

# Perspective on Trends in U.S. Electricity Markets and Nuclear Power Plant Shutdowns

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**NEI**

NUCLEAR ENERGY INSTITUTE

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STORIED HISTORY  
BRIGHT FUTURE

# Nuclear Plant Shutdowns: The Situation

- Five reactors shut down
  - Four in 2013
  - One at the end of 2014
- Crystal River 3, SONGS 2 and 3 were unique events
  - Over 110 PWRs (57 in the U.S.) have replaced steam generators; three ended badly
  - Not a trend
- Kewaunee, Vermont Yankee shutdown because of adverse economics

# Trends in the Electricity Markets

- Electricity demand has not returned to 2007 level
- Excessive dependence on natural gas
- Merchant power markets dysfunctional to varying degrees
  - Price signals do not support investment in new capacity, or continued operation of existing capacity
  - Playing field is not level
- Older, smaller single units facing large capital expenditures most vulnerable

# Fuel Diversity at Risk

Generating Capacity Built in the United States in the Last 15 years


Fuel	Total
Coal	25,922
Gas	341,771
Nuclear	1,413
Oil	7,458
Renewables	66,599
Other	4,270
Total	448,806

Source: Ventyx Velocity Suite

# Fuel Diversity at Risk

## Natural Gas, Coal and Nuclear Capacity Expected 2013–20 (MW)

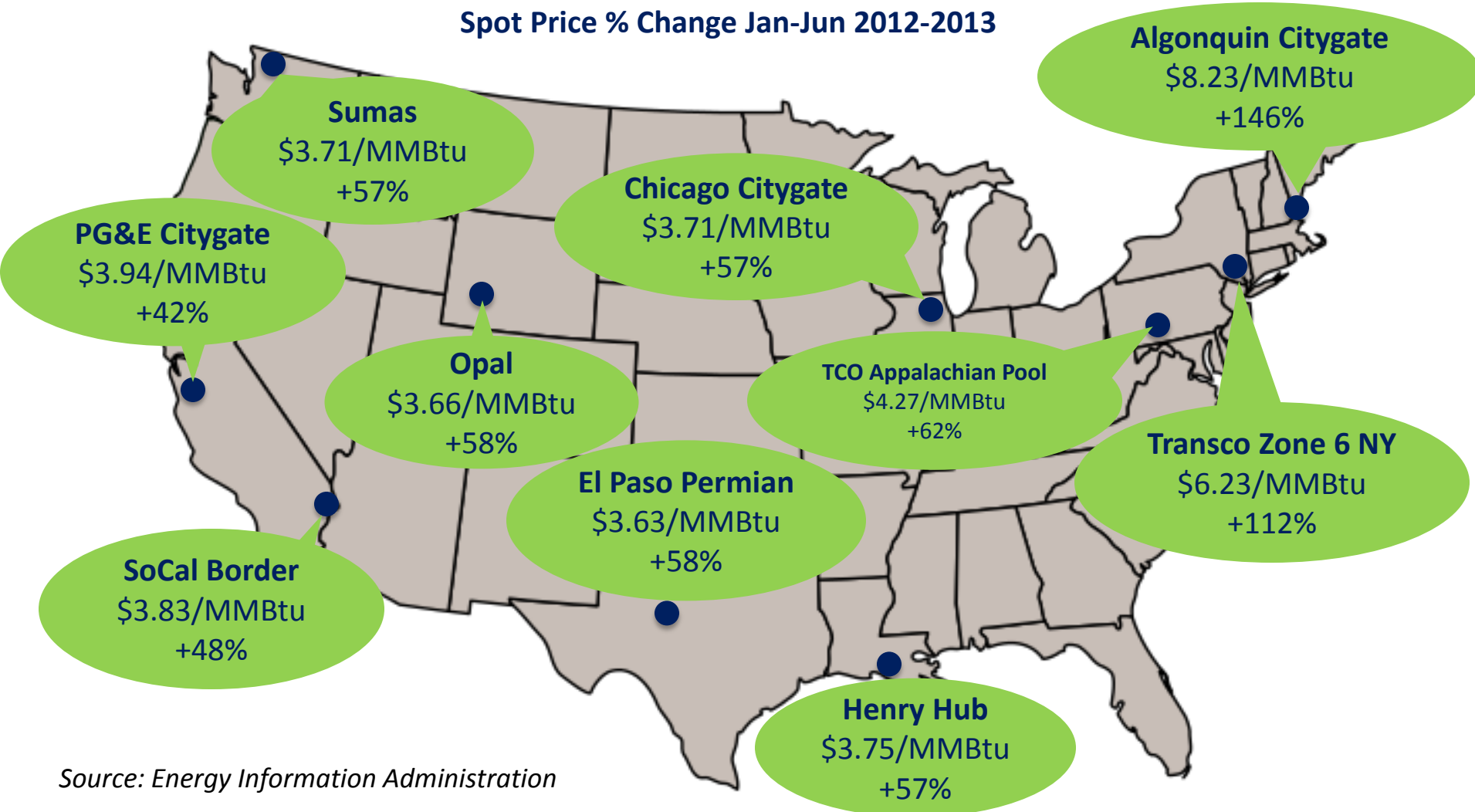
Gas Combined Cycle	Gas Combustion Turbine	Coal	Nuclear
34,413	15,485	2,333	7,151

  
49,898

Source: Ventyx Velocity Suite

# Natural Gas Price Increases

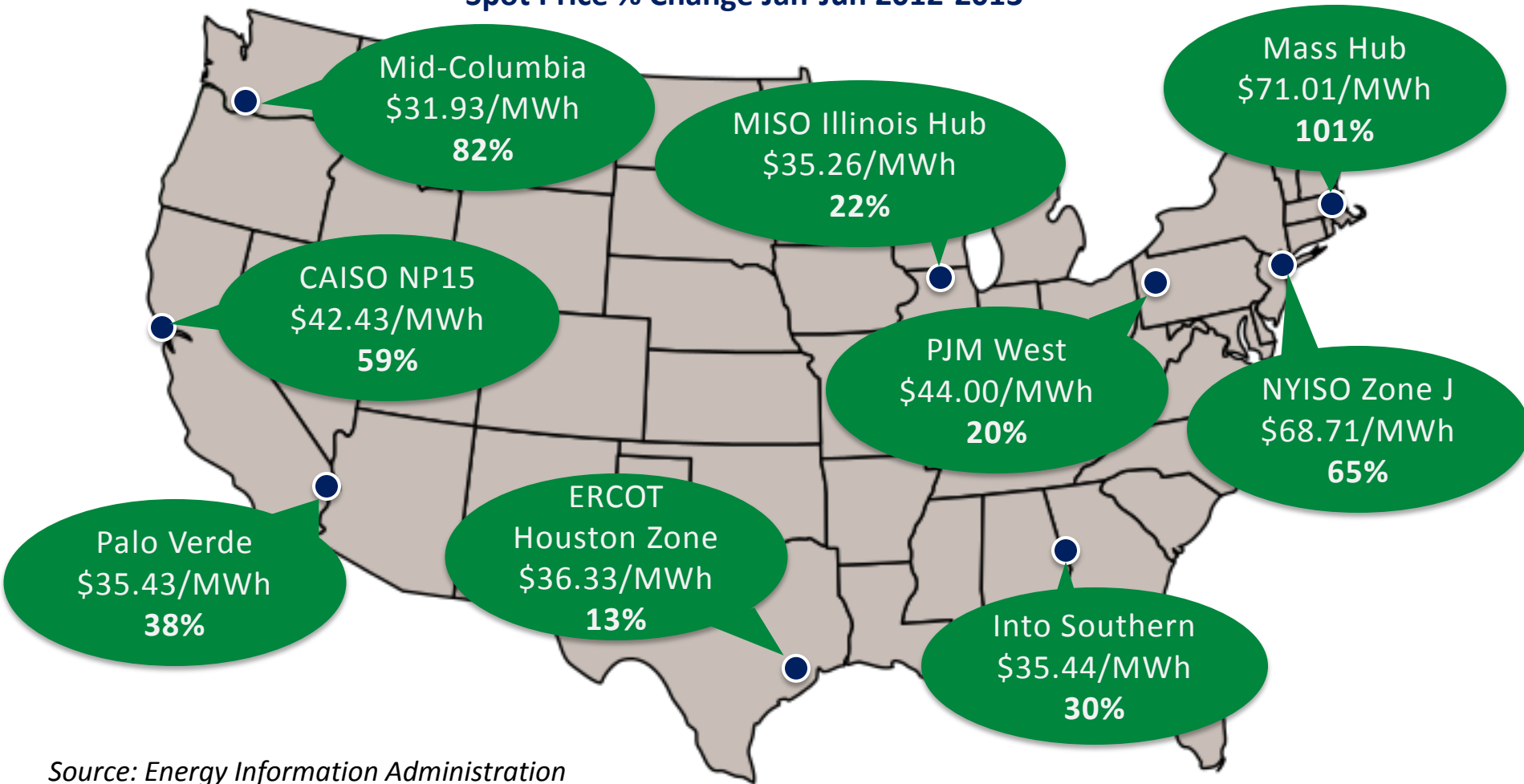
Spot Price % Change Jan-Jun 2012-2013



Source: Energy Information Administration

# Average Wholesale (Spot) Electricity Prices

Spot Price % Change Jan-Jun 2012-2013



Source: Energy Information Administration

# Natural Gas Price Volatility Will Continue

## Northeast Natural Gas, Electricity Prices

*(Gas in \$/MMBtu, Electricity in \$/MWh)*

Day-Ahead Spot Gas Price	1.22.2013*	1.23.2013	1.24.2013	1.25.2013
New England	\$12.34	\$21.25	\$29.94	\$34.25
New York City	\$16.03	\$20.75	\$33.96	\$36.00

Day-Ahead On Peak Electricity Price	1.22.2013	1.23.2013	1.24.2013	1.25.2013
New England	\$143.37	\$200.74	\$226.84	\$260.51
New York City	\$146.80	\$173.10	\$224.96	\$253.36

Price for 4-day weekend (Sat.-Tues.)

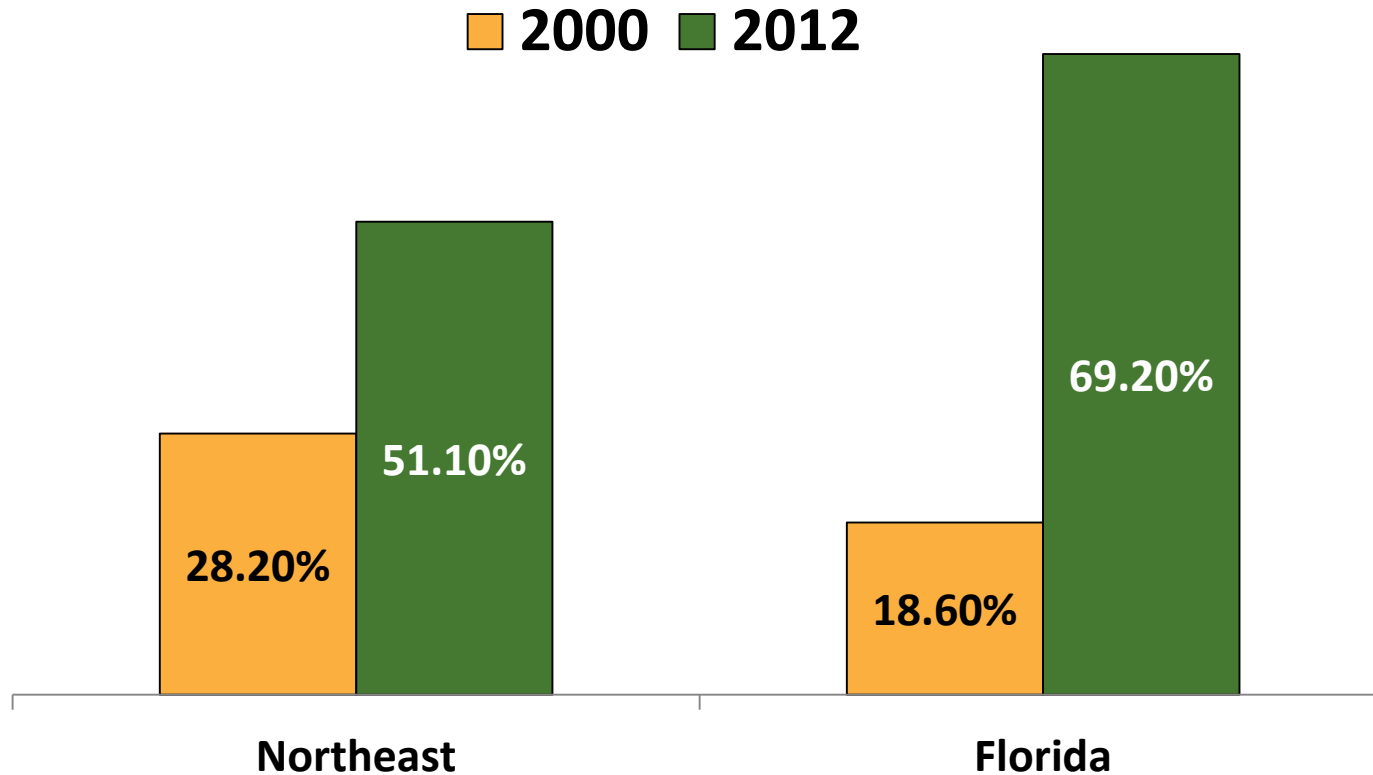
Source: Energy Information Administration

**“Serious operational challenges facing New England’s power system ... natural gas has become the predominant fuel used to produce electricity in New England ... The status quo is not sustainable.”**

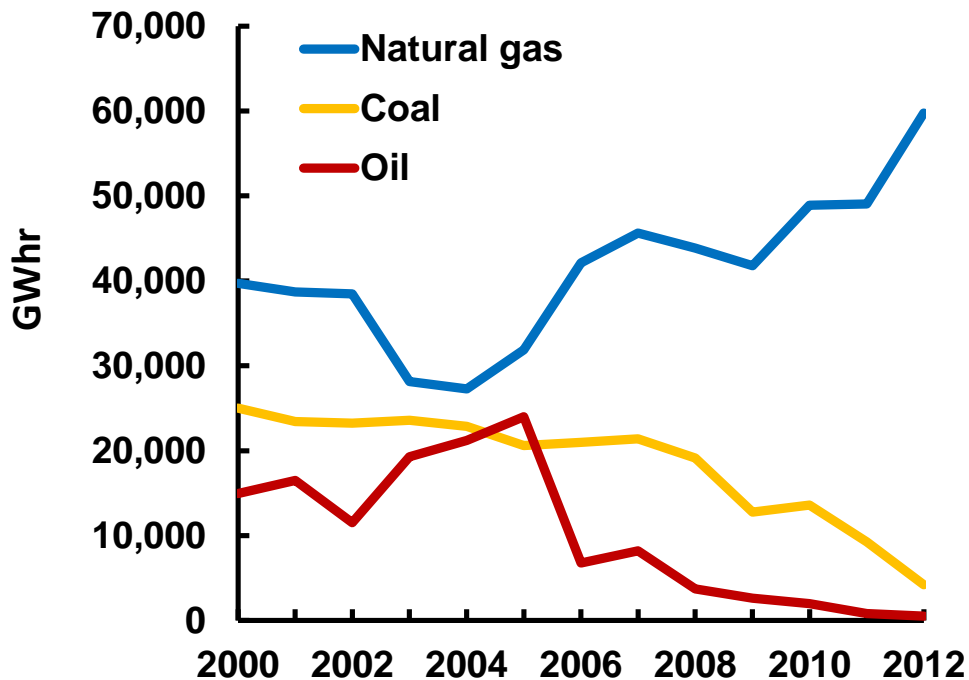
*– Gordon Van Welie, CEO, New England ISO, March 19, 2013, in testimony to House Energy and Commerce Committee*



# Warning Signs: Dramatic Increase in Dependence on Natural Gas



# Declining Fuel Diversity in New York



- Gas-fired generation increased from 29% of New York's electricity supply in 2000 to 44% by 2012
- Coal declined from 18% to 3%.
- Oil-fired generation dropped to less than 1% of generation, down from 11% in 2000.

