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ScottMadden's Energy Industry Update

"As Yogi Berra Might Say…"

November 4, 2016

Today's Agenda and Your Presenters

Stuart Pearman
Partner and
Energy Practice Leader

Welcome and Introduction

Chris Vlahoplus
Partner and Clean Tech & Sustainability Practice Leader

The Duck Curve

- Does It Mean What We Think It Means?
- Duck Curve Is Real – and Growing Faster than Expected
- Shrinking Net Loads and Increasing Ramps (2011–2015)
- Most Severe on the Weekends
- Occurring in Multiple Seasons, Not Just Spring Months
- Driven by Utility-Scale Solar, Not Distributed Resources
- Implications

Sean Lawrie
Partner

Nuclear Challenges and Responses

- Understanding the Present Situation
- Policy Solutions and Market Reforms
- Delivering the Nuclear Promise
- Decommissioning as a Last Resort

Rick Starkweather
Partner and Regulatory Practice Leader

Federal and State Energy Jurisdictions

- Federal Policy Prescriptions
- States Assert Their Interests
- Some Recent State Actions Drawing State-Federal Conflict into Focus
- The Latest "Workaround:" PJM Demand Curve Adjustment
- Implications

Questions and Answers

Greg Litra
Partner and Energy, Clean Tech, and Sustainability Research Leader

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Stuart Pearman
Partner and Energy Practice Leader

Stuart Pearman is a partner with ScottMadden and leads the firm's energy practice. As a management consultant for 21 years and a partner for 15, he has performed more than 190 projects for more than 60 clients. Stuart has expertise in energy utilities, related businesses, and several other industries. He is also a seasoned practitioner, with experience in both line and staff management roles. Stuart earned a B.A. in psychology from Williams College and an M.B.A. from the University of North Carolina Kenan-Flagler Business School, where he won the Best Industry Analysis Award and graduated at the top of his class. In addition to his full-time work at ScottMadden, Stuart is Professor of the Practice at Kenan-Flagler, teaching consulting and leadership.

Welcome and Introduction

Sean Lawrie
Partner

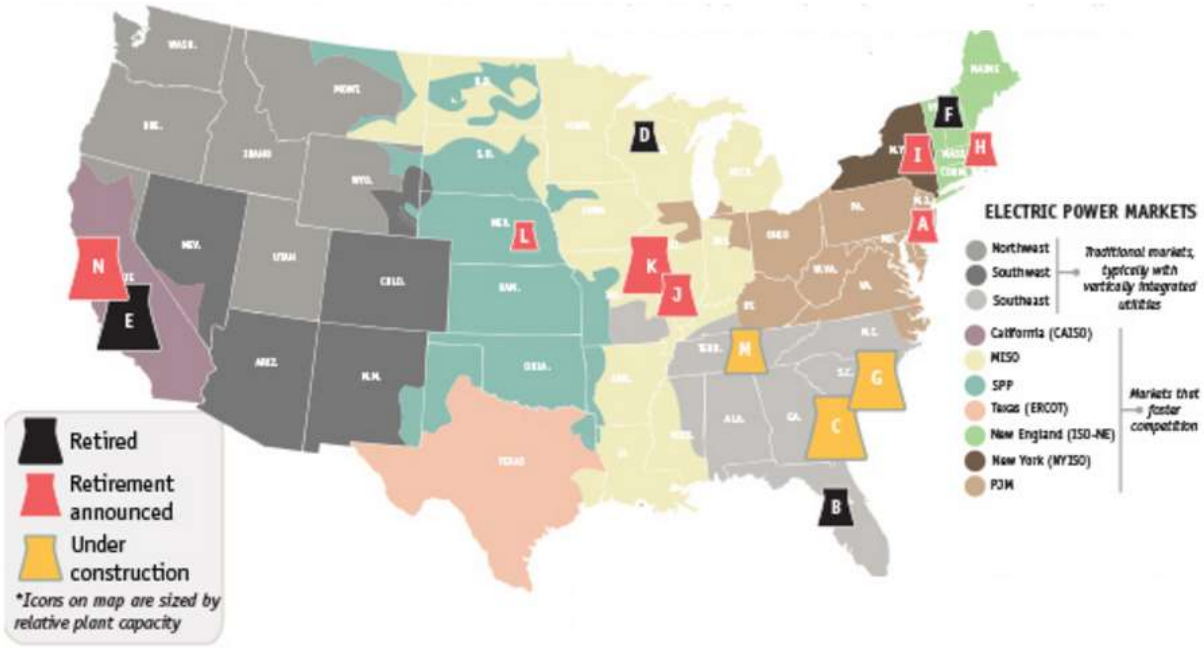
Sean Lawrie joined ScottMadden in August 2005. Prior to joining ScottMadden, he graduated from the Babcock Graduate School of Management at Wake Forest University, where he was a Cooper Cass Scholar. Sean has assisted 16 of North America's nuclear energy operators with a variety of improvement efforts, including organizational design and restructuring, Fukushima-Daiichi response enhancements, federal regulatory responses, business planning, performance management, and fleet management model implementation. Prior to joining ScottMadden, Sean worked with in energy equipment financing and procurement with General Electric Canada. Sean has worked as the executive assistant to one of the station vice presidents at Bruce Power in Kincardine, Ontario, Canada.

Nuclