Welcome to the National Council on Electricity Policy
Experts Roundtable on Applying Valuation to Baseload

The Meeting will begin at 9:30 AM Eastern
Wi-Fi Information:
Connection: Mariott_Conf
Pass code: NARUC2017

January 5, 2017
Baltimore, Maryland

Welcome and Introductions

Commissioner Elizabeth B. “Lib” Fleming

South Carolina

Jan Brinch

National Council on Electricity Policy (NCEP)

Acknowledgements

- Thank you to the U.S. Department of Energy and the National Energy Technology Laboratory for supporting this work.

- Thank you all for coming here to today to share your perspectives on this topic.

NCEP's Benefits

- A "marketplace of ideas" encouraging multiple viewpoints, not requiring unanimity but rather an exchange of perspectives
- A forum for unbiased information, not a policy-making organization
- No lobbying or legislative advocacy
- A place to discuss and debate "outside the box" ideas, for peer exchange, and to improve electricity policy for the betterment of all

NCEP Organizational Structure

- Executive Committee: Composed of 12 individuals representing national interests:
  - Energy and air regulatory agencies
  - State legislatures and energy offices
  - Consumer advocacy agencies
- Policy Committee: Self-identifying and composed of participating state officials

NCEP Activities

- Sponsor facilitated meetings, trainings, and other information exchange
- Conduct research and education activities
- Host webcasts and other outreach efforts
- EISPC to continue its interface with EIPC
- Five work areas, identified and supported by NCEP members:
  - Air and Energy Resources
  - Reliability, Resilience and Recovery
  - Resource Adequacy and Diversity
  - Transmission
  - The Evolving Electricity Marketplace

How you can get involved in NCEP's work

- Join one of the five Work Groups
- Spread the word about our outreach and training opportunities
- Engage with us – share the issues you care most about
- Attend and participate in our programs

Applying Valuation to Baseload

What we pay for electricity is based on a combination of commodity (kW) throughput and attributes (such as capacity, RECs, flexibility, reliability, ancillary service products, etc.) What is the right balance between paying for kilowatt hours and paying for other attributes and characteristics?

What are the existing and possible attributes that are not compensated when we pay for kilowatt hours?

What criteria can state policymakers consider to determine whether compensating any of these attributes is worth it?

What information is unknown that would help us fill these gaps?

Objectives for Today's Roundtable

- Discussion and weigh-in on the attributes of baseload power that are valuable, e.g., flexibility, resiliency, capacity, ancillary services?
- Discussion and determination of criteria that decision-makers could use to determine which attributes "make it on to the ledger sheet?"
- Characterization of how electric rates are set that reflect new market and technology changes
- Identification of information needed that could help fill our knowledge gaps

Valuation in the Electricity Sector: A Key Input to Grid Modernization

David Meyer
U.S. Department of Energy, Office of Electricity

The Buzz about Valuation

NCEP Roundtable
on
Applying Valuation to Baseload Capacity

January 5, 2017

David Meyer, Senior Advisor
DOE Office of Electricity Delivery
and Energy Reliability

Why has valuation become such a hot topic?

Not so long ago, "valuation" usually meant estimating the net costs and benefits associated with rooftop solar technology.

Now it is a concern for many other kinds of electric sector issues. What has changed?

Answer: "Grid modernization" has arrived. Many kinds of assets – and the value of the services they provide – are in question.

Result: We need to think more systematically about valuation, and find ways to do it better. Electricity planners and policy makers need valuation processes that produce credible results.

A working definition of valuation

- **Primary definition: A *process* for estimating what something is worth, relative to similar objects, entities, or services.**
- **Secondary definition: The *result* of such a process – i.e., a price, an appraisal, or an estimate of value.**
- **For clarity, I propose to use "valuation" only in the sense of valuation-as-process. If the process is analytically flawed or some of its inputs lack credibility, the significance of its results will be uncertain at best.**

Valuation processes are very diverse – but they have a common function

- **Processes may be highly structured and repeatable (as in formal markets); or they may rely on expert judgement (by appraisers); or they may rely on economic models or combinations of them to produce analytic results ("value of solar").**
- **Results may be wholly monetized, partially monetized, or wholly non-monetizable.**
- **The common function: They provide essential information to *someone's* reasoned business decision.**
- **Without such information, both the speed and the quality of decision-making are degraded. Productivity suffers. If procrastination is not an option, the probability of poor choices rises.**

Key features of strong valuation processes

- Credibility, transparency, and repeatability are all highly important.
- They must be designed with the decision-makers' needs in mind – the process must fit the context.
- Strong processes are highly data-dependent, and require:
  - Broadly accepted concepts and working definitions for the particular costs and benefits to be valued.
  - Broadly-accepted metrics that are consistent with the definitions.
  - Reliable data with which to operationalize the metrics.

A proposal for going forward

- A DOE-national lab team is working with stakeholders to develop a set of broadly-accepted basic concepts and associated vocabulary about valuation in the electricity sector.
- Long-term goal: establish a valuation analogue to the accounting profession's Generally Accepted Accounting Principles (GAAP). For example, valuation principles could:
  - Set documentation requirements for analytic models used in valuation processes.
  - Provide guidance for dealing fairly, openly, and systematically with subjective or hard-to-monetize elements of a valuation process.
- Near term study (GMLC 1.4.1, now in process):
  - In addition to the basic concepts and vocabulary, the DOE-lab team will work with stakeholders to develop a generic conceptual framework that --- with appropriate adaptation -- could be applied to a range of electric valuation problems.
  - The team will then test the framework by adapting and applying it to two use cases, one at the bulk power level, and one at the distribution level.
  - This study is part of DOE's Grid Modernization Initiative. Results are expected in 2018.

For more information …

- For more information about the DOE-lab valuation study, contact Chris Irwin, Christopher.Irwin@hq.doe.gov, or Patrick O'Connor, oconnorpw@ornl.gov.
- For information about DOE's coordinated portfolio of 88 projects related to grid modernization under way at its national laboratories, go to: http://energy.gov/doe-grid-modernization-laboratory-consortium-gmlc-awards.
- Or, contact David.Meyer@hq.doe.gov .

Setting the Stage: The Perspectives of Two Regulators

Hon. Asim Haque

Public Utilities Commission of Ohio

Hon. Dave Danner

Washington Utilities and Transportation Commission

Panel Presentation:
Cost of Service Evaluation Methodologies

***Moderator:* Hon. Edward Finley**
North Carolina Utilities Commission

Frank Wolak
Stanford University

Glen Snider
Duke Energy

Denis Bergeron
Maine Public Utilities Commission

Maintaining Baseload Generation Capacity

Frank A. Wolak
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National Council on Electricity Policy Meeting
January 5, 2017

Challenge of Baseload Energy

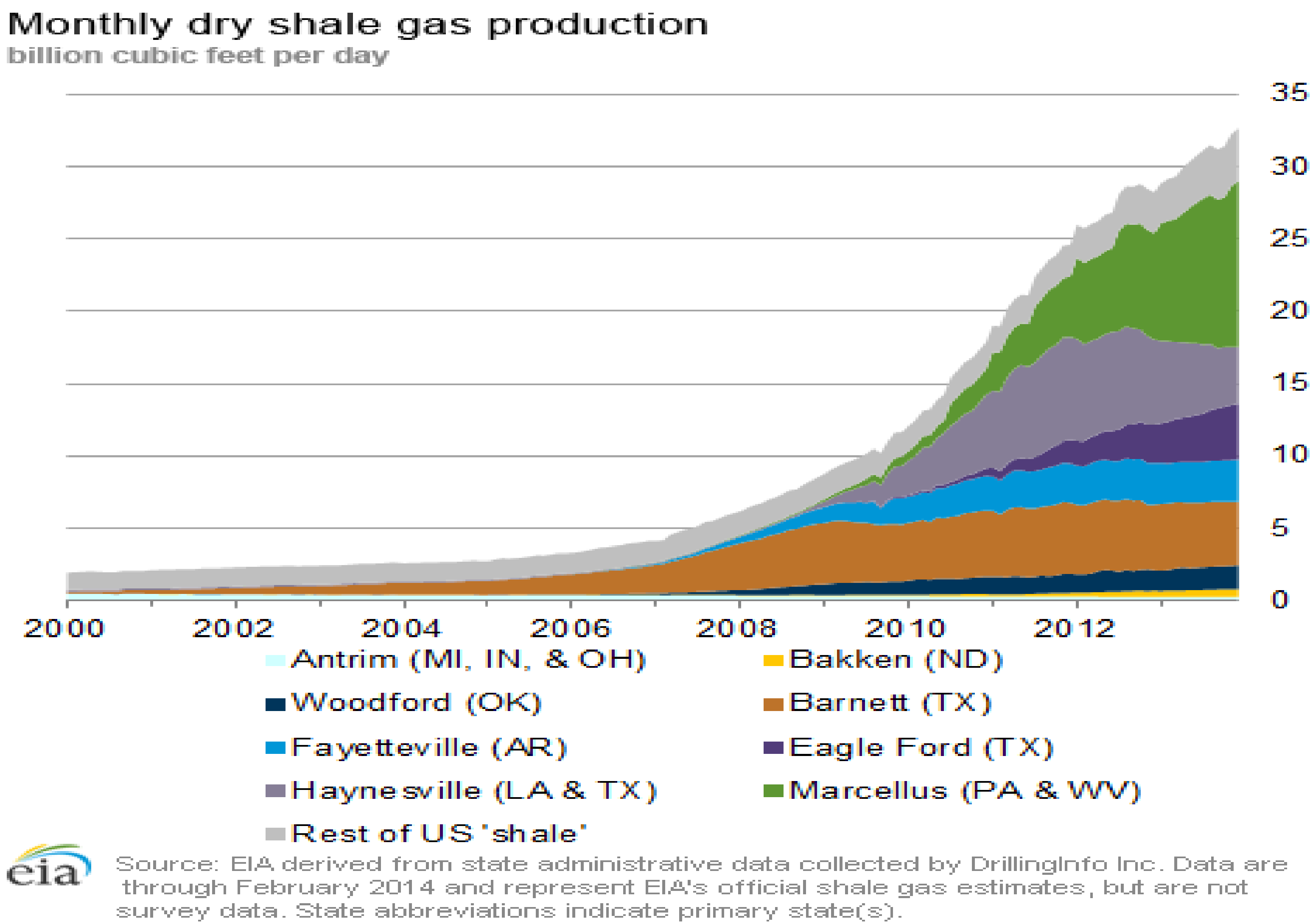
- Coal-fired and nuclear capacity is exiting or proposing to exit in all US markets
  - PJM, ISO-NE, NYISO, MISO, ERCOT, CAISO
- This pattern of exit does not appear to be occurring in other parts of the world
- Two major factors explain US experience
  - Low natural gas prices and environmental regulations favor natural gas over coal use
    - Shale gas boom in the US
  - Renewable energy goals supported state and federal government financial incentives
    - Renewables Portfolio Standard (RPS) goals

Challenge of Baseload Energy

- Different challenge for vertically-integrated utilities in non-restructured regions
- Regulator determines whether coal and nuclear capacity are needed for a reliable supply of energy at least cost to consumers
  - If so, regulator can allow recovery of total cost of generation units in regulated retail prices
- Problem not significantly different from traditional generation adequacy question in vertically-integrated regime
  - More complex with significant renewables

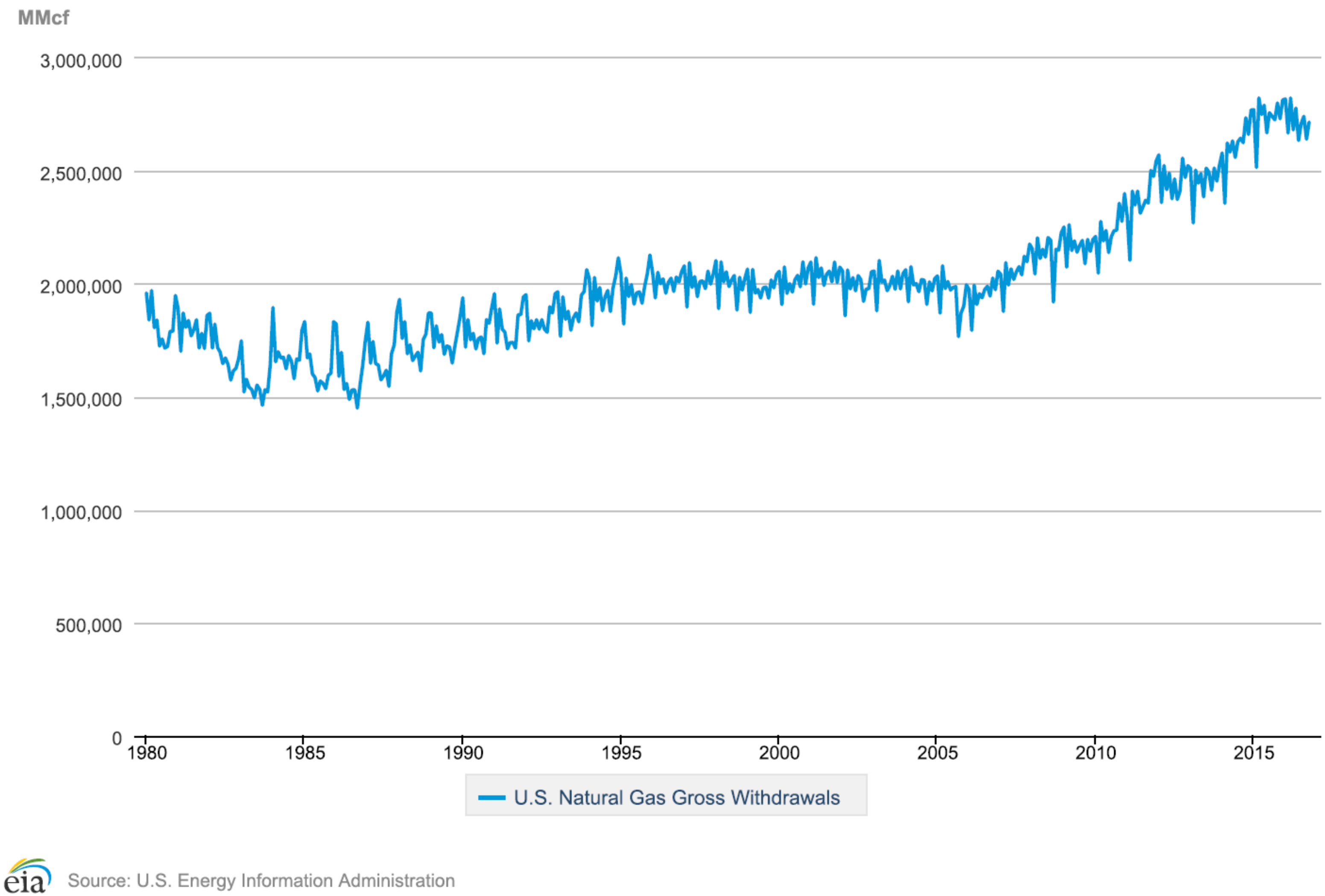
Explanation #1: Technical Change Renders Existing Suppliers Obsolete in Wholesale Market Regime

US Monthly Shale Gas Production



Monthly U.S. Natural Gas Withdrawals

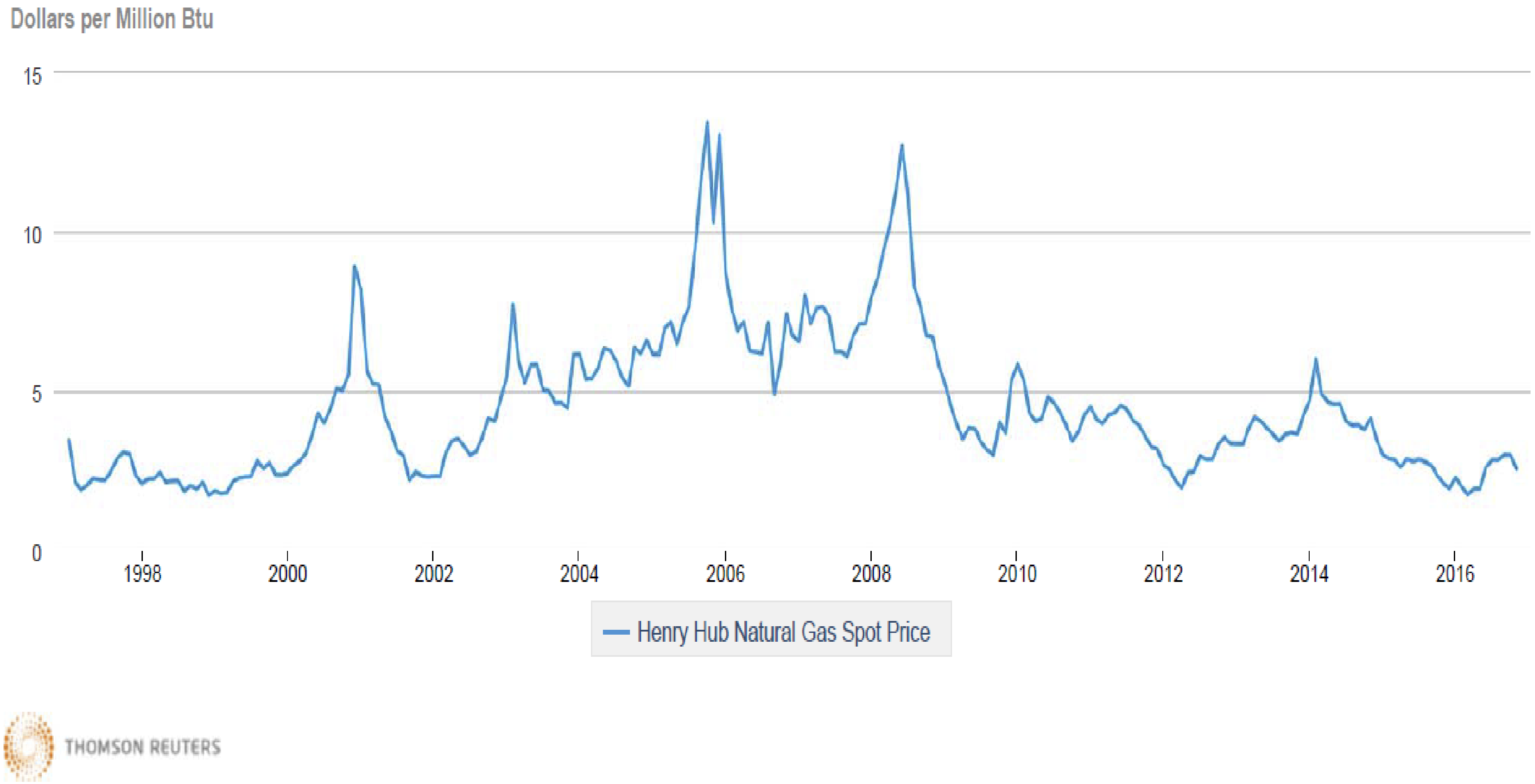
(Millions of Cubic Feet (MMcf))



Source: http://www.eia.gov/dnav/ng/hist/n9010us2m.htm

Price of Natural Gas at Henry Hub

(Monthly Average Prices in $/MMBTU)



Source:http://www.eia.gov/dnav/ng/hist/rngwhhdM.htm

Major North American Shale Gas Plays

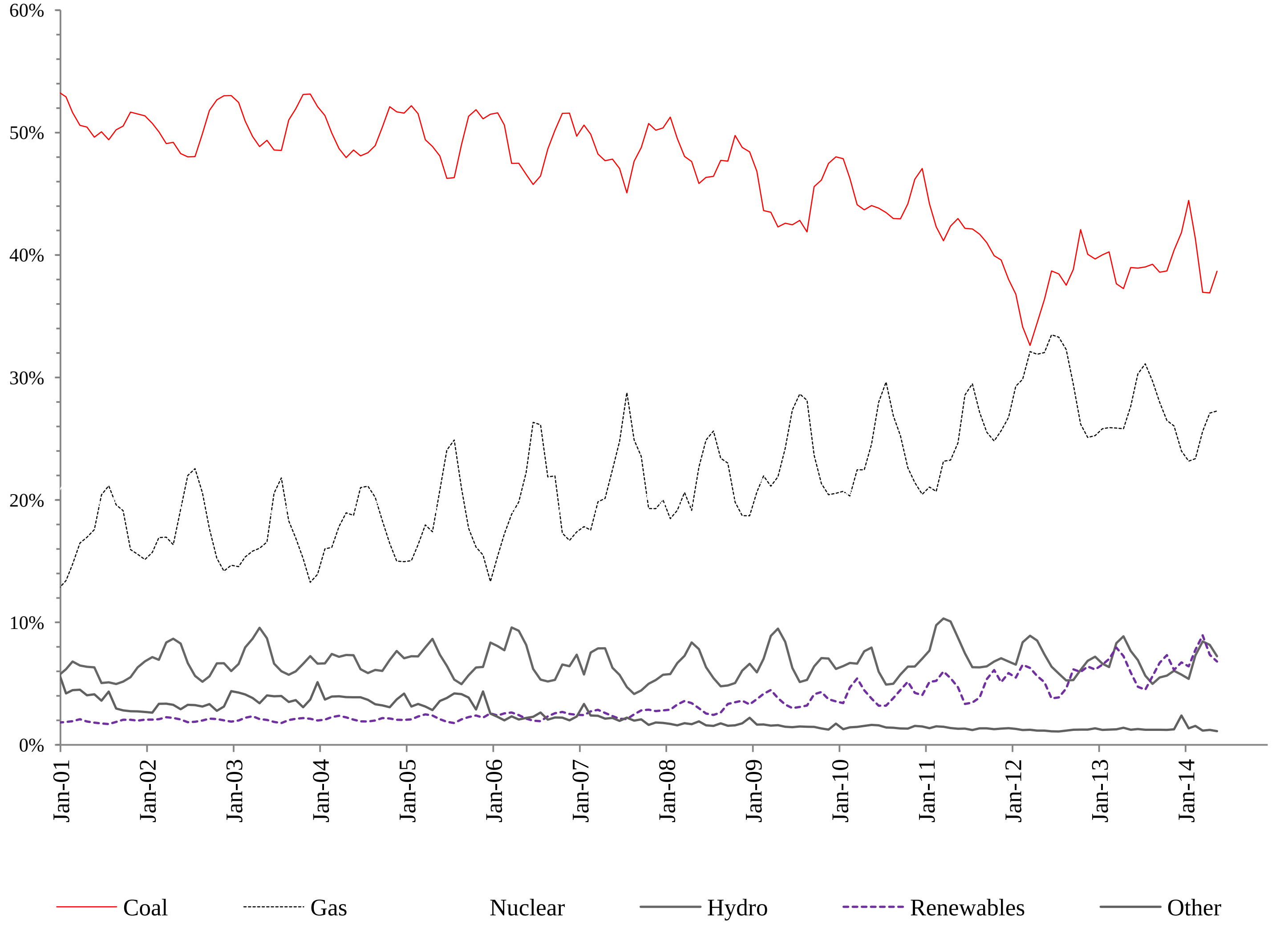
Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

Shale Gas as Disruptive Innovation

- Shale gas has significantly reduced variable cost of producing baseload energy
  – Combined cycle gas turbine (CCGT)
- More stringent environmental regulations have increased cost of continuing to operate coal and nuclear generation units
- Conclusion--Retirement of coal and nuclear capacity based on unique economics and environmental regulations in the US
  – Markets with low barriers to entry and exit quickly find least cost mode of production

Increasing Role of Gas in US Power Sector

Share of Total US Generation by Input Fuel



In April 2012, Coal provided 34% and Natural Gas 32% of Total US Generation

What Explains Increasing US Gas Use?

– Economics favors natural gas-fired generation versus coal-fired generation
  - Average heat rate of typical coal-fired unit significantly larger than that for combined-cycle gas turbine (CCGT) unit
    - Heat Rate = MMBTU of input fuel per MWh of electricity produced
      - » MMBTU = millions of British Thermal Units
      - » MWh = Megawatt-hour
  - Average Heat Rate of Coal unit could be twice that of CCGT generation unit
    - Even if price of coal is less than price of natural gas, economics could favor running CCGT unit because of lower heat rate
      - » 12 MMBTU/MWh x $2/MMBTU coal = $24/MWh from coal
      - » 7 MMBTU/MWh x $3/MMBTU gas = $21/MWh from gas
      - » Variable O&M cost for coal > Variable O&M cost for gas
  - $/MW of capacity cost for coal-fired power unit greater than $/MW of capacity cost for natural gas-fired unit

Increased US Gas Use in Power Sector

- Environmental Protection Agency (EPA) rules
  - Mercury and Air Toxics Standards (MATS) for coal-fired power plants
  - Cross-State Air Pollution Rule (CSAPR)
    - Reduce SO_2, NO_x, and Particulate emissions
  - At many existing power plants substantial new capital investments are necessary to meet these standards
- Economics (low-priced natural gas) appears to dominate coal and nuclear capacity retirement decisions
  - Most of these units are very old, 40 to 60 years old
  - Most coal units have high heat rates
- Replacing these units with modern natural gas-fired units makes economic sense and has environmental benefits
  - Hedge against future carbon policy

Explanation #2: Impact of Renewables Mandates on Baseload Generation

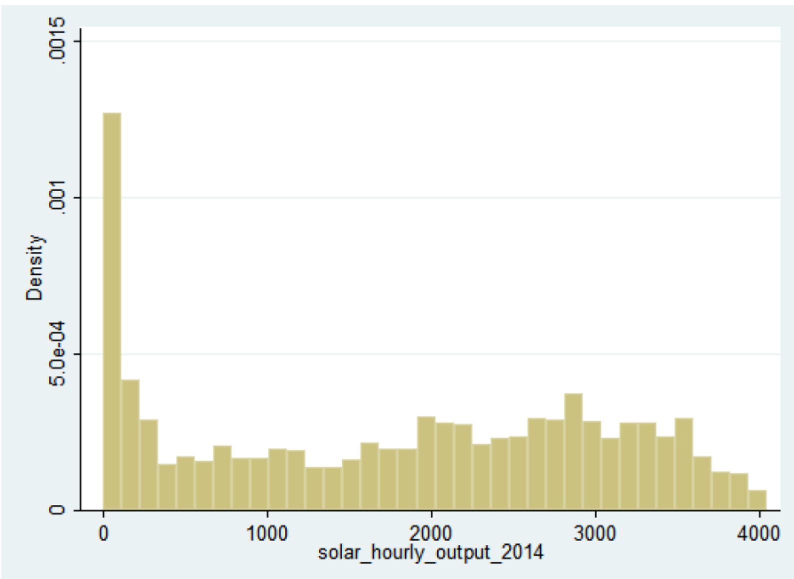
Renewable Portfolio Standards

- Majority of states have a renewables portfolio standards (RPS) that require either
  - Absolute levels of renewable generation capacity in state
  - A pre-specified share of the total energy consumed in the state must come from “qualified” renewable sources
- Under an RPS, above-market payments to renewable resource owners must be sufficient to obtain the mandated annual renewable energy share
- Renewable energy has two unique features
  - Variable cost of production is zero or close to zero
  - Intermittent--Energy can be produced only when underlying resource, primarily wind and solar, is available