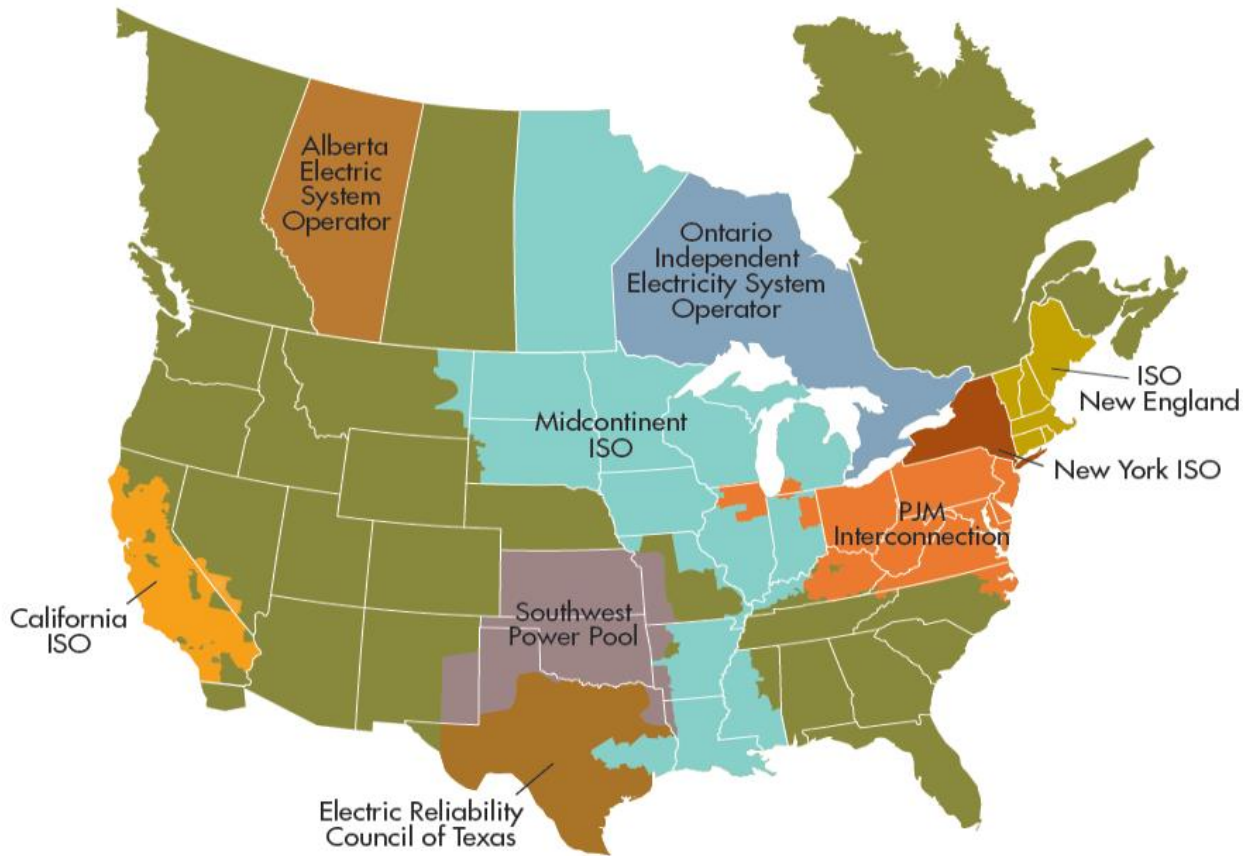
In 2012, New York's six nuclear power plants represented 13% of installed generating capacity, but 31% of the kilowatt-hours produced.

# Increasing Pressure on Natural Gas

- Current U.S. natural gas demand ~ 67 Bcf/day
- 20-30% increase by 2020

Sector	Demand Increase by 2020
Electric Power	4.0 – 4.5 Bcf/day
Industrial	3.3 – 8.0 Bcf/day
LNG Exports	6.0 – 8.0 Bcf/day
<b>Total</b>	<b>13.3 – 20.5 Bcf/day</b>

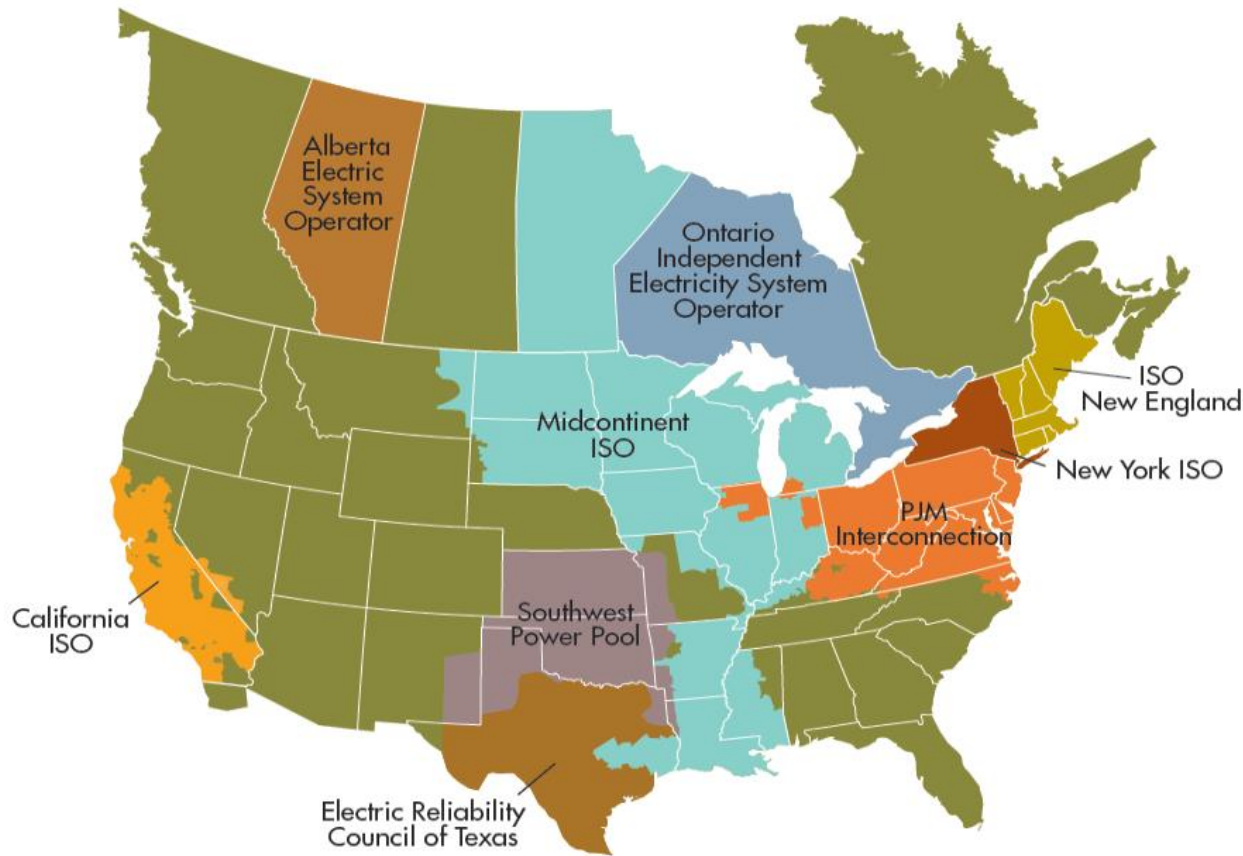
# Inadequate Price Signals



**“It is unlikely that significant generation investment will occur until capacity clearing prices increase significantly.”**

– 2012 *State of the Market Report*,  
Potomac Economics

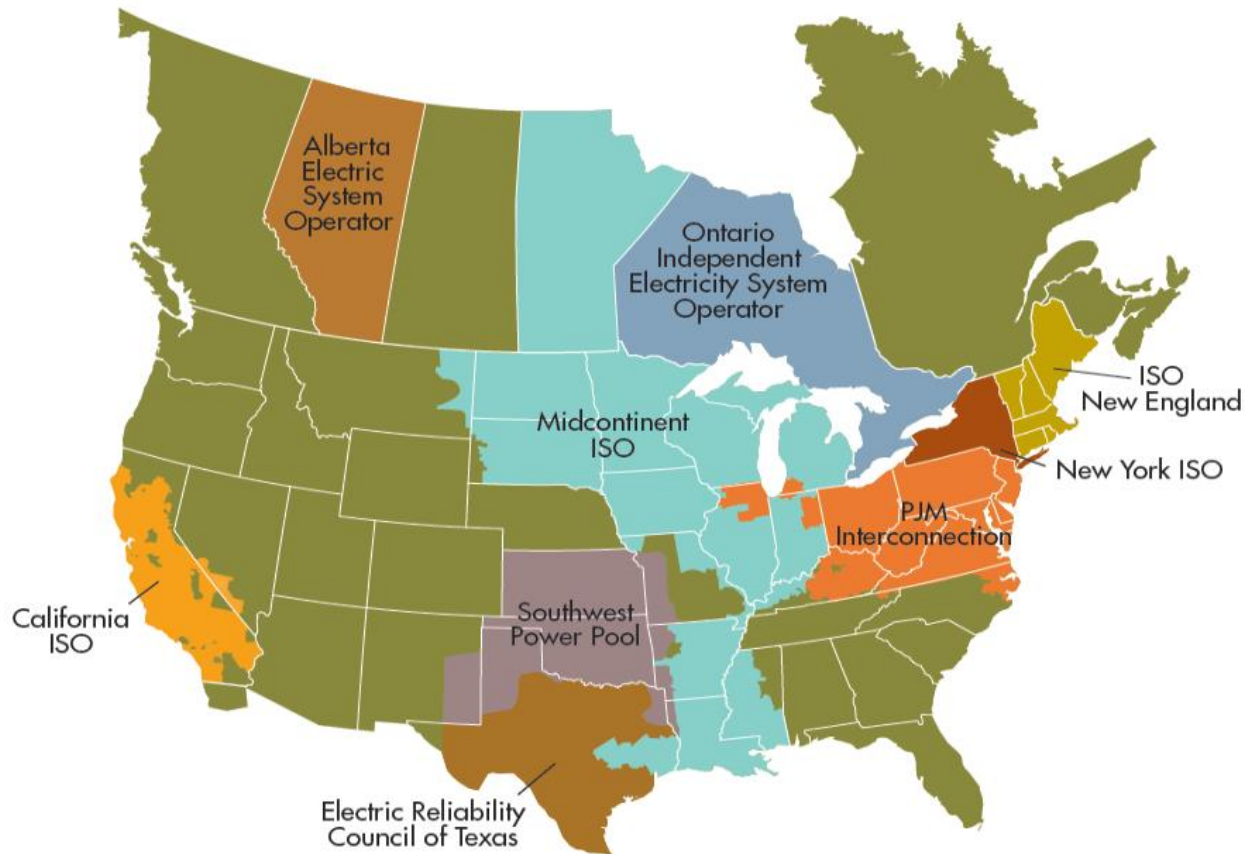
# Inadequate Price Signals



**“MISO’s economic signals would not support private investment in new resources ... MISO markets will not facilitate efficient investment and retirement decisions that will sustain an adequate resource base.”**

*– 2012 State of the Market Report, Potomac Economics*

# Inadequate Price Signals

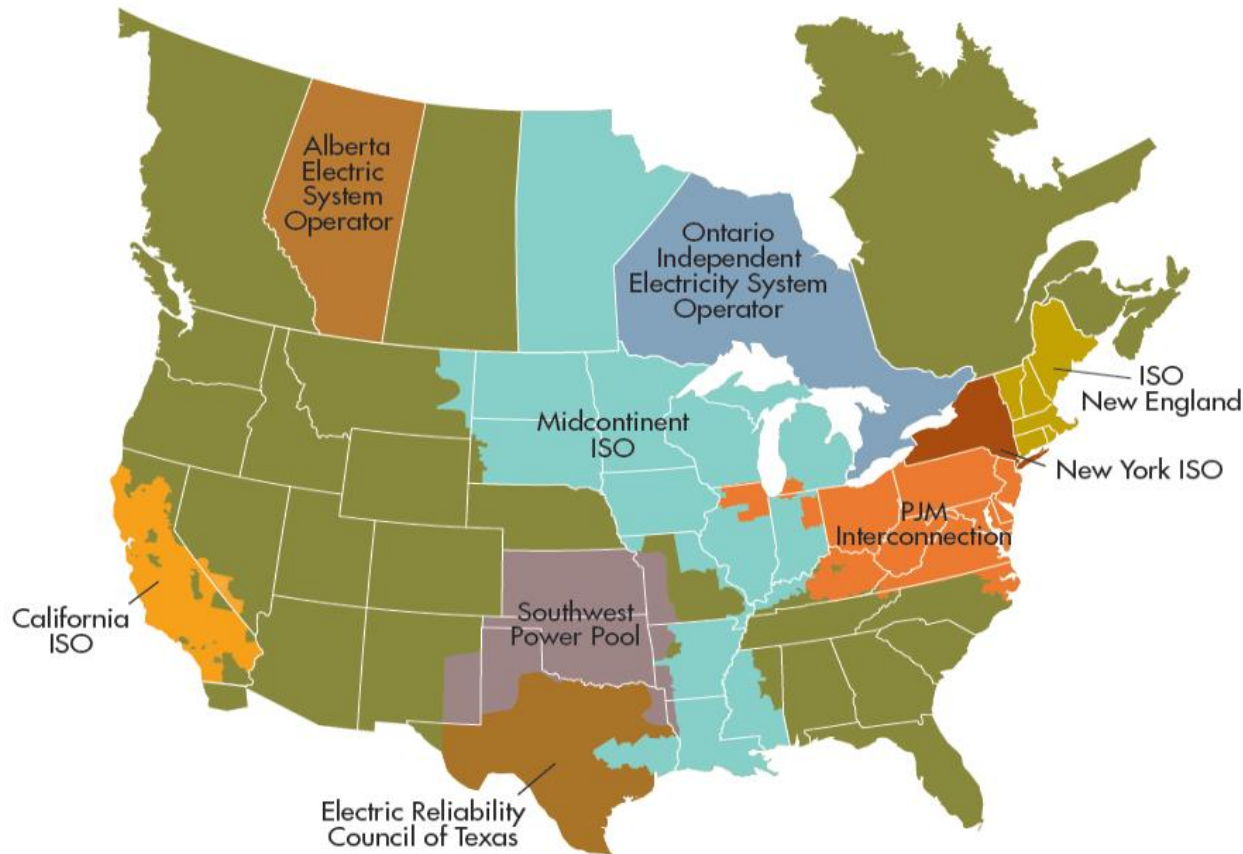


**“The ERCOT markets would not have provided sufficient revenues to support profitable investment in any of the types of generation technology evaluated.”**

*– 2012 State of the Market Report, Potomac Economics*



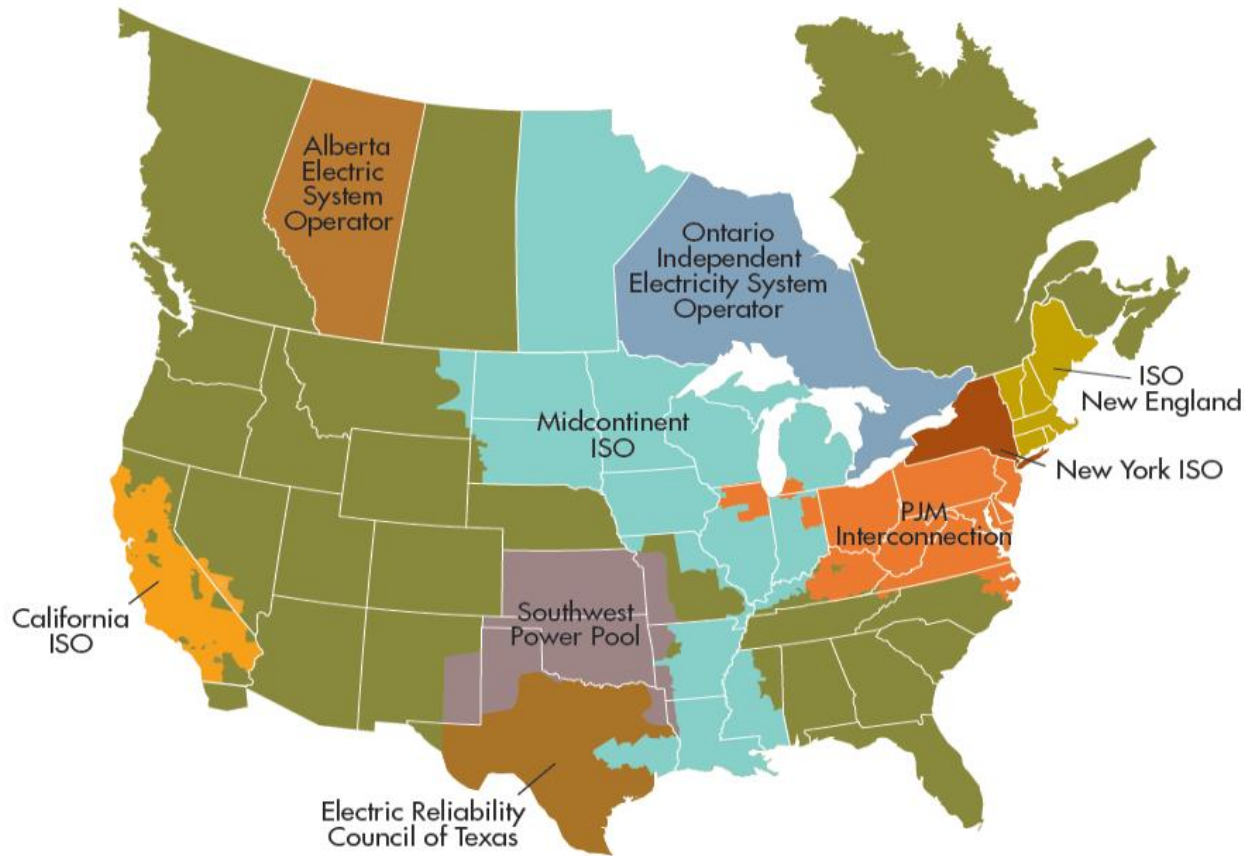
# Inadequate Price Signals



**“Capacity resources in ERCOT have drifted to a level below the Planning Reserve Margin target and are projected to further diminish .... [R]eport to NERC ERCOT’s plan to address the declining reserve margin and projected capacity shortfall.”**

