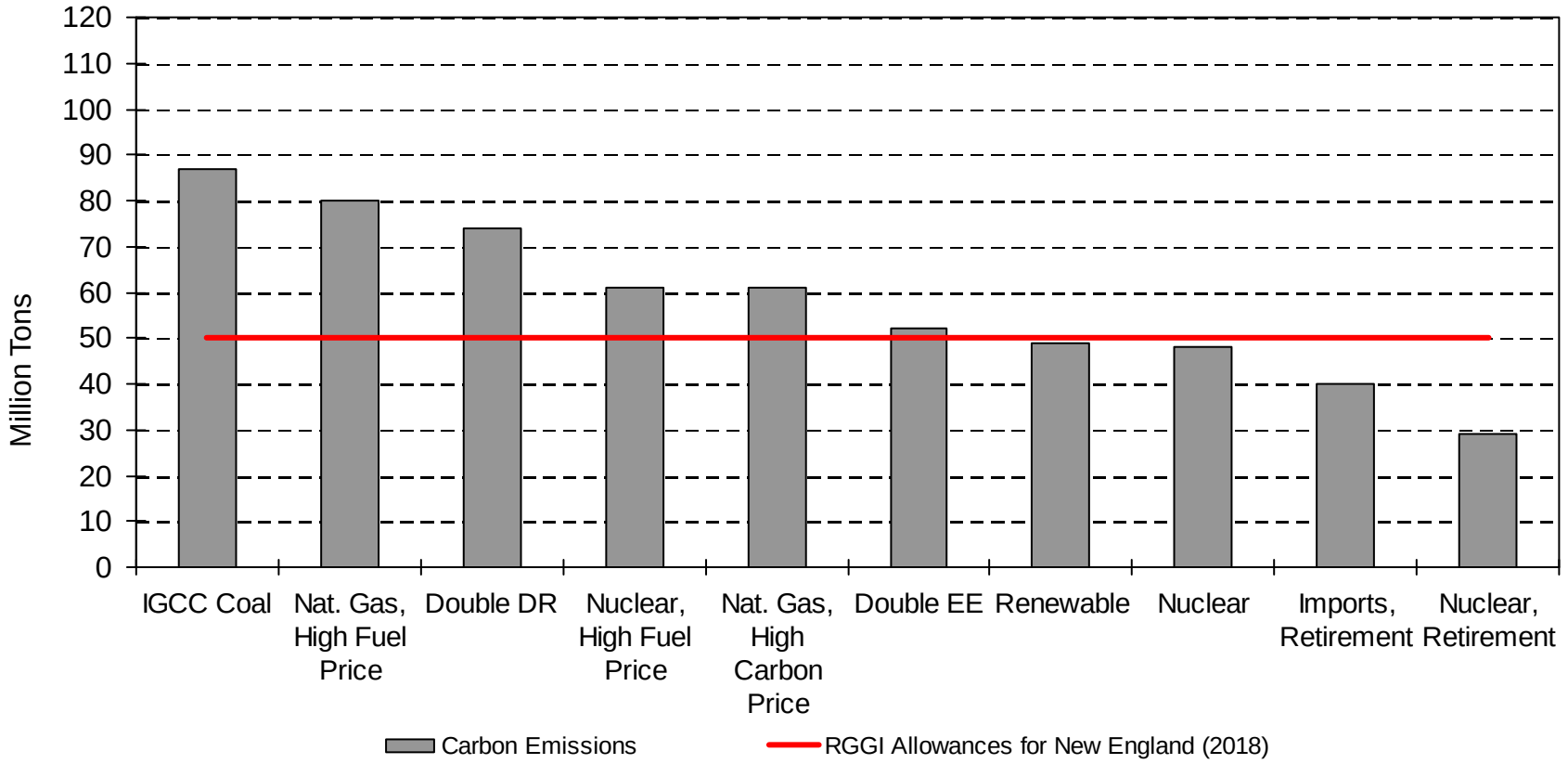
Nuclear Power Plant Availability Exceeds System Average in New England

Unit Type	Availability Calendar 2009
Nuclear	**89%**
Fossil steam	89%
Combustion turbine	94%
Combined cycle	81%
Hydro	96%
Pumped-storage hydro	96%
System average	**87%**

Source: *2009 Annual Markets Report*, ISO New England, May 2010.

Nuclear Power can Help Meet RGGI Requirements

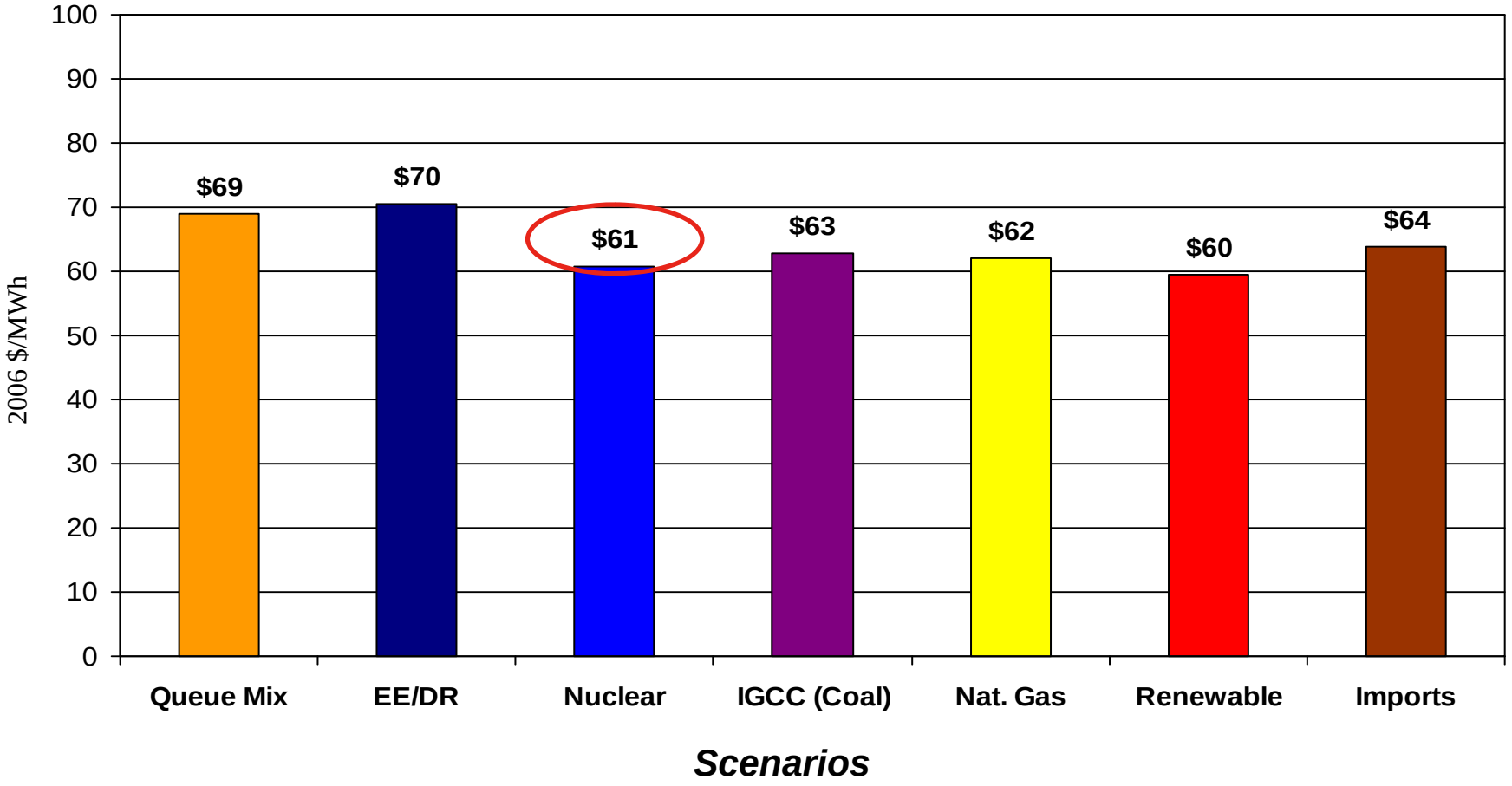
New England CO_2 emissions vs. RGGI CO_2 cap allowances



Combination of Scenarios and Sensitivities

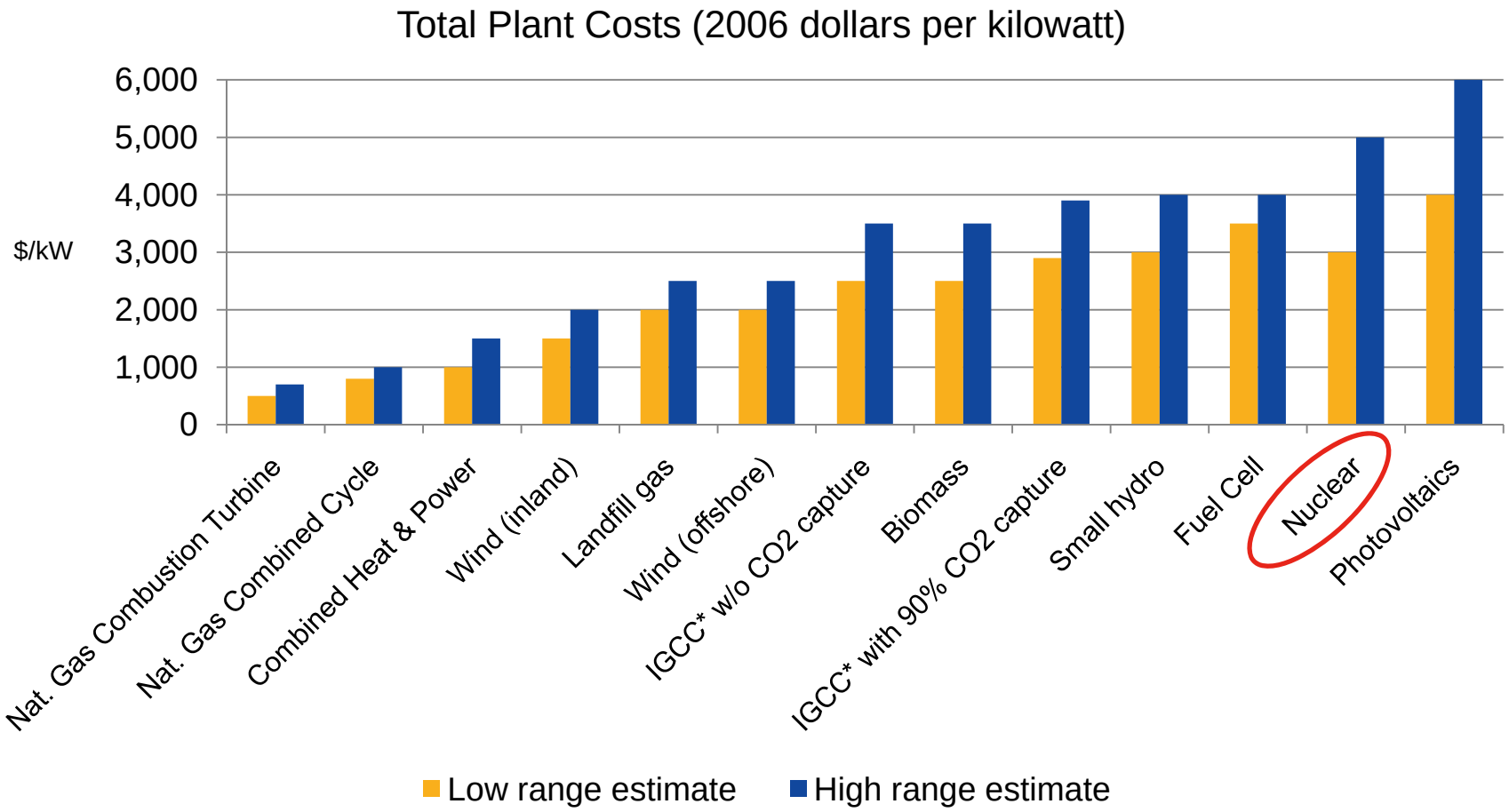
Source: *New England Electricity Scenario Analysis*, ISO New England, August 2007.

Nuclear Power Produces Low Average Wholesale Prices Relative to Other Resources



Source: *New England Electricity Scenario Analysis*, ISO New England, August 2007.

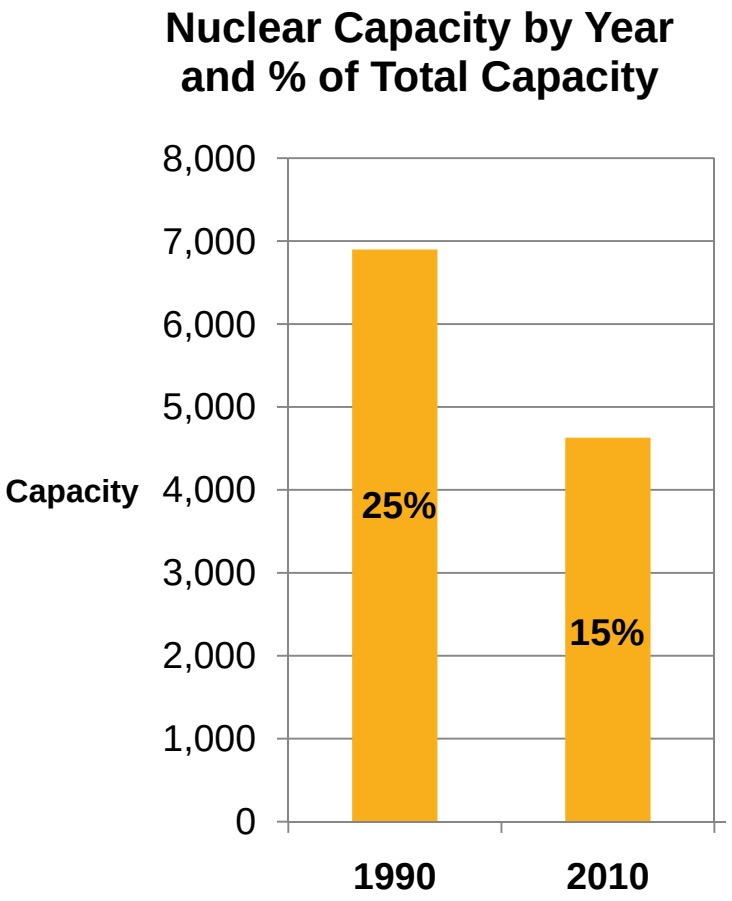
Nuclear Plants Have Low Production Costs and Long Operational Life, But High Capital Costs (Shown) and Significant Regulatory Costs



Sources: *New England Electricity Scenario Analysis*, ISO New England, 2007.
* IGCC: Integrated Gasification Combined Cycle

Recent History of Nuclear Power Plants in New England

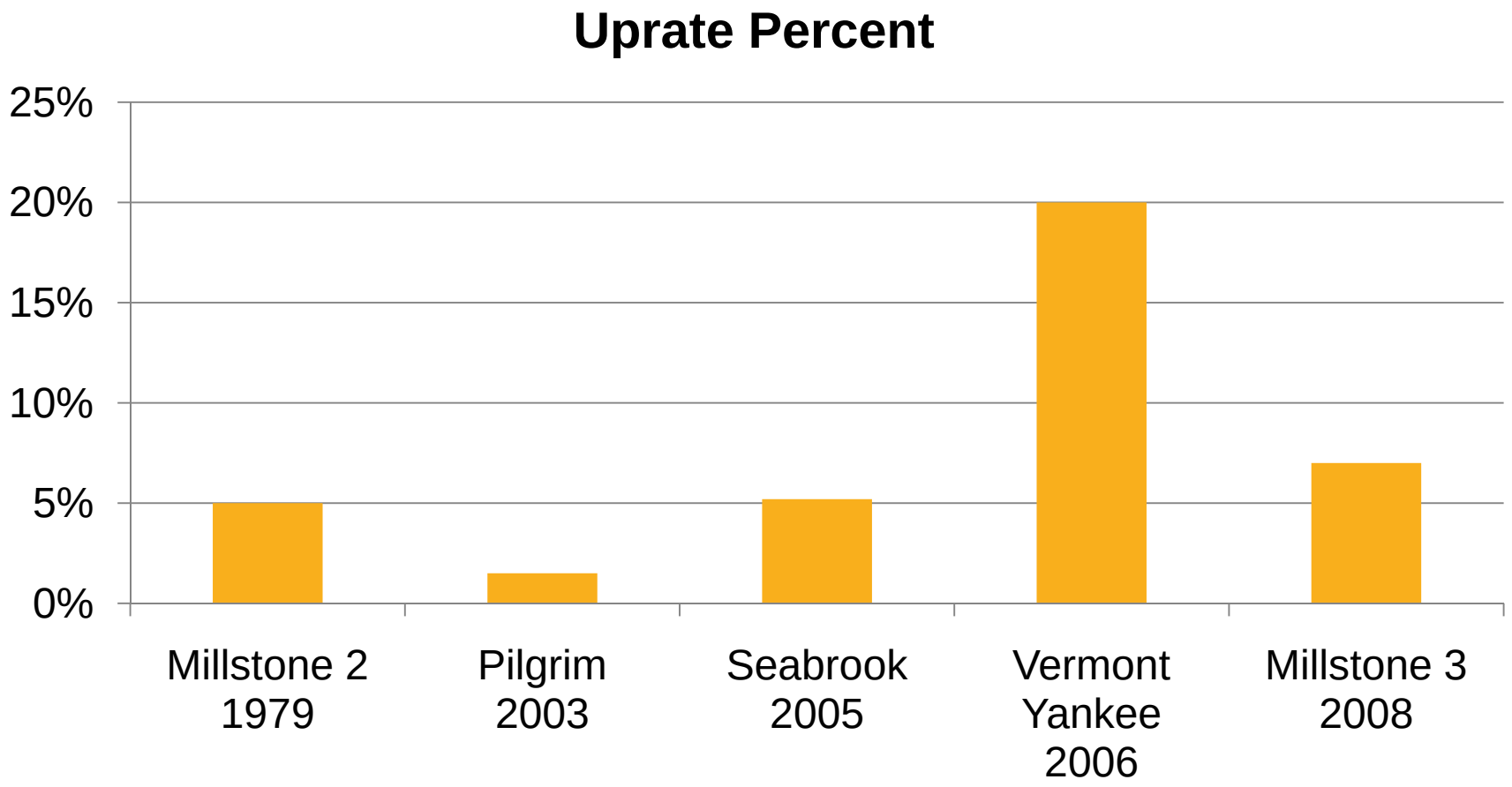
- A total of 8 nuclear power plants have operated in New England
  - 1990 was the height of nuclear capacity
- 4 generators have closed citing the cost of regulatory compliance as a factor
- 5 generators remain in service in Massachusetts, New Hampshire, Vermont and Connecticut



Recent History of Nuclear Power Plants in New England, cont.

Plant Name	Location	Capacity (MW)	Shut down	NRC License Expires
Yankee Rowe	MA	185	1991	
CT Yankee	CT	619	1996	
Maine Yankee	ME	870	1996	
Millstone 1	CT	652	1995	
Total Capacity of Closed Plants		**2326 MW**		
Millstone 2 & 3	CT	2102		2 - 2035 3 - 2045
Seabrook	NH	1245		2030
Pilgrim	MA	677		2012
Vermont Yankee	VT	604		2032
Total Capacity of Plants in Operation		**4628 MW**		

Increasing Capacity at Existing Nuclear Facilities



Relicensing Process

- Nuclear Regulatory Commission (NRC) issues licenses for commercial power reactors to operate for up to 40 years and allows these licenses to be renewed for up to another 20 years.
  - A 40-year license term was selected on the basis of economic and antitrust considerations, not technical limitations

- A total of 29 plants have been relicensed by NRC
  - A total of 104 nuclear power plants are currently in operation in the US

- Average length of time from receipt of application to relicensing is 2 years

Status of Relicensing for New England Nuclear Plants

Plant Name & Units	Date App. Received	Date NRC Issued GEIS	Date NRC Issued SER	Date NRC Issued License
Millstone 2 & 3	January 2004	July 2005	August 2005	November 2005
Vermont Yankee	January 2006	August 2007	February 2008	March 2011
Pilgrim	January 2006	July 2007	June 2007	Pending

Seabrook was licensed in March 1990. Its current license expires in March 2030.

GEIS – Generic Environmental Impact Statement
SER – Safety Evaluation Report

ISO Planning Responsibility Includes Study of Plant Additions and Retirements

- As part of its tariff requirements, ISO performs in-depth analysis on the impact of new generation and transmission -- and the retirement of facilities on the regional transmission system

- Currently, ISO is doing an analysis of the retirement of a large nuclear facility
  - Vermont Yankee (VY) provides over 50% of Vermont's capacity
  - VT is unique in that the legislature must act before VT Public Service Board can issue a certificate that is required for the plant to continue to operate
    - At this time, legislative approval is uncertain

- This type of analysis requires the simulation of power system operations under a variety of conditions
  - Highly technical, resource-intensive

Analysis of Vermont Yankee

- Analysis shows that Vermont will require upgrades to its electric infrastructure to meet future needs -- with or without VY
- Potential violations of reliability standards are shown to occur in New Hampshire and in north central and western Massachusetts
- Potential solutions may include new 345 kV and/or 115 kV transmission lines and generation and demand resources
- Given the timing of a potential shutdown of the plant compared to the time it takes to implement electric system solutions, an operating plan to maintain reliability in Vermont and the region is being developed
  - Procedures to manage contingencies occur so that reliability standards can be maintained
- It is likely that the dispatch of more expensive generation and imports will be required and will add to the cost of running the system

ISO Operators in Regular Contact with Nuclear Plant Operators

- Training:
  - ISO operators trained on nuclear plant requirements
  - On-site joint training between nuclear plant operators and ISO operators each year
    - Rotates among the region's nuclear plants
- Transmission Interface Program
  - Quarterly meetings between the ISO, transmission owners, local control centers and nuclear plant personnel
    - Discuss past and future operations
    - Identify and discuss emergent issues to maintain nuclear plant and transmission system reliability
    - Identification of future nuclear plant and transmission system equipment outages that need to be coordinated

ISO Coordinates Outages with Nuclear Plant Operators

- Refueling Outages
  - ISO coordinates the outage schedules of each of the nuclear plants, approximately 6 months before refuel
    - Typically refuel every 18 months during off-peak times, for approximately 4-6 weeks
      - Off-peak: April – May and October – November

- Transmission Line Outages
  - ISO coordinates with nuclear plants when transmission line outages are occurring and could impact nuclear plant operations
    - Internal lines and external ties

System Restoration

- ISO maintains **System Restoration Plan** in the event of an electric system shutdown
  - Procedures give priority to nuclear plants after an event

- ISO conducts annual training on restoring the system after a shutdown
  - System restoration training has been integrated into ISO training cycle which provides six opportunities for nuclear plant personnel to participate

Conclusions

- Energy production from nuclear plants is a significant part of New England's energy mix
- Nuclear power can lower overall carbon emissions and produce lower energy prices -- relative to other resources
- Without nuclear resources, significant investment in the transmission system and/or new resources would be needed to maintain reliability
- ISO is in regular communication with nuclear plant operators to ensure proper training, manage infrastructure outages and establish contingency and restoration plans

Appendix

History of Nuclear Power Plant Closures in New England

- Yankee Rowe Nuclear Station (MA)
  - Shut down Oct. 1, 1991
  - The owners chose early retirement for economic reasons, including the cost of addressing NRC concerns about the metallurgical status of certain components during its review of the plant's license renewal efforts

- Millstone – Unit 1 (CT)
  - Shut down Nov. 4, 1995
  - The owners chose to shut down the plant due to violations of NRC regulations and the cost associated with safety improvements

History of Nuclear Power Plant Closures in New England, cont.

- Haddam Neck - Connecticut Yankee (CT)
  - Shut down July 22, 1996
  - Following an economic analysis of operations, expenses, and the cost of inexpensive replacement power, the owners felt a shutdown was the best option
- Maine Yankee Atomic Power Station (ME)
  - Shut down Dec., 1996
  - The owners cited the rising cost of safety measures which made generating electricity too expensive in a deregulated market

New England's Nuclear Fleet: Millstone 2 & 3

Millstone 2
Operator: Dominion Nuclear Connecticut, Inc.
Operating License: Issued - 09/26/1975, Expires - 07/31/2035
Reactor Type: Pressurized Water Reactor
Electrical Output: 869 MW
Reactor Vendor / Type: Combustion Engineering
Containment Type: Dry, Ambient Pressure

Millstone 3
Operator: Dominion Nuclear Connecticut, Inc.
Operating License: Issued - 01/31/1986, Expires - 11/25/2045
Reactor Type: Pressurized Water Reactor
Electrical Output: 1233 MW
Reactor Vendor / Type: Westinghouse Four-Loop
Containment Type: Dry, Subatmospheric

New England's Nuclear Fleet: Seabrook

Operator: FPL Energy Seabrook

Operating License: Issued - 03/15/1990, Expires - 03/15/2030

Reactor Type: Pressurized Water Reactor

Electrical Output: 1245 MW

Reactor Vendor / Type: Westinghouse Four-Loop

Containment Type: Dry, Ambient Pressure

New England's Nuclear Fleet: Vermont Yankee

Operator: Entergy Nuclear Operations, Inc.

Operating License: Issued - 03/21/1972, Expires - 03/21/2032

Reactor Type: Boiling Water Reactor

Electrical Output: 604 MW

Reactor Vendor / Type: General Electric Type 4

Containment Type: Wet, Mark I

New England's Nuclear Fleet: Pilgrim

Operator: Entergy Nuclear Operations, Inc.

Operating License: Issued - 06/08/1972, Expires - 06/08/2012

Reactor Type: Boiling Water Reactor

Electrical Output: 677 MW

Reactor Vendor / Type: General Electric Type 3

Containment Type: Wet, Mark I

Potential for New Nuclear Power Plants

- Applications for new nuclear facilities received by NRC
  - 2007 = 5 applications
    - Total of 8 new units
    - Located in: AL, TX, MD, SC, VA
  - 2008 = 12 applications
    - Total of 17 new units
    - Located in: NC, MS, GA, SC, FL, MI, TX, LA, MO, NY, PA
  - 2009 = 1 application
    - Total of 2 new units
    - Located in: FL
- The NRC regulates the design, siting, construction, and operation of new commercial nuclear power facilities

Potential for New Nuclear Power Plants, cont.

- No applications made in 2010
- All but three of the applications are at sites with existing nuclear plants
- None in New England
- Concentrated in the southeast