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Making Sense of U.S. Energy Markets

Task Force on Energy Supply

National Conference of State Legislators

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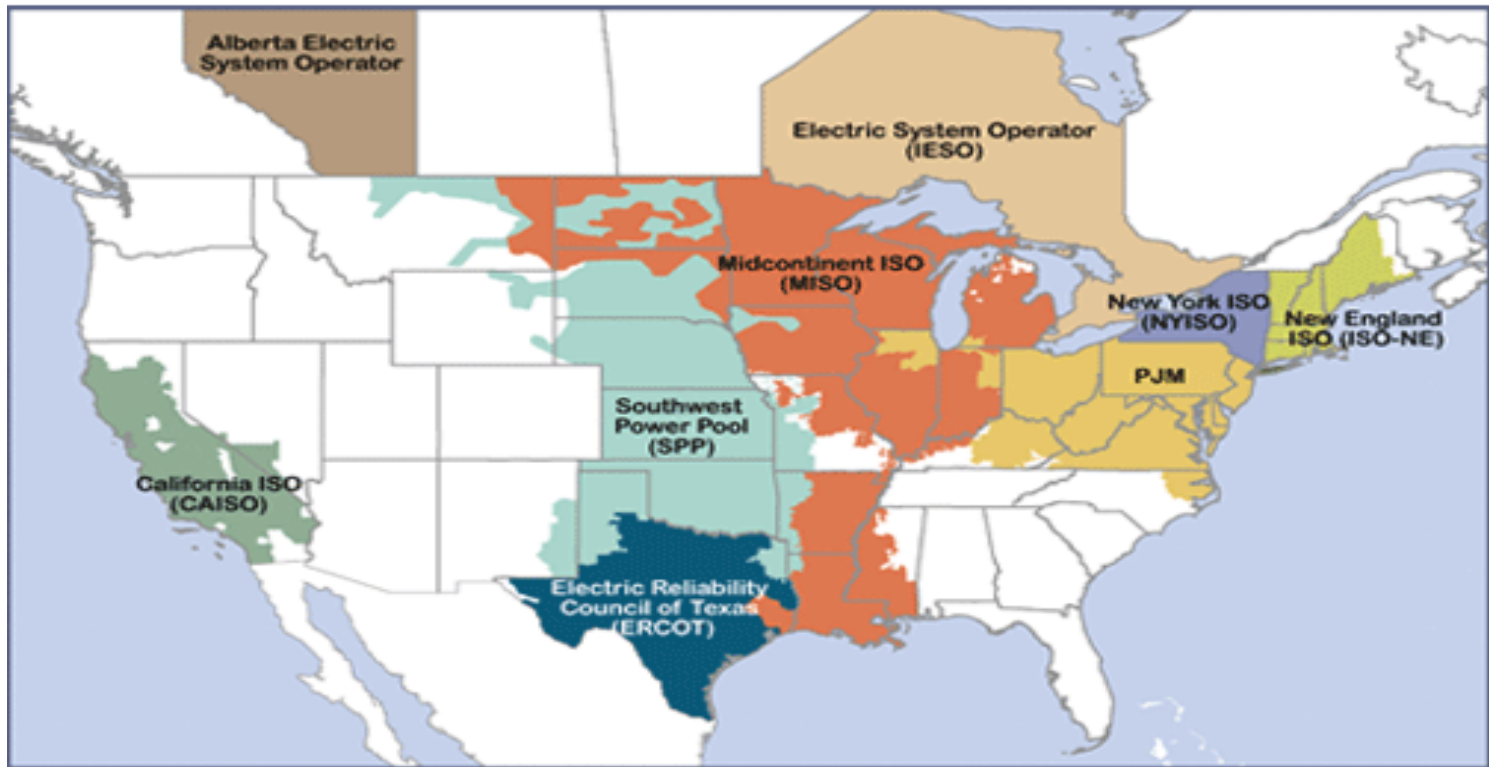


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Wholesale Markets

RTO/ISO Markets

RTO/ISO Markets



Market Issues

- Market Structure - Energy Price Formation
- How to incorporate state public policy goals into the wholesale markets
- Role of storage and behind the meter resources in the markets
- Will new essential reliability services be needed to accommodate changing generation mix

Keys to Realizing Market Structure Objectives

- **Accurate Energy Price Formation**
- **Fair and Competitive Capacity Market Design**
- **Compensating Valuable Resource Attributes**



Reliability

- Sufficient capacity the system can rely on
- Fuel diversity

Economic Sustainability

- Low cost/efficient system
- Reasonable return/sustained investments

Environmental Sustainability

- Achieve carbon targets
- Reduce other pollutants

Wholesale Markets vs. Public Policy

Current market structure is not achieving all outcomes desired by policymakers:

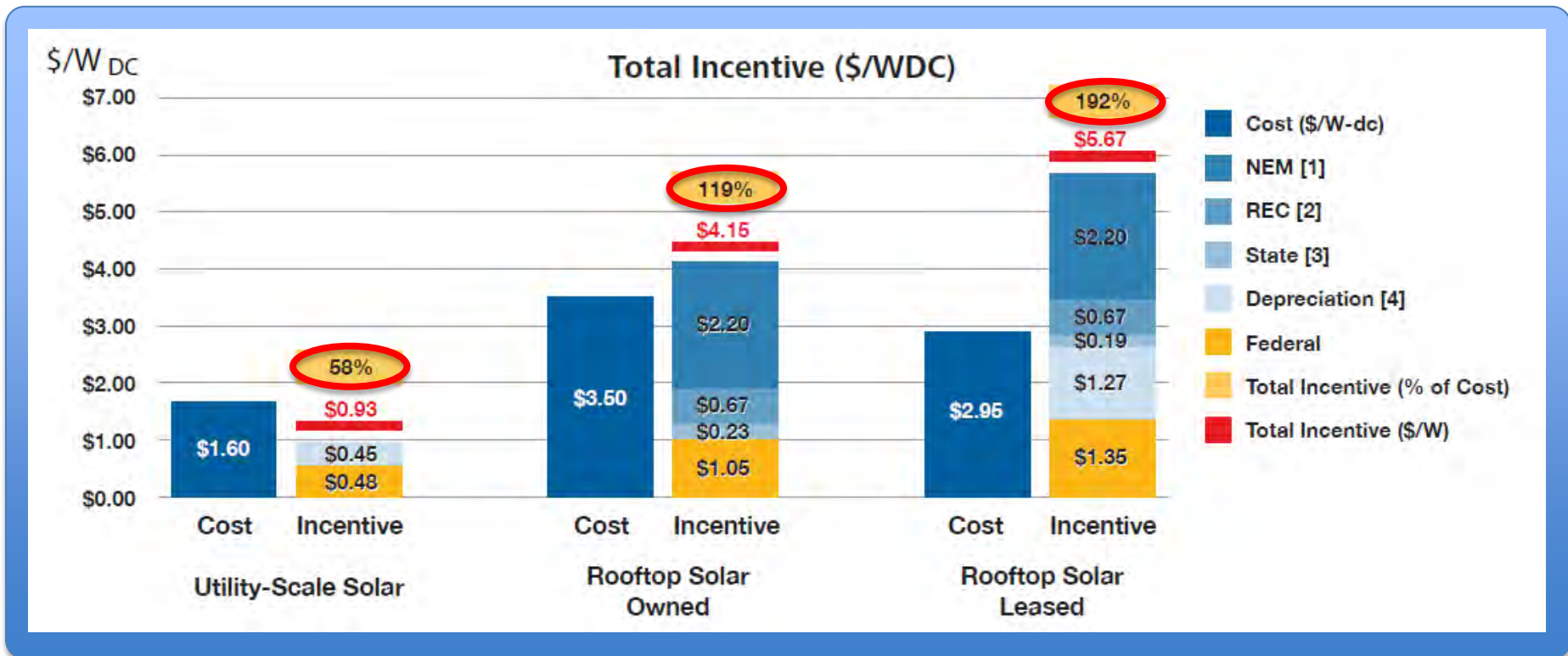
- Over-reliance on gas
- Lack of merchant investment
- Loss of nuclear units
- No recognition of environmental stewardship objectives