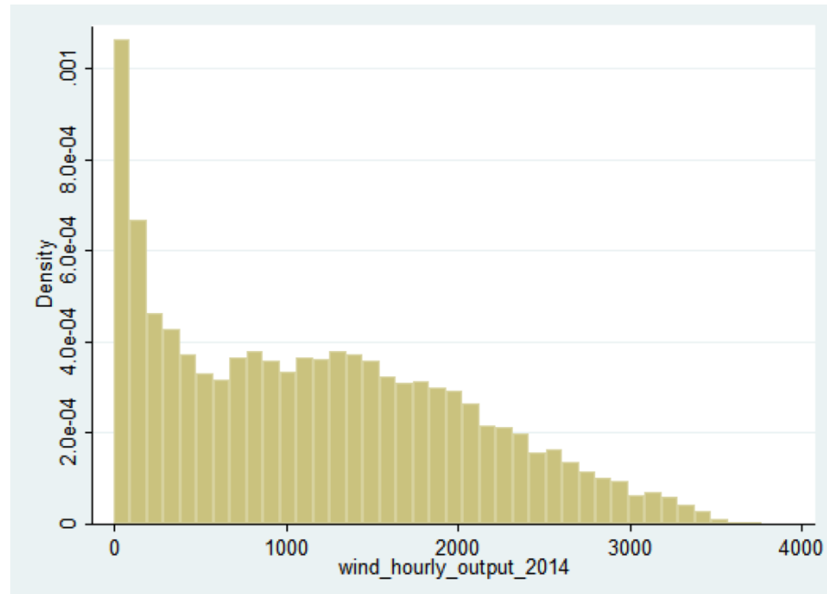
Renewable Portfolio Standards

- Renewable energy purchased at above-market prices displaces energy from conventional “dispatchable” baseload generation units
  - Less sales by conventional baseload units
  - Lower short-term prices
- Both factors reduce revenues earned by conventional baseload generation units
  - Increases likelihood of exit of conventional baseload units
- Outcome due to excess generation capacity relative to that needed to meet demand, not the existence of RPS
- Intermittency of the renewable generation units implies continued need for conventional “dispatchable generation” units

Histogram of Hourly Wind and Hourly Solar Output in CAISO

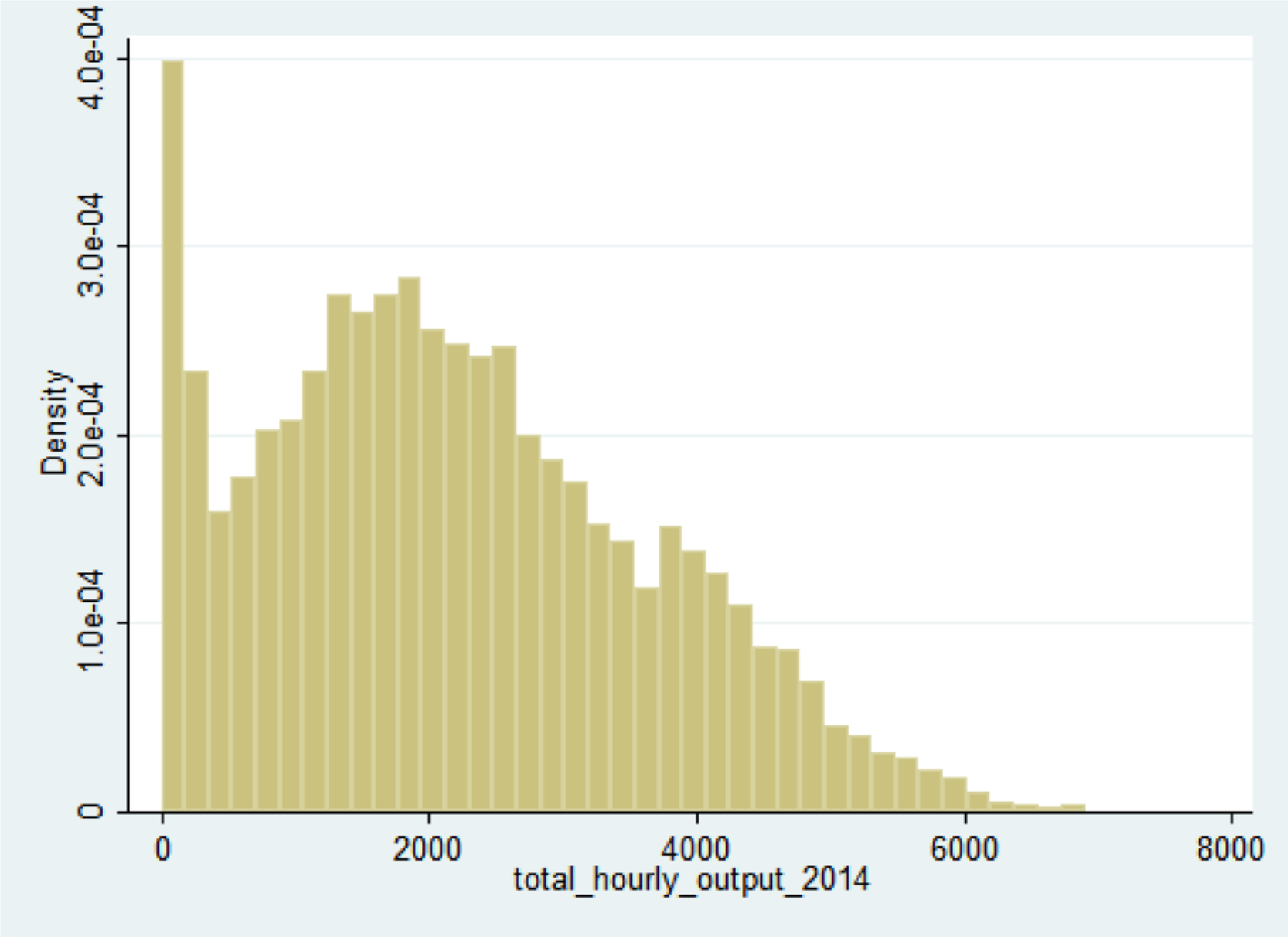


P(solar_hourly_output = 0) = 0.4361



P(wind_hourly_output = 0) = 0.0345

Histogram of Hourly Wind and Solar Output in CAISO



$$P(\text{total\_hourly\_output} = 0) = 0.0280$$

Demand for Dispatchable Energy

- Despite having more than 8,000 MW of wind and solar capacity in California, in majority of hours of year these units produce less than 2,000 MWh
  - Wolak (2016) "Level and Variability Trade-offs in Wind and Solar Investments: The Case of California," demonstrates very high degree of positive correlation in hourly output across CA wind locations and CA solar locations
- Without significant storage, virtually all dispatchable capacity is still needed because ~3 percent of hours of year no renewable energy is produced

Obtaining Financial Viability for Baseload Generation

Value versus Price

- "[An economist is] a man who knows the price of everything, and the value of nothing"
  - With apologies to Oscar Wilde
- "Value" is a personal assessment
  - Purchase good if value greater than price
- Key issue is long-term financial viability of sufficient dispatchable generation capacity for a reliable supply of energy
- Financial viability requires
  - Price paid for energy must be sufficient to recover total cost of constructing and operating unit over useful life of unit

Shale Gas as Innovation

- If shale gas boom continues coal and nuclear generation cannot compete with CCGT units on a levelized cost basis
- Primary rationale for continued operation of coal and nuclear generation is hedge against high natural gas prices in future
- Financial sector believes shale gas boom will continue
  - Flat forward price curve for Henry Hub deliveries of natural gas out to 2020

RPS Mandates and Excess Capacity

- Despite RPS mandates, all markets still require a significant amount of dispatchable generation capacity
  - Until significant storage capacity is constructed
- Sufficient dispatchable capacity to produce energy when renewable resources are unavailable
  - Water, wind, and solar energy
- Policy Challenge—How to ensure that sufficient dispatchable generation capacity is financially viable for a reliable of energy all hours of the year

Are All Attributes of Generation Units Priced in RTO Markets?

Locational Marginal Pricing (LMP)

- All restructured US regions operate multi-settlement LMP markets
  - All relevant operating constraints are accounted for in locational marginal prices
    - Transmission, ramping, and other operating constraints
- Price characteristics of generation units needed for system operation in ancillary services
  - Regulation (AGC), Spinning and Non-Spinning Reserve
  - Mileage charges for regulation
  - Pay-for-performance prices responsiveness of unit ISO operates grid
- LMP market ideally suits to price all characteristics of generation units required by system operator
  - Add another constraint to LMP pricing problem

A Mechanism for Maintaining Sufficient Dispatchable Energy

Forward Market for Energy

- Electricity industry restructuring eliminates entity traditionally responsible for long-term resource adequacy
  - ISO operates grid
  - Generation unit owners sell wholesale energy
  - Retailers purchase wholesale energy
- State regulator is still responsible for long-term resource adequacy but it has limited tools to achieve this goal
  - Can no longer require vertically-integrated utility to construct new generation capacity and set price that allows it the opportunity to recover these costs

Forward Market for Energy

- Retirement of coal and nuclear capacity can be addressed by long-horizon forward market for energy
- Even at current natural gas prices, purchasing a fixed-price forward contract for energy from coal or nuclear capacity may be justified as a hedge against future natural gas price volatility
  - Longer duration contract allows coal and nuclear to compete against natural gas
- Forward market energy purchases can ensure sufficient dispatchable energy for markets with substantial renewable energy goals

Alternative Approach to Reliability

- Eliminate capacity payment mechanisms
  - Capacity shortfalls are not the problem, energy shortfalls are
- Implement approach based on standardized forward contracts for energy
  - Product can be traded through ISO
- Extend logic of multi-settlement market to long-horizon forward market
  - Product can clear against quantity-weighted average of locational marginal prices at all load withdrawal points in region

Alternative Approach to Reliability

- Mandate that all retailers and free consumers must purchase pre-specified fractions of realized demand at various horizons to delivery in standardized forward contract
  - 95 percent one year in advance
  - 90 percent two years in advance
  - 85 percent three years in advance
- Retailers and free consumers subject to financial penalties for under-procurement
  - No prohibition on additional bilateral trading of energy by retailers or suppliers
- Goal of mechanism is to encourage development long-horizon forward market for energy

Alternative Approach to Reliability

- Contracts used for compliance with obligation by retailer or free consumer must be held until expiration
  - Contracts used for compliance with mandate are placed in separate “compliance” account and cannot be unwound by either counterparty
  - These contracts must be held until expiration
- If regulator believes that insufficient generation capacity is being built, it can increase annual contracting percentages and length of contracting horizon
  - 98 percent one year in advance
  - 93 percent two years in advance
  - 90 percent three years in advance
  - 87 percent four years in advance
- Suppliers decide how much and what mix of generation capacity is necessary to produce contracted levels of demand
  - Provides strong incentive for market to supply this energy at least cost

Alternative Approach to Reliability

- Use firm capacity designation of generation unit from capacity market to determine amount energy a supplier can sell in forward market
  - Renewable resource owner can sell Q(Contract) ≤ Q(Firm)
  - Thermal resource owner must sell Q(Contact) ≥ Q(Firm) and Q(Contract) ≤ Capacity of Unit
- Restrictions on standardized energy contract sales by technology ensures a reliable supply of energy at a reasonable price
  - Competition among all technologies ensures reasonable prices during other system condition
  - Creates a strong incentive to manage low renewable energy production conditions
- Does not require high degree of sophistication from suppliers

Alternative Approach to Reliability

- Incentive for Supplier Behavior with Standardized Forward Contracts
- Supplier k's variable profit during hour h:
- Profit(P(h)) = (Q(h) - QC(h)) P(h)
  + PC(h)QC(h) - C(Q(h)) ,
  – Q(h) = output in hour h
  – QC(h) = forward contract obligations in hour h
  – P(h) = short-term price in hour h
  – PC(h) = forward contract price in hour h
  – C(Q) = variable cost of producing output Q
- Supplier has strong incentive to supply QC(h) at least cost

Alternative Approach to Reliability

- Suppose that supplier k is a dispatchable baseload unit and there is plenty of renewable energy during hour, so it does not sell any energy (Q(h) = 0)
- Supplier k's variable profit during hour h is:
- Profit(P(h)) = (PC(h) – P(h))QC(h)
- Supplier earns profit by selling at PC(h) and buying from market at P(h)
- To discipline incentive of renewable suppliers to exercise unilateral market power, dispatchable supplier should submit offer into short-term market at its marginal cost
  - This ensures efficient ``make versus buy'' decision by dispatchable unit to supply QC(h)

Alternative Approach to Reliability

- Load-Profile-Shaped Standardized Forward Contract
- Goal of alternative approach is to make QC(h) for supplier k as close as possible to output of supplier k in hour h under least cost dispatch of system
- Allocate more of total quarterly energy sold to higher demand hours of the day
- This provides incentive for dispatchable suppliers to submit offers for peak hours of day
  - The fact that thermal suppliers are compensated for start-up costs increases likelihood that this will occur

Advantages of Alternative Approach

- Stimulates development of liquid forward market for energy at long horizons to delivery
  - Can provide revenue stream to sustain needed dispatchable baseload energy
- Uses Firm Energy value for generation unit from Capacity Mechanism to set energy sales
  - Provides strong economic signals for efficient short-term operation of grid
  - If renewables are unavailable or attempt to raise short-term price, dispatchable generation will supply energy sold in forward contract rather than purchasing it from the short-term market at P(h)

Advantages of Alternative Approach

- Minimal regulatory intervention into market mechanisms
  - Does not specify value of capacity obligation
  - Allows suppliers to figure out least cost mix of generation capacity to meet forward energy sales
  - Eliminates need for regulated price-setting process that characterizes most US capacity markets
    - For example, “dee-mand” curve for capacity and rule that only new suppliers can submit offers
- No stranded contracts unless total system demand falls substantially
  - Retailers that lose customers have valuable contract to sell to retailers that gain customers

Conclusions

- Shale gas boom and RPS mandates both likely causes of coal and nuclear retirements
- In restructured markets, regulator no longer able to mandate long-term resource adequacy
- Mandated purchases of forward contracts for energy at various horizons to delivery can achieve this goal at least cost to consumers
  - Maximum reliance on market mechanisms to retain financial viability of sufficient dispatchable baseload capacity
  - Strong incentive for least cost provision of a reliable supply of energy all hours of the year

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Related papers available from
http://www.stanford.edu/~wolak

Lunch Break

The Changing Generation Fleet

Steve Mitnick

Public Utilities Fortnightly

Panel and Discussion: What Do We Actually Pay For?

Moderator: **Hon. Paul Kjellander**
Idaho Public Utilities Commission

Denise Foster
PJM Interconnection

Tanya McCloskey
Pennsylvania Office of Consumer Advocate

Matt Wald
Nuclear Energy Institute

APPLYING VALUATION TO BASELOAD: AN EXPERTS ROUNDTABLE

A Meeting of the National Council on Electricity Policy

Baltimore, Maryland
January 5, 2017

Tanya J. McCloskey
Acting Consumer Advocate
Pennsylvania Office of Consumer Advocate
555 Walnut Street, Harrisburg, PA 17101

Some Historical Perspective

Duquesne Light Co. v. Barasch, 488 U.S. 299 (1989)

"For example, rigid requirement of the prudent investment rule would foreclose hybrid systems such as the one Pennsylvania used before the effective date of Act 335 and now uses again. See n. 4, *supra*. It would also foreclose a return to some form of the fair value rule just as its practical problems may be diminishing. *The emergent market for wholesale electric energy could provide a readily available objective basis for determining the value of utility assets.*"

Duquesne Light v. Barasch, *Id.* at 316, Fn. 10 (emphasis added)

Attributes

- Attributes of Electric Service:
  - Reliability
  - Adequacy
  - Affordability
  - Stability
  - Environmental sustainability
  - State Policy goals

- Least Cost Over Time

THE NATIONAL ASSOCIATION OF STATE UTILITY CONSUMER ADVOCATES RESOLUTION

Acknowledging the Need to Reduce Emissions of Greenhouse Gases and Recommending to the Utility Industry that Its Resource Planning Must Take Into Account the Growth in those Emissions

* * *

WHEREAS,	NASUCA has previously endorsed the concept of least cost utility resource planning, whereby the revenue requirements to ratepayers is minimalized;
WHEREAS,	although no one may be able to chart the future of the Earth's climate, findings such as those of the IPCC make clear that the utility industry will be reassessing its resource plans to account for increased environmental risks of fossil fuel use;
WHEREAS,	such findings will also likely result in steadily increasing international pressures to reduce fossil fuel use both in the United States and abroad;

NASUCA RESOLUTION 1990-10 (con't)

WHEREAS, those pressures, in turn, suggest several likely possibilities, such as: (1) reassessment of investment in long-lived fossil fuel technology; (2) prudency challenges if identified risks and alternatives are not responsibly addressed; and (3) reassessment of utility plant extension and refurbishment programs compared with other demand-side and supply-side alternatives, including conservation and energy efficiency;

WHEREAS, both ratepayers and utilities stand to gain when utilities cost-effectively substitute what amount to climate defense technologies against additional greenhouse gas emissions; and

WHEREAS, incorporating climate defense technologies where appropriate, will ensure greater stability from the perspective of regulators and financial markets alike;

NOW THEREFORE, BE IT RESOLVED, that NASUCA acknowledges the need to reduce emissions of greenhouse gases;

BE IT FURTHER RESOLVED, that NASUCA hereby recommends that the utility industry take into account the growth in greenhouse gas emissions in its resource planning[.]

Panel and Discussion: What Do We Actually Pay For?