– *Gerry Cauley  
President and CEO  
North American Electric  
Reliability Corp.*

# Inadequate Price Signals

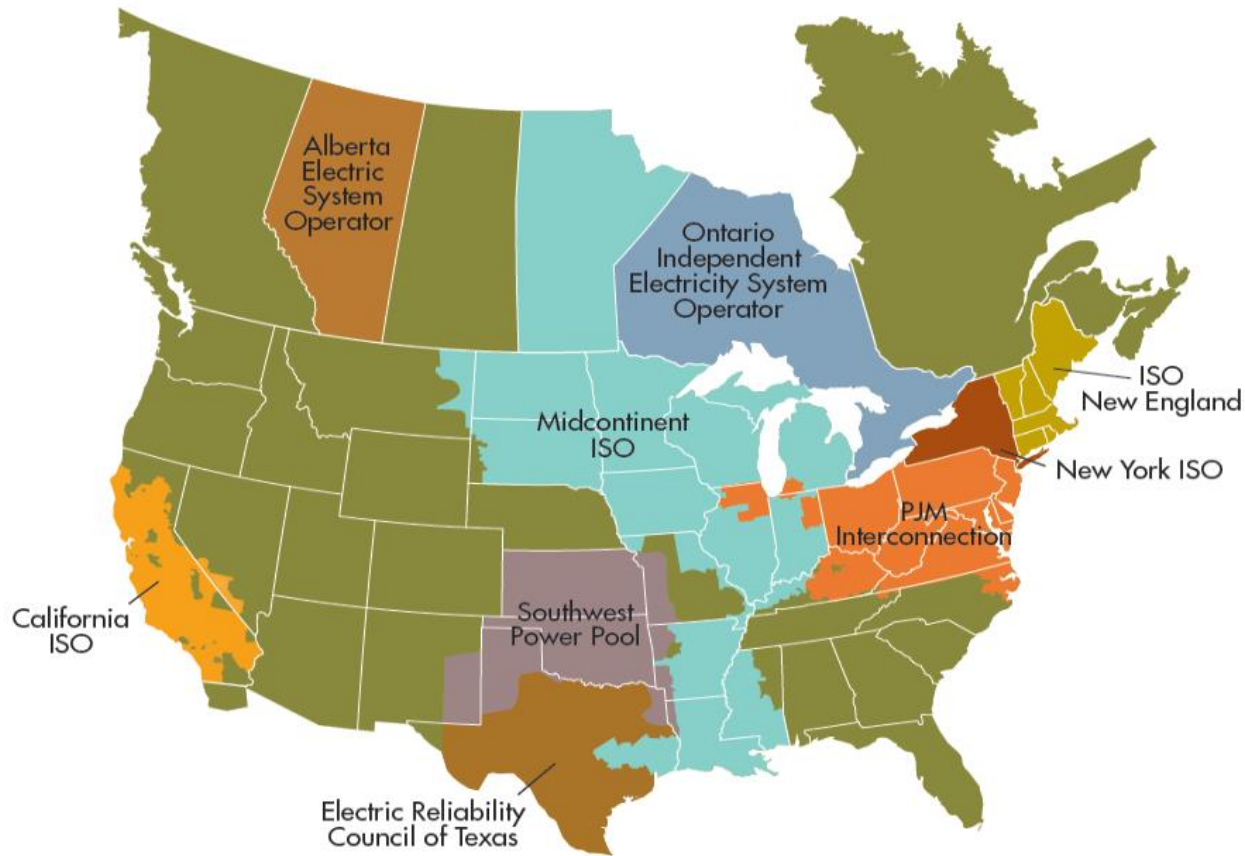


**“There is no long-term pricing structure for anyone to go out and build and construct and finance new capacity.”**

*– Nicholas Akins  
President and  
CEO American  
Electric Power*



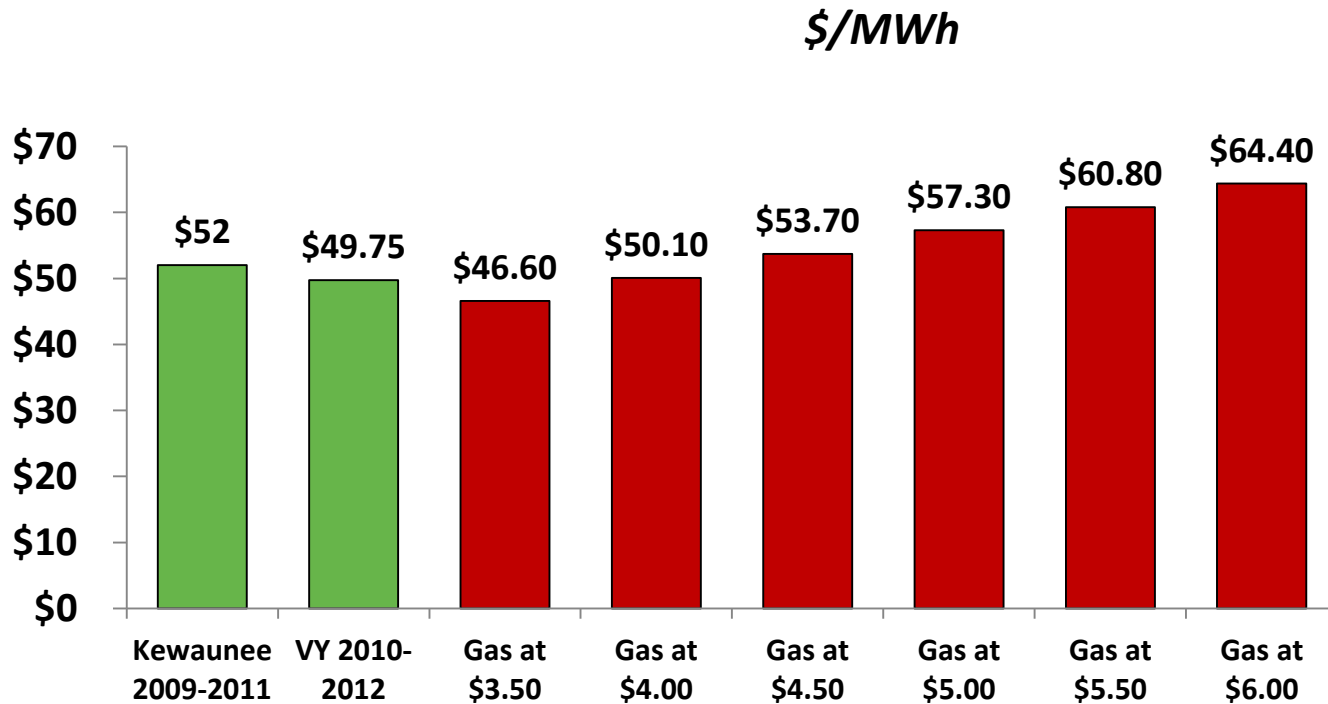
# Inadequate Price Signals



**“There are significant and fundamental flaws in the process. These flaws will not only impede investments in competitive generation resources and the development of a robust competitive market but will also, ultimately, impact reliability.”**

*– Anthony Alexander  
President and CEO  
FirstEnergy*

# Efficient Markets Do Not Make Inefficient Economic Decisions



- Kewaunee 2009-2011 capacity factor = ~ 95%
- Vermont Yankee 2010-2012 capacity factor = ~ 90%
- Nothing wrong with the plants; something wrong with the markets

Sources: Kewaunee, VY 3-year average total generating cost: Electric Utility Cost Group. Gas-fired combined cycle plant costs from NEI financial model: Debt at 5.0%, 15% return on equity, debt/equity structure of 50/50. Capital, O&M and fuel cost assumptions for natural gas are from the Energy Information Administration's *Annual Energy Outlook 2013*.

# We've Been Through This Before ...

Reactor Name	Type	MW	Operating License Issued	Shutdown
Millstone 1	BWR	670	10/31/1986	Jul-98
Big Rock Point	BWR	80	5/1/1964	Aug-97
Zion 1	PWR	1,083	10/19/1973	Feb-97
Maine Yankee	PWR	900	6/29/1973	Dec-96
Haddam Neck	PWR	608	12/27/1974	Dec-96
Zion 2	PWR	1,083	11/14/1973	Sep-96
San Onofre 1	PWR	449	3/27/1967	Nov-92
Trojan	PWR	1,137	11/21/1975	Nov-92
Yankee Rowe	PWR	200	12/24/1963	Oct-91
Rancho Seco	PWR	924	8/16/1974	Jun-89

# We've Been Declared Dead Before ...

The 1997 *Annual Energy Outlook* reference case assumes that ... 50 units (38 percent of current nuclear capacity) will retire between 1995 and 2015 ... AEO97 assumes that individual reactor performance improves for the first 20 or 25 years of operation, after which it declines as units age. As a result, the national average capacity factor stays near the current level of 77 percent, with a slight decline from 2007 through 2012 due to reactor aging.”

- U.S. Energy Information Administration,  
*1997 Annual Energy Outlook*

# Electric Industry Campaign: Goals

- Create greater political, policy-maker awareness:
  - value of fuel and technology diversity
  - existing fuel and technology diversity seriously at risk
- Ensure that policy-makers, political leaders, financial community and others
  - understand the strategic value of nuclear plants as part of diverse portfolio
  - have appropriate context and perspective on the shutdown of U.S. nuclear plants, recent and potential
- Ensure that recent shutdowns do not compromise
  - confidence in nuclear energy as part of the electric supply portfolio
  - industry's ability to pursue other policy priorities (e.g., used fuel, SMR development, trade/export agenda)

# Major Elements of Campaign

- Facilitate broad-based industry campaign (EEI, APPA, NRECA, other industries)
- Develop analysis to demonstrate value of diverse fuel/technology portfolio
- Shape supportive efforts by think tanks, policy organizations
- Outreach to:
  - Federal and state officials and Executive Branch
  - Financial community
  - Media
  - Policy organizations, other allies

# Long-Term Fundamentals Still Strong

- Electricity demand will grow as the economy recovers
  - EIA forecast: 0.7% per year = 339,000 MW by 2040
- ~110 GW of fossil capacity retired 2011-2020, most by 2016
  - ~ 20% of coal-fired fleet shut down by 2020 (without carbon)
- Natural gas price volatility will continue
- Value of diverse fuel and technology portfolio will become clear

**“We should be having policy discussions now about how we intend to replace 100 gigawatts of nuclear capacity that will be retired by about 2040. One hundred gigawatts can power 25 million typical households. Can we realistically expect natural gas and renewables to fill that void? As a practical matter, the answer is no. And the generation of electricity is about as practical as it gets.”**

*– Thomas Farrell  
President and CEO  
Dominion Resources*

# Nuclear Energy: A Solid Value Proposition