Some states seeking outcomes via Out of Market Measures

- New York
- New England
- Ohio

Solar Subsidies – National Perspective

A recent study highlights the subsidies available to various implementations of Solar PV

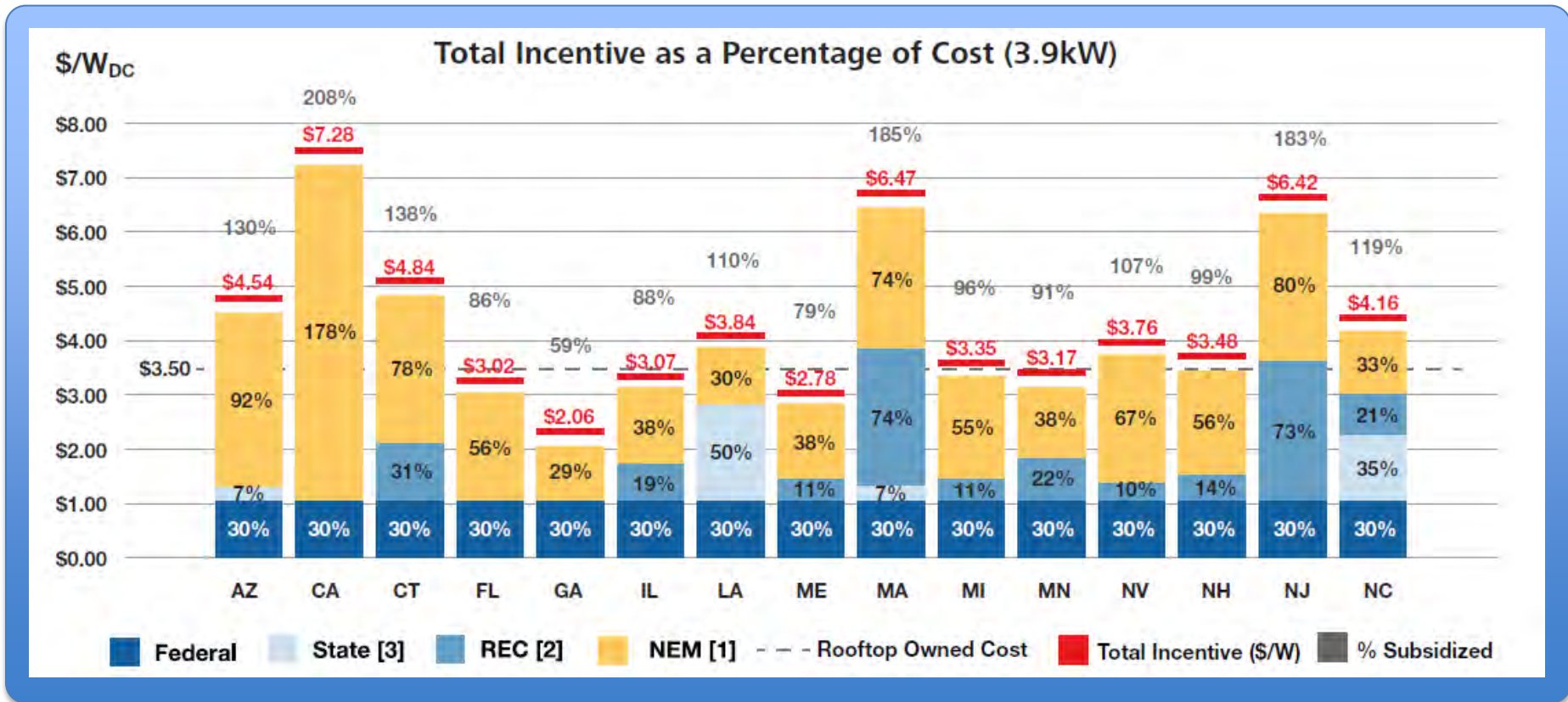


Note: Based on 3.9 kW-dc Customer-Owned and -Leased Solar PV Facilities and an Equivalent Amount of Utility-scale Solar PV Capacity.

Source: "Incentivizing Solar Energy: An In-Depth Analysis of U.S. Solar Incentives", Consumer Energy Alliance.

Residential Solar Subsidies in Select States

Residential solar receives subsidies in all states



1. NEM incentive is the difference between the present values of the customer's bill savings and the utility's avoided costs over the facility's life. For the Typical Lease, the incentive flows to the homeowner and is largely passed through to the Third-Party Owner as a lease or PPA payment.
2. Renewable Energy Certificates are incentives available through applicable programs.
3. Incentives mandated by state legislatures are upfront and/or performance-based compensation, often through the state tax code.

Source: "Incentivizing Solar Energy: An In-Depth Analysis of U.S. Solar Incentives", Consumer Energy Alliance.