Moderator: **Hon. Paul Kjellander**

Idaho Public Utilities Commission

Denise Foster

PJM Interconnection

Tanya McCloskey

Pennsylvania Office of Consumer Advocate

Matt Wald

Nuclear Energy Institute

Pedigree vs. Commodity in Electricity Policy

National Council on Energy Policy
Experts Roundtable on Applying Valuation to Baseload
Baltimore, January 5, 2017

Matthew L. Wald, policy analyst
Nuclear Energy Institute
mlw@nei.org
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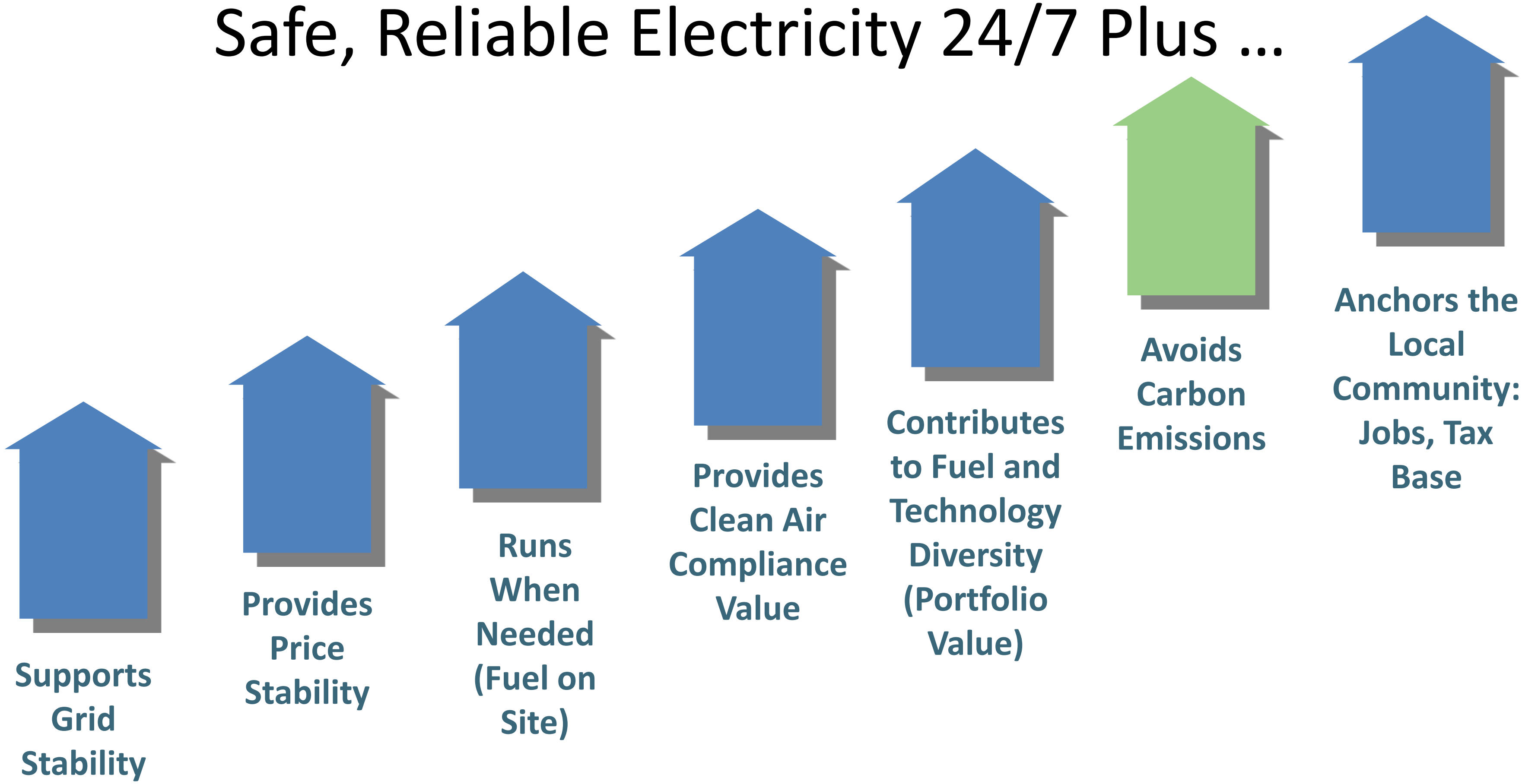
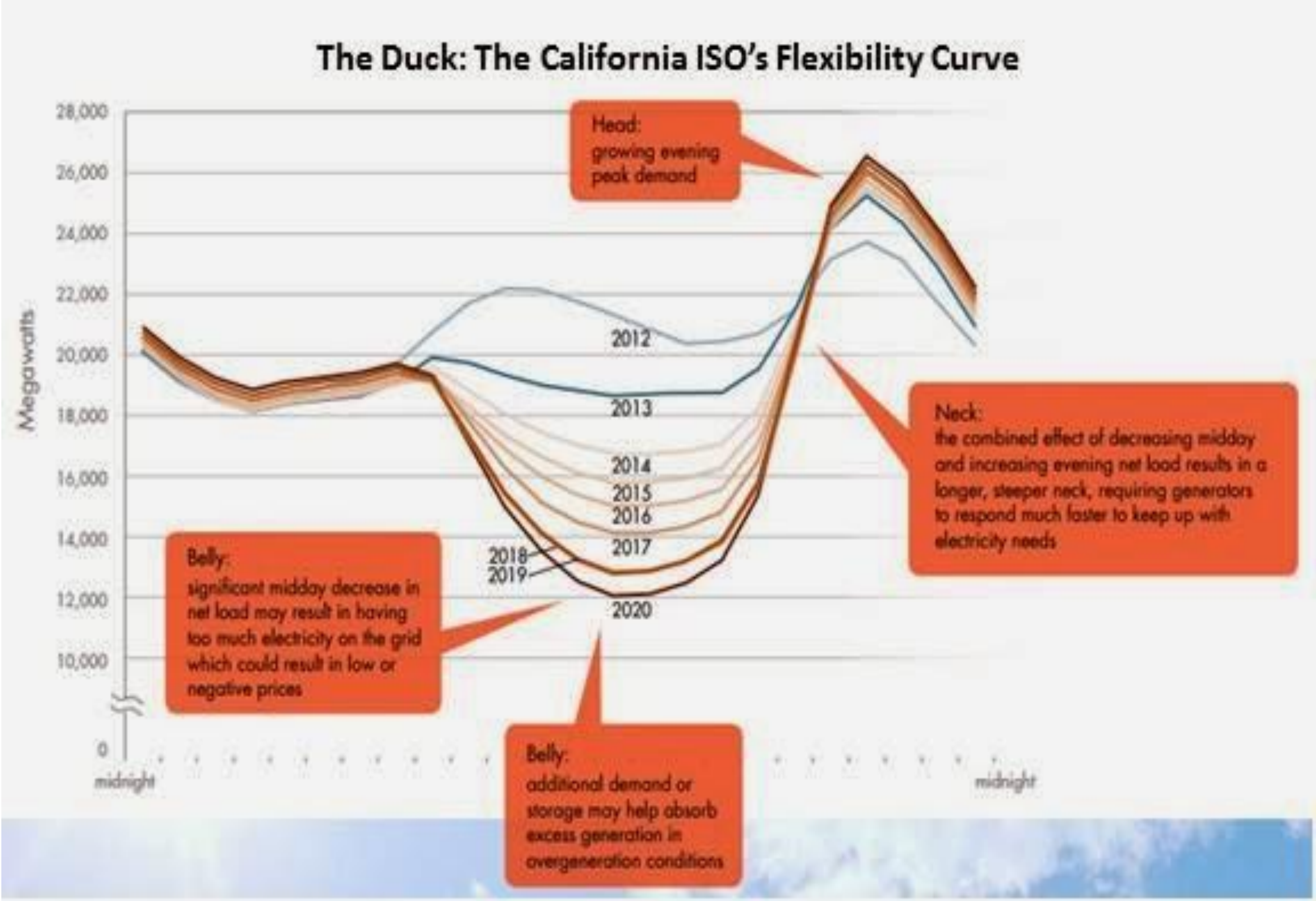
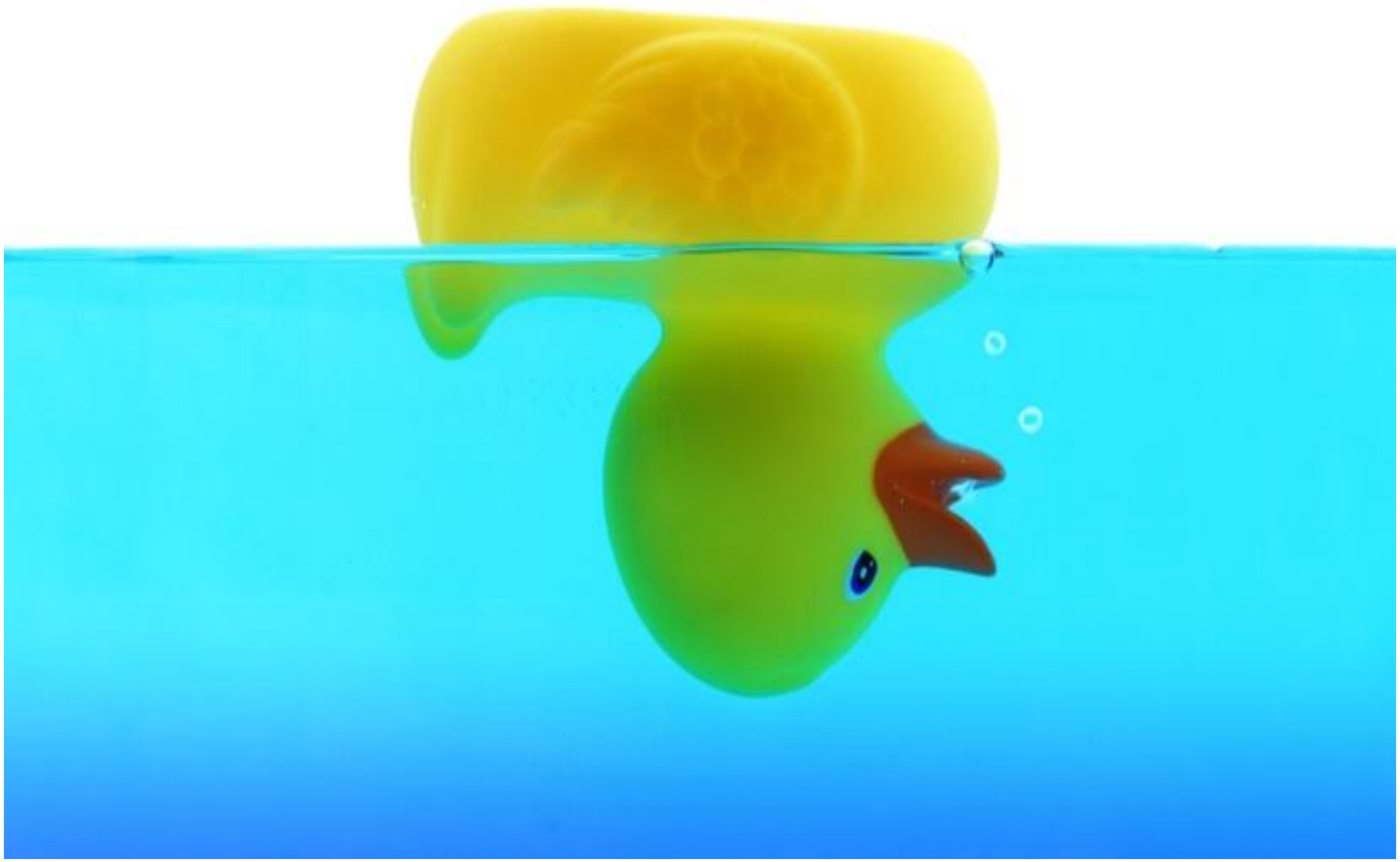
Nuclear Energy’s Solid Value Proposition

Safe, Reliable Electricity 24/7 Plus …

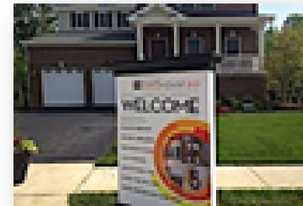


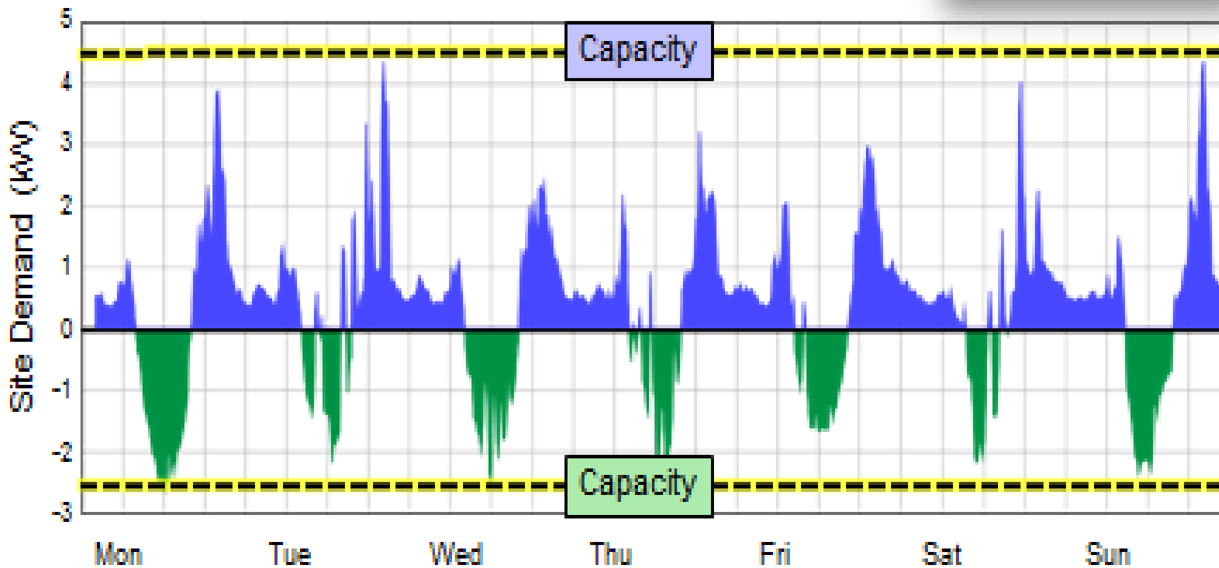


(the ISO's *Building A Sustainable Energy Future; 2014-2016 Strategic Plan*)



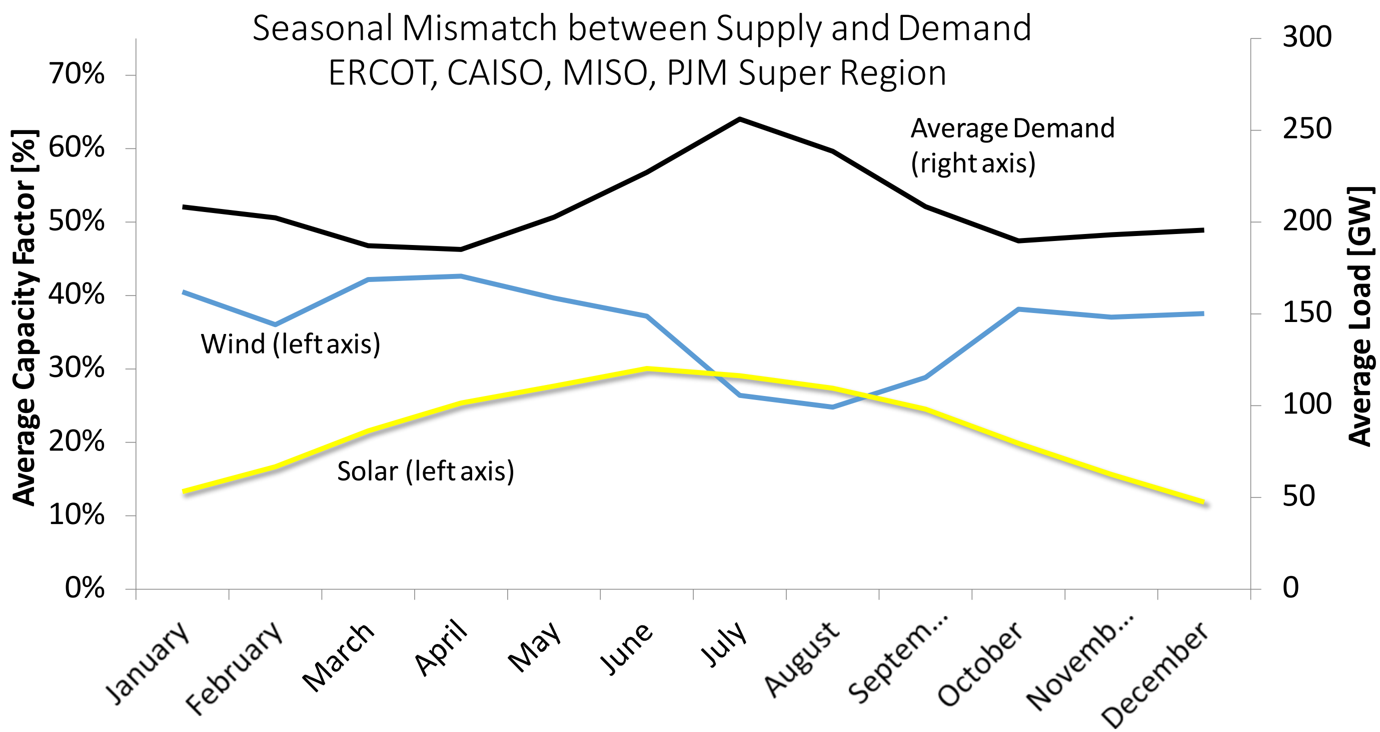
Zero Energy Home but Not Zero Capacity Home





Customer Sited Generation Will Impact Local and System Level T&D Infrastructure Planning

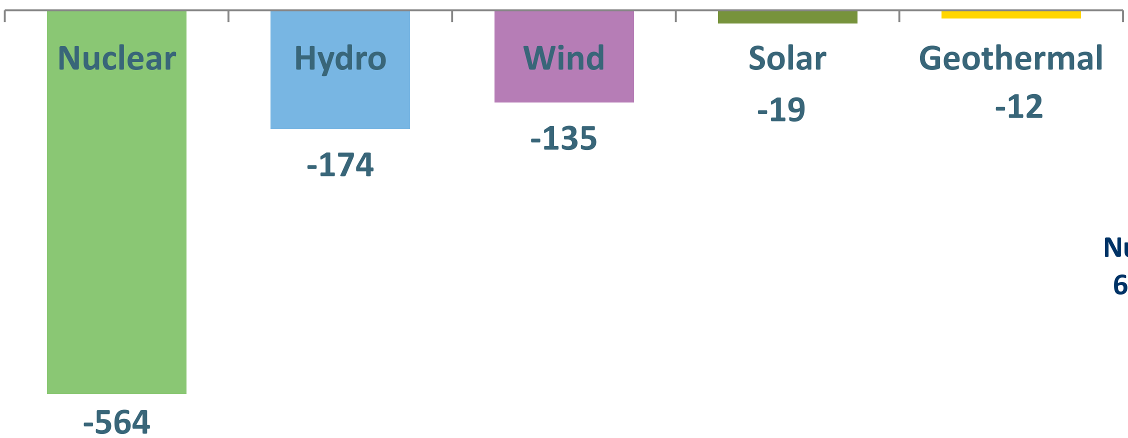
The need for (seasonal) electricity storage will be exacerbated with increasing penetration of intermittent renewables.



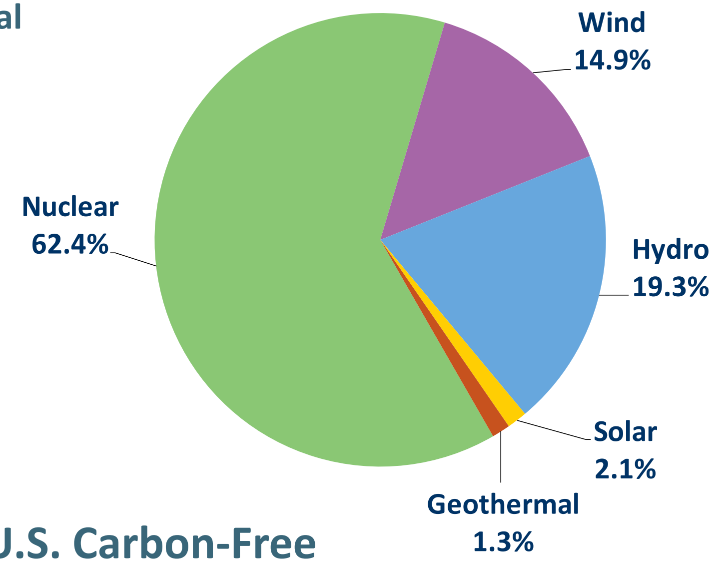
Jared Moore, Meridian Energy

Recognizing Nuclear Energy's Carbon-Free Value

U.S. Electric Power Industry CO_2 Avoided
Million Metric Tons 2015



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



U.S. Carbon-Free Electricity Sources *2015*

Impacts of Losing A Nuclear Plant

A typical nuclear power plant:

- 400-700 permanent jobs plus equivalent number of indirect jobs in local area to support the plant
- Plant salaries 36% higher than average in the local area
- $16 million per year in state and local taxes

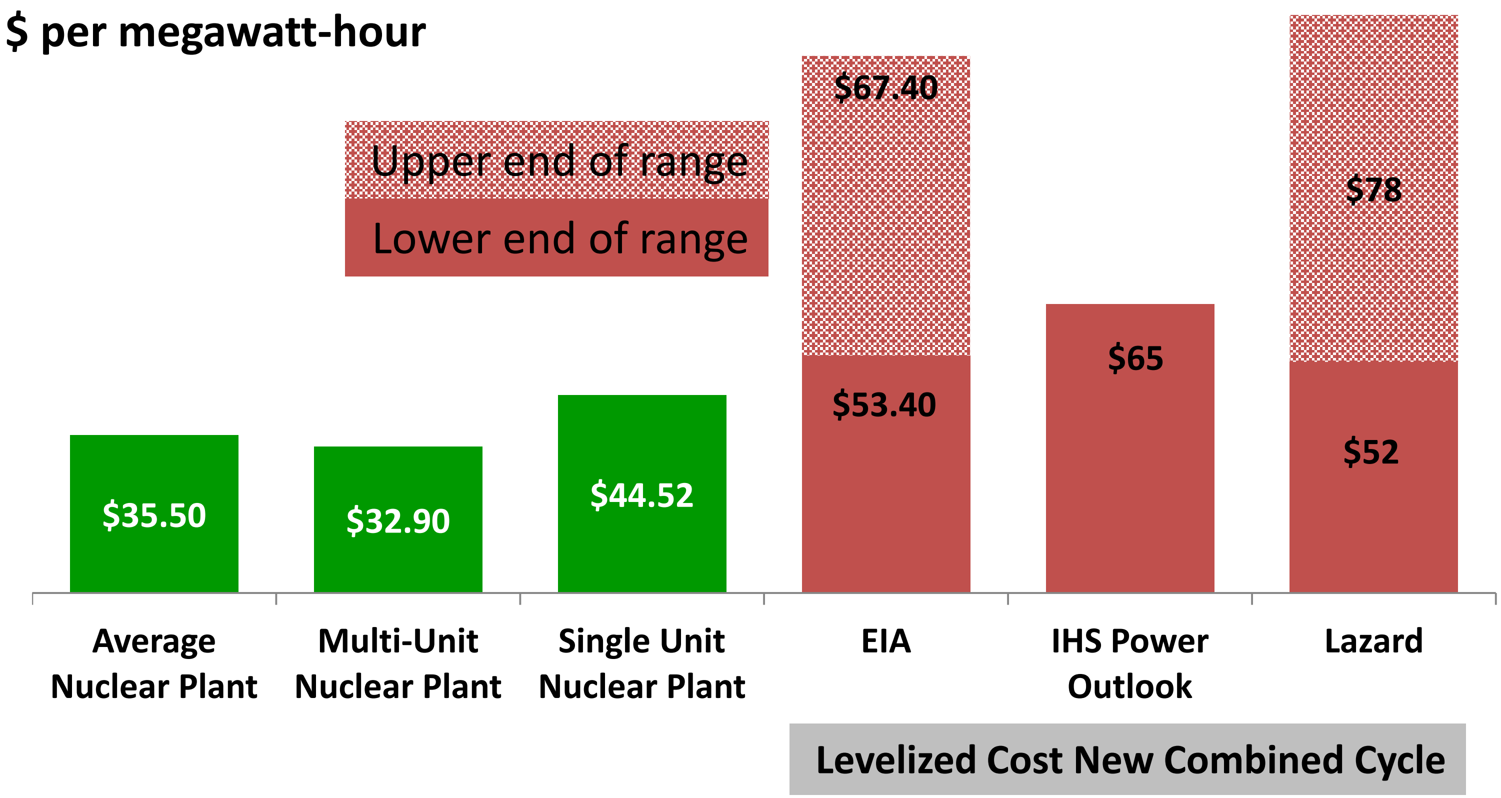
R.E. Ginna

- Employs 700 direct jobs
  - Generates 800 additional jobs
- Generates $358 million in economic output in New York and $450 million across the U.S. annually.
- Largest taxpayer in Wayne County, NY resulting in $80 million in annual tax revenue to local, state and Federal governments.
- Prevents 2.4 million metrics tons of carbon dioxide, or approximately 400,000 cars per year

Closing nuclear facilities "would eviscerate the emission reductions achieved through the state's renewable energy programs, diminish fuel diversity, increase price volatility, and financially harm host communities."

– New York Gov. Andrew Cuomo
Dec. 2, 2015

Better Deal for Consumers ... Existing Nuclear or New Combined Cycle Gas?



Sources: Existing nuclear costs are 2015 total generating costs (fuel, O&M, capital) from Electric Utility Cost Group. Gas-fired combined cycle costs are levelized costs from (1) Energy Information Administration, *Annual Energy Outlook 2016;* (2) IHS North American Power Market Outlook, September 30, 2016; (3) Lazard*, Levelized Cost of Energy Analysis*, 9.0, 2015.

Panel and Discussion: What Do We Actually Pay For?

***Moderator:* Hon. Paul Kjellander**
Idaho Public Utilities Commission

Denise Foster
PJM Interconnection

Tanya McCloskey
Pennsylvania Office of Consumer Advocate

Matt Wald
Nuclear Energy Institute

Break: Resume at 2:48

How Legislators, Consumer Advocates, and Others Address Baseload Valuation

Moderator: Jan Brinch
NCEP

Synthesis and Recommendations

- Valuation tools and techniques that "rise to the top" for baseload generation
- Recommendations – "the ask" – to research organizations, national laboratories, and academia to improve the valuation platform for baseload as well as distributed energy generation
- *Moderator:* Miles Keogh, NARUC

Thank you for your time and participation!