The Value of Fuel Diversity: The January 2014 “Polar Vortex”

Fuel diversity helps to protect consumers from contingencies such as fuel unavailability and fuel price fluctuations

A variety of generation sources helped maintain reliability during the Polar Vortex

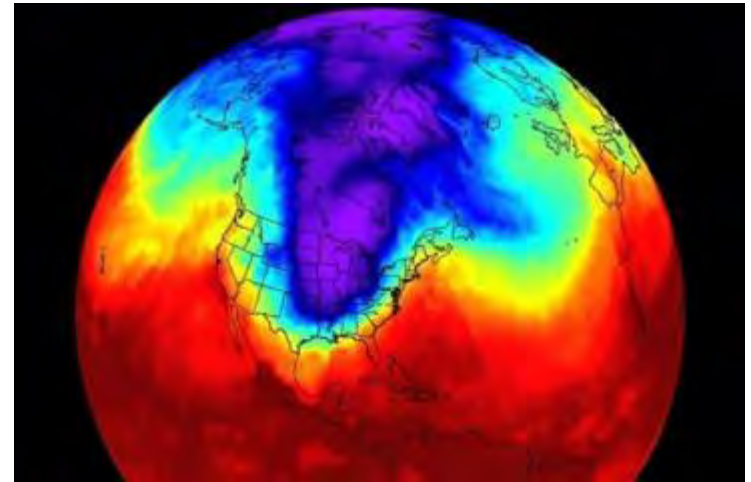


Image Source: NASA

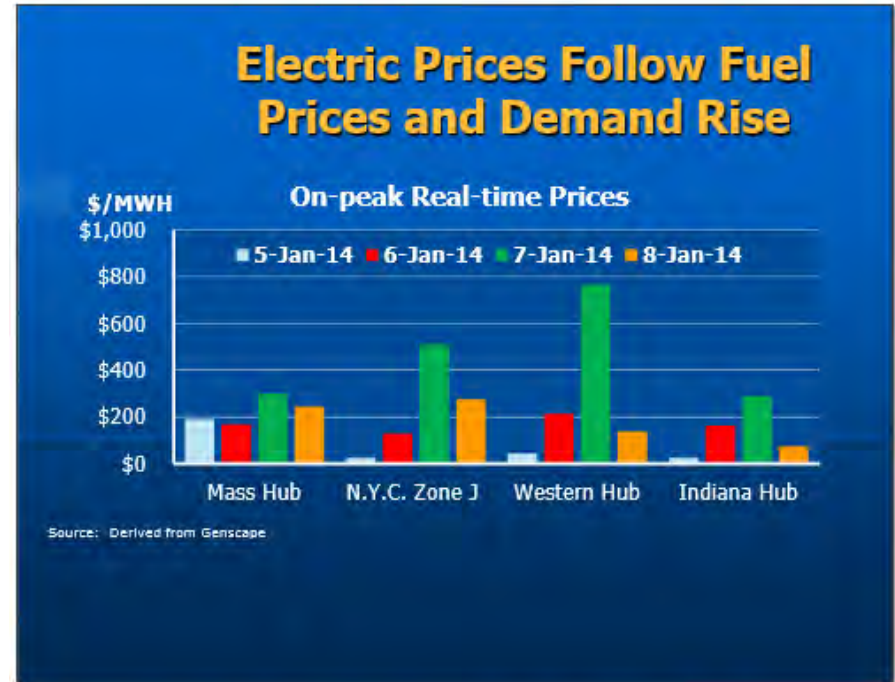
- Record storage withdrawals helped meet increased demand for **natural gas**.
- Dual-fueled generators were able to rely on **oil** during times of gas pipeline constraints.
- The **nuclear** fleet operated at 95% capacity at the height of the polar vortex. (NEI)
- **Coal** plants, many currently slated for retirement, were employed to help meet demand.
- Regional **wind** generation was strong, providing PJM with 3,500 MW while electricity prices averaged more than \$500/MWh. (AWEA)

Case Study: Price Impacts of The Polar Vortex

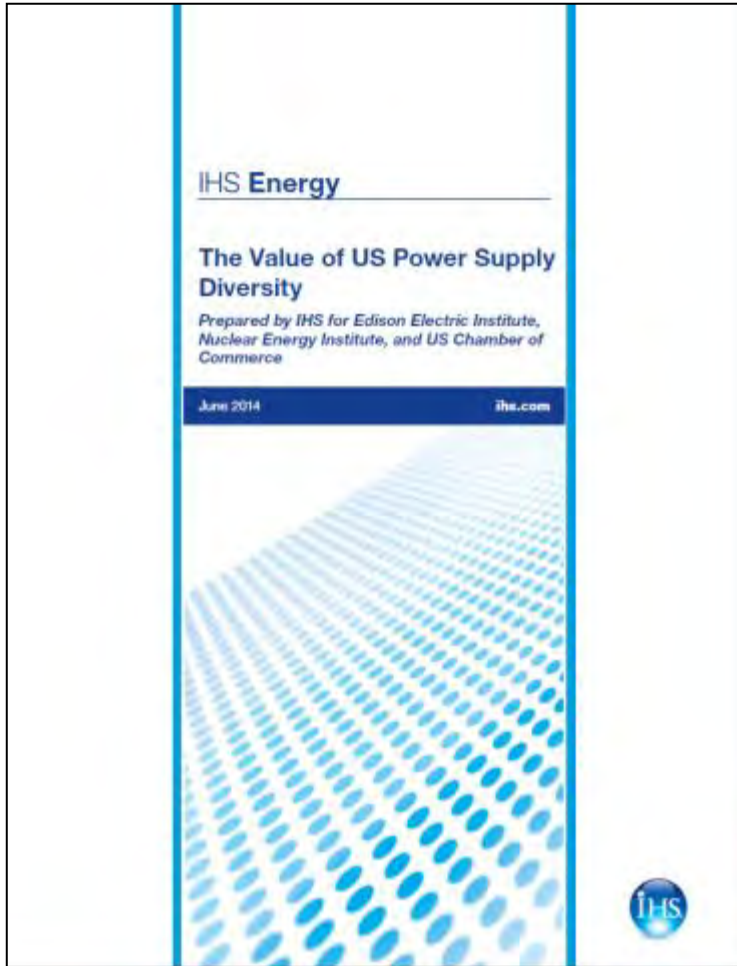
- Load exceeded forecasts by 7-9% in PJM and MISO.
- Increased demand and pipeline constraints led to a surge in natural gas prices to more than \$70/MMBtu in the Northeast and Mid-Atlantic.

➔ On-peak avg. real-time wholesale electricity prices reached \$765/MWh in PJM and \$510/MWh in the NY-ISO.

➔ Minimal wholesale electricity price impact in the central U.S., despite record natural gas demand, because of the region's diverse fuel portfolio.



The Value of U.S. Power Supply Diversity



The study examines the risks to a diversified electricity portfolio and finds:

*“[A] combination of factors—tightening **environmental** regulations, depressed **wholesale power prices**, and **unpopular opinions** of coal, oil, nuclear, and hydroelectric power plants—is currently moving the United States down a path toward a significant reduction in power supply diversity.”*

The study quantifies the impact of a reduced fuel and technology diversity profile in America’s electric sector, concluding:

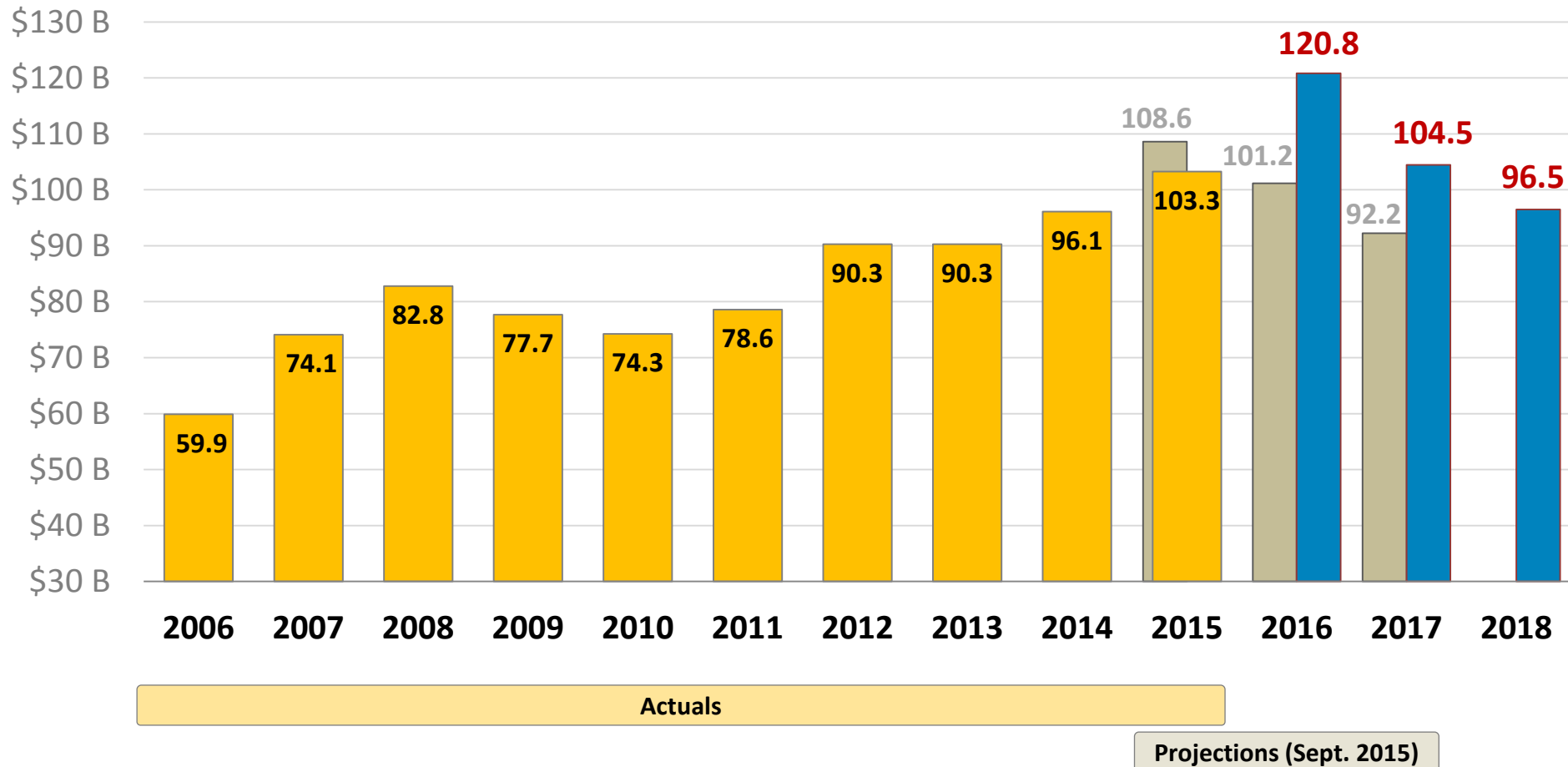
- Electricity supply in the reduced diversity case increases average wholesale power prices by about 75 percent and retail power prices by **25 percent**
- Electricity price impacts would reduce U.S. gross domestic product by nearly **\$200 billion**
- Price impacts would also lead to roughly **one million** fewer jobs
- The typical household’s annual disposable income would decline by about **\$2,100**



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State of the Industry

Industry Capital Expenditures

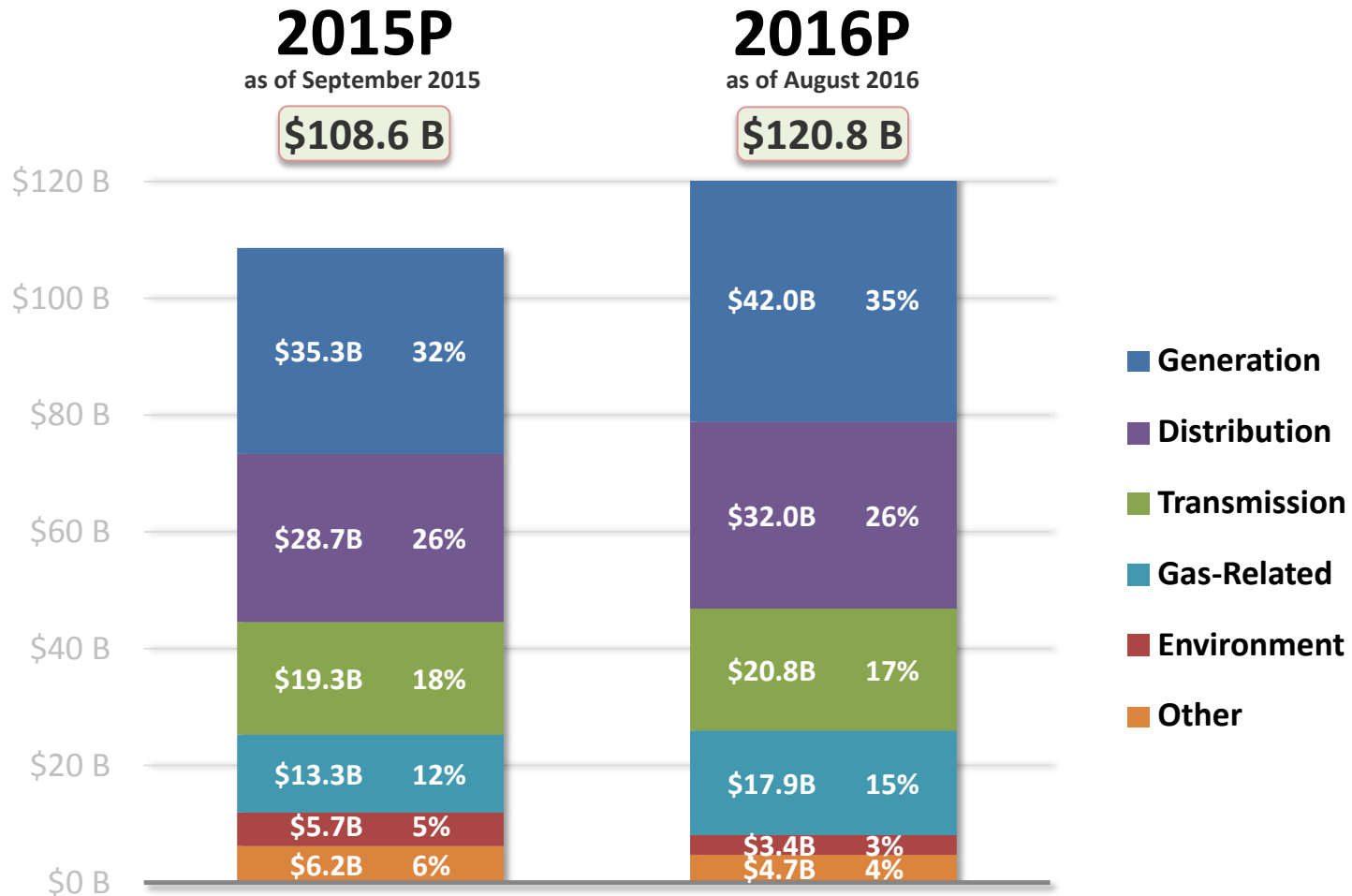


Notes: Total company spending of U.S. Investor-Owned Electric Utilities, consolidated at the parent or appropriate holding company. Projections based on publicly available information and extrapolated for companies reporting fewer than three projected years (11% and 15% of industry for 2017 and 2018).

Source: EEI Finance Department, company reports, S&P Global Market Intelligence (August 2016).

Projections (Aug. 2016)

Projected Functional CapEx

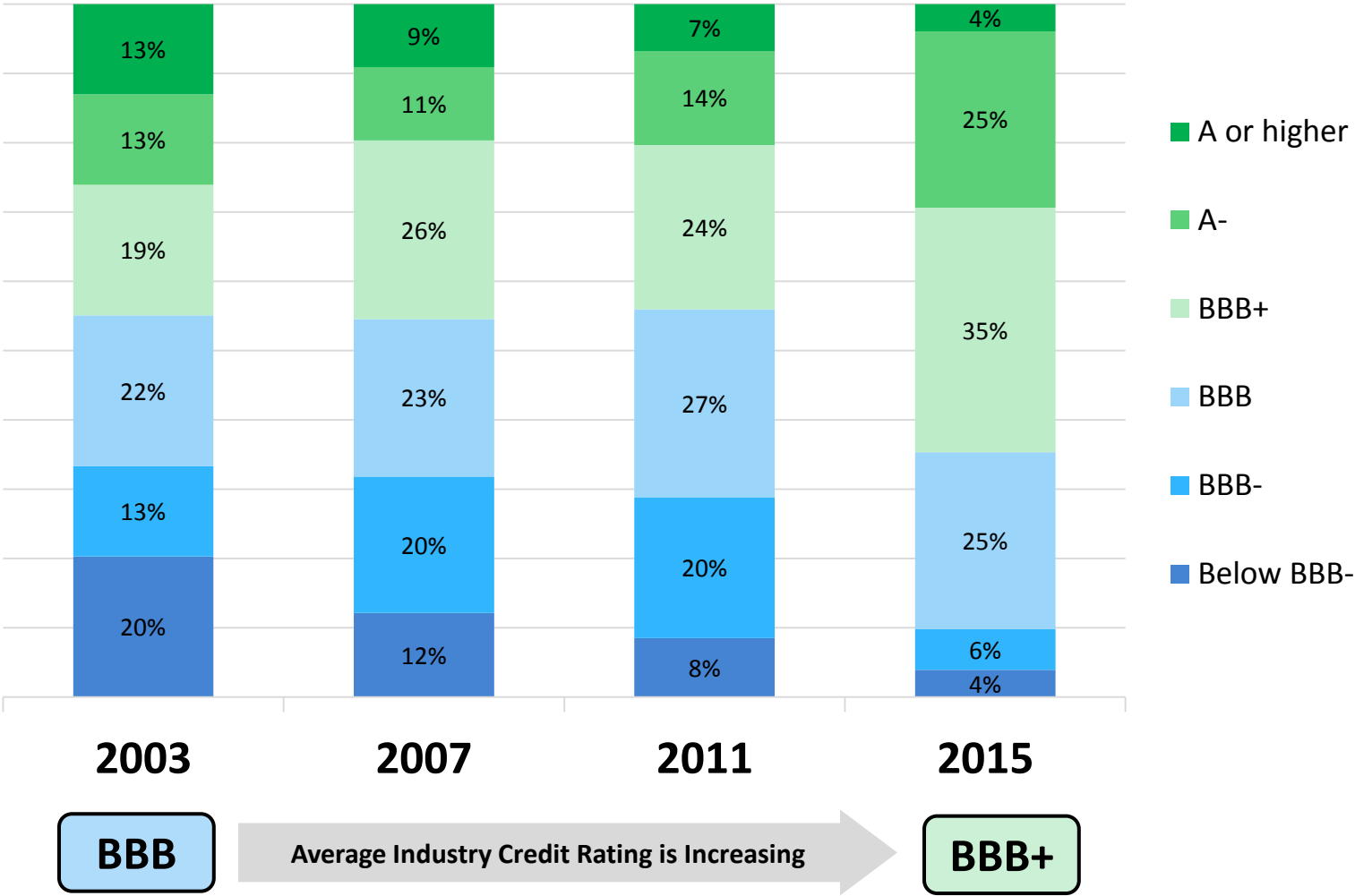


Notes: Total company functional spending of U.S. Investor-Owned Electric Utilities. 2015P total does not sum to 100% due to rounding. Projections based on publicly available information and extrapolated for companies not reporting functional detail (1.3% and 0.7% of the industry for 2015 and 2016, respectively).

Source: EEI Finance Department, company reports, S&P Global Market Intelligence (August 2016).

US Electric IOUs Rating History

2003 – 2015



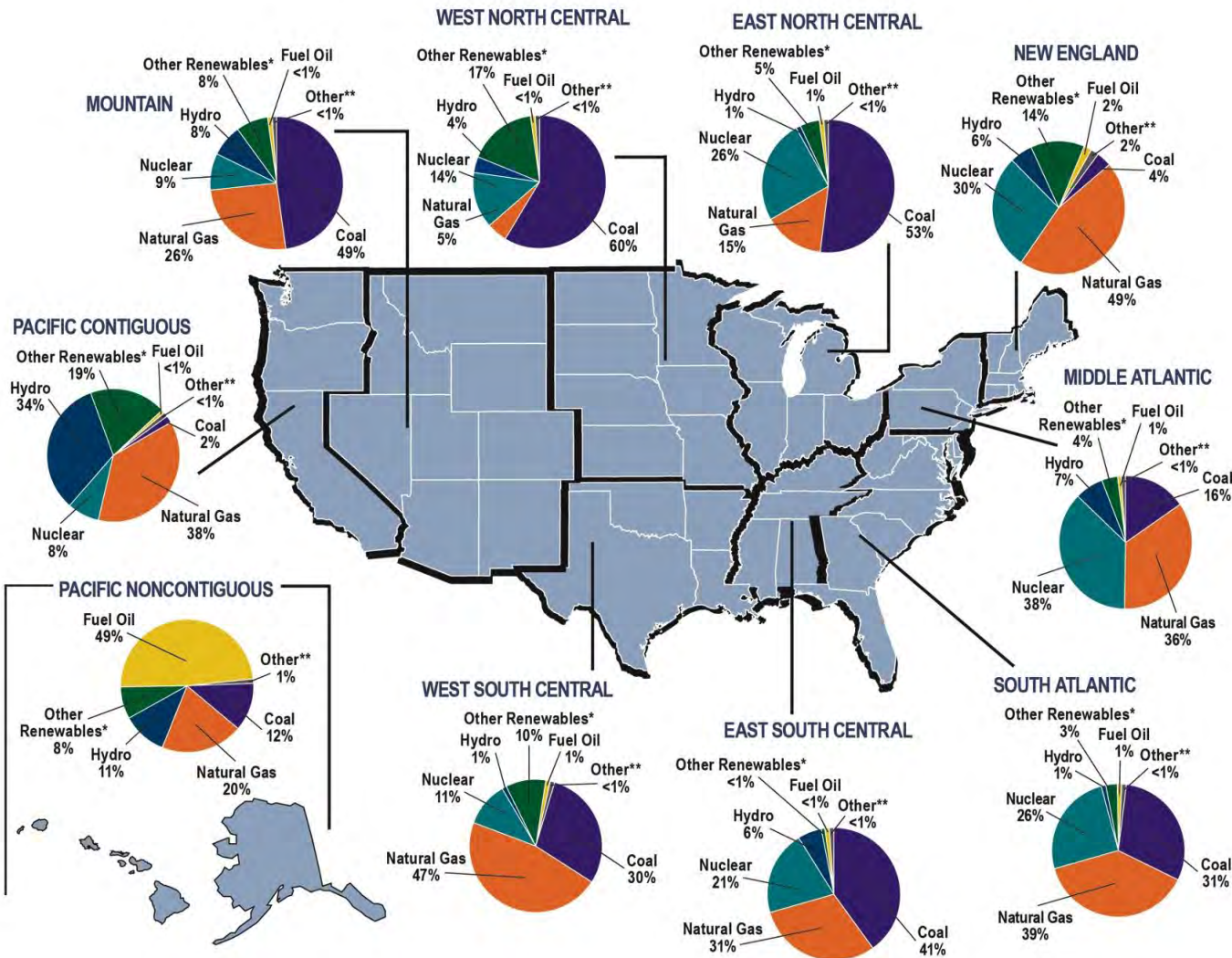
Source: EEI Finance Department.



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Fuels and Storage

Electric Companies Use a Diverse Mix of Fuels to Generate Electricity



*Includes generation by agricultural waste, landfill gas recovery, municipal solid waste, wood, geothermal, non-wood waste, wind, and solar.

** Includes generation by tires, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

Sum of components may not add to 100% due to independent rounding.

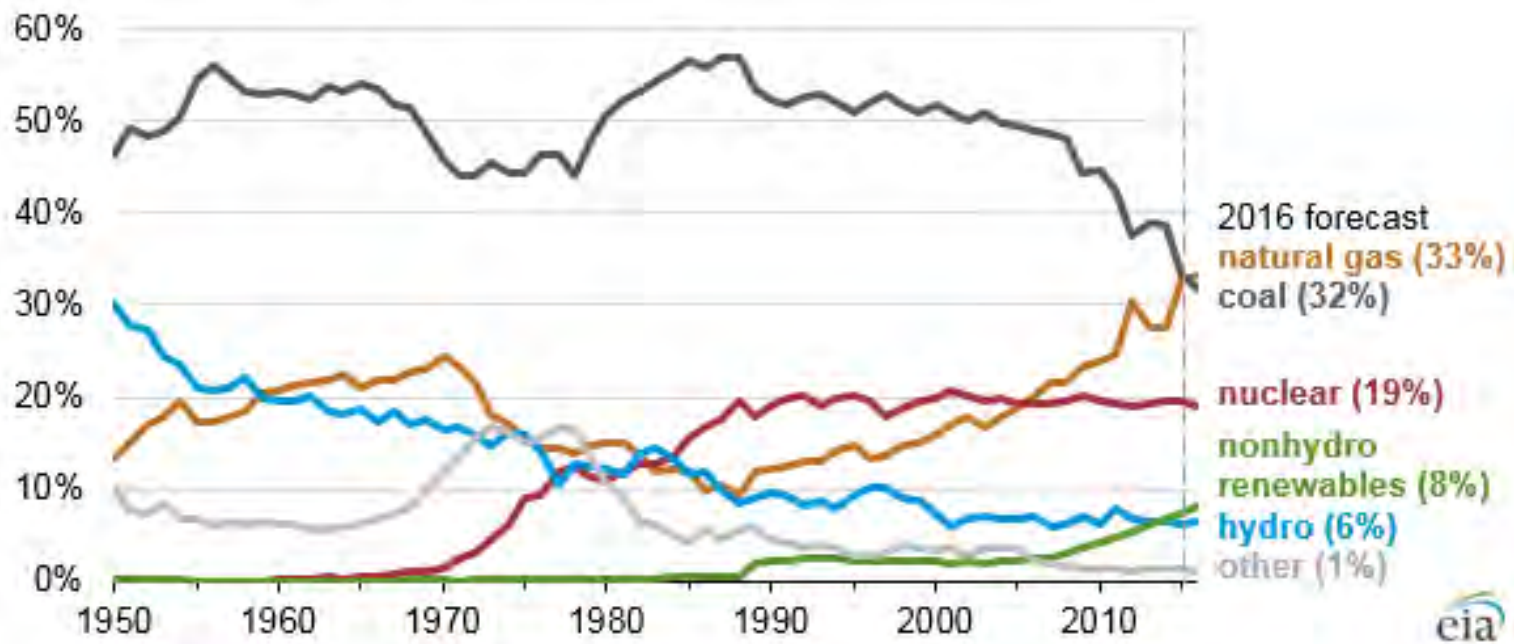
Source: U.S. Department of Energy, Energy Information Administration, Power Plant Operations Report (EIA-923); 2015 final generation data.

January 2017

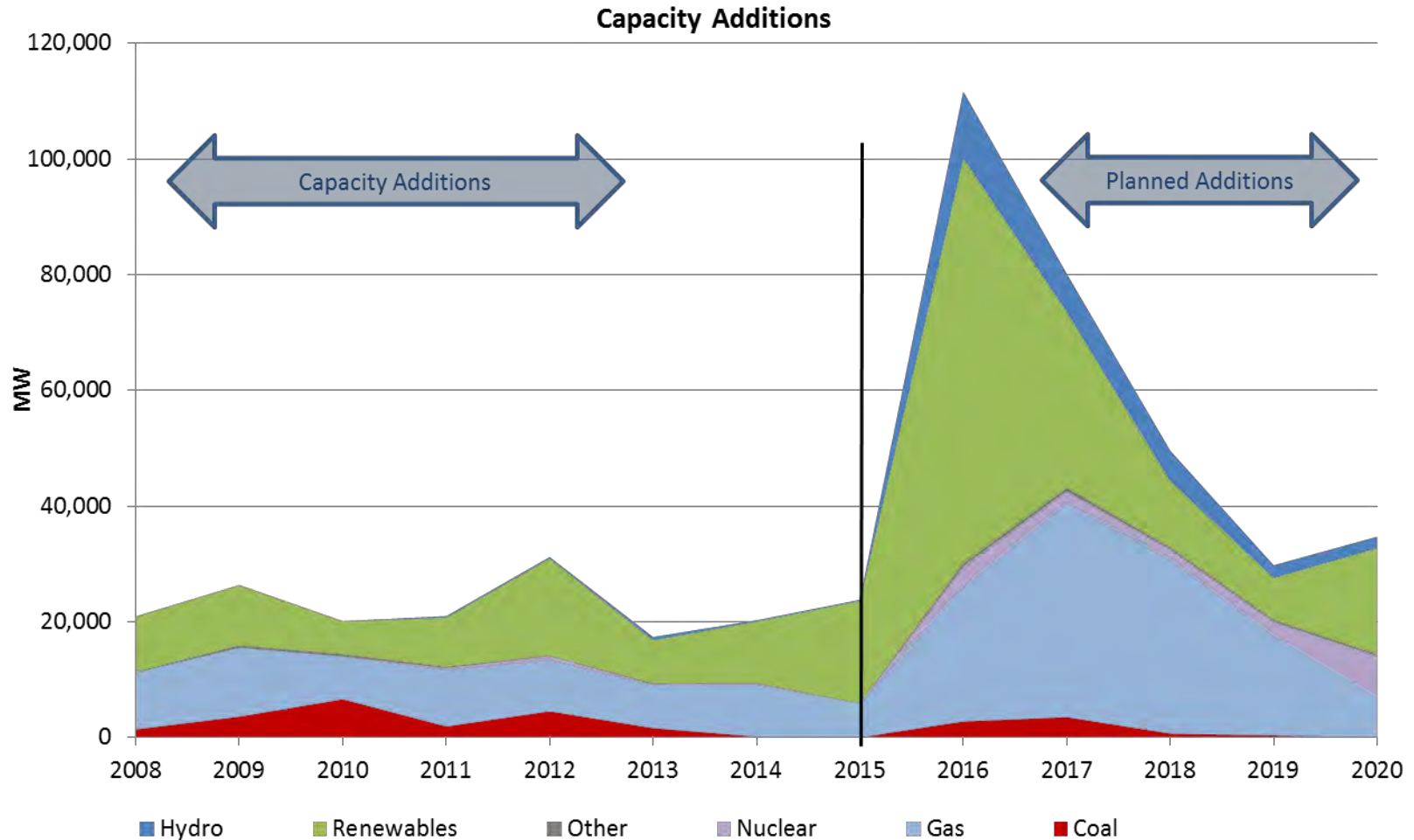
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Natural Gas Generation Surpassed Coal in 2016

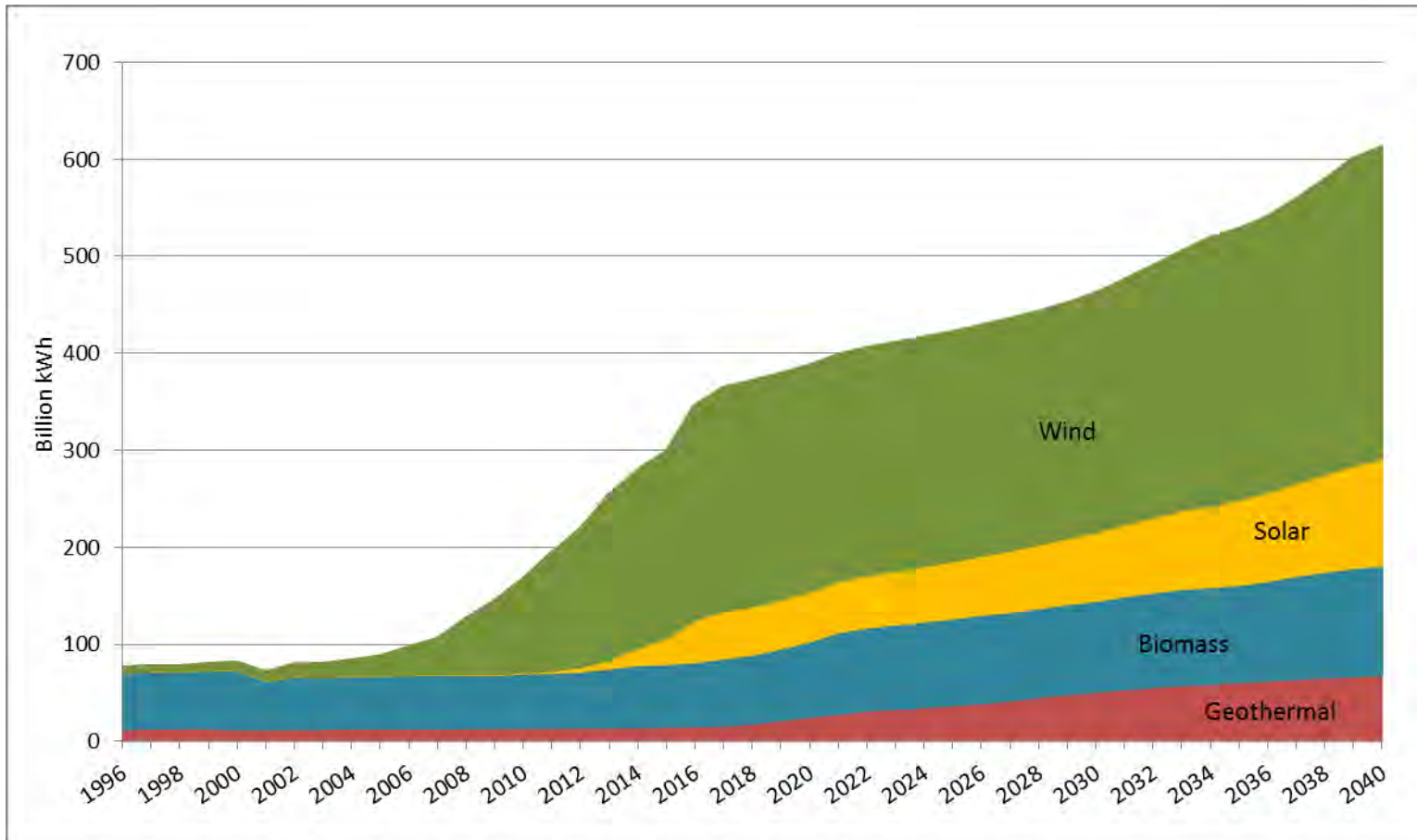
Annual Share of Total U.S. Electricity Generation by Source (1950-2016)



New Capacity: Gas & Renewables



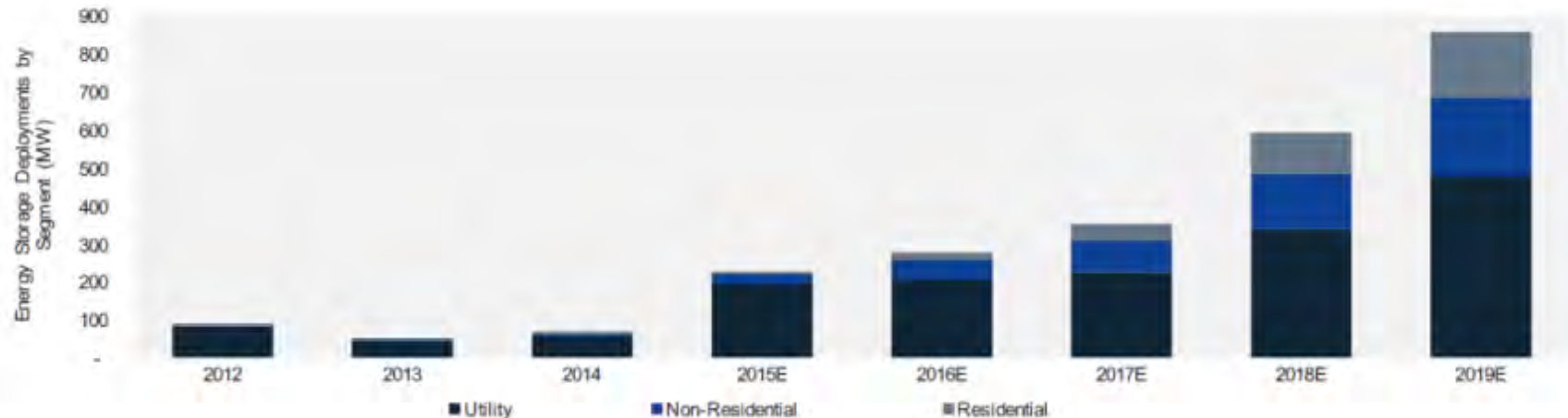
Non-Hydro Renewables Generation to Almost Quadruple Between 2010 and 2040



Source: DOE – Energy Information Administration, *Annual Energy Outlook 2015*, April 2015; DOE – Energy Information Administration, *Electric Power Monthly*

Energy Storage Rapidly Becoming Part of the Energy Mix

Driven by mandates, favorable market rules and need, energy storage is growing rapidly



- More than 300 MW of storage was installed in 2015
- More than 850 MW per year by 2019 (projection)

Source: GTM Research, Energy Storage Monitor
E = estimated

Storage

- FERC seeking to remove barriers to storage participation in RTO/ISO markets
 1. NOPR (Docket No. RM16-23)
 - Propose to require RTOs/ISOs to modify tariffs to recognize operational characteristics of storage and accommodate participation in all markets
 - Propose to allow distributed energy resource aggregators to aggregate distributed resources, including storage, and participate in the RTO/ISO markets (RM6-23)
 - Define distributed energy resource as source or sink of power that is located on distribution system
 - Propose minimum aggregation size 100 kw

Storage Continued

2. Technical Conference (Docket No. AD16-25)
 - Examines the use of storage as transmission assets and whether they should be able to receive cost of service transmission rates and provide wholesale electric services.
 - Examines whether a storage asset can provide a compensated grid service and transmission service.
- EEI supports the participation of electric storage resources in the RTO and ISO markets on a non-discriminatory basis with other resources in a manner that recognizes the value and attributes that all resources provide to maintaining system reliability and resource adequacy.

Questions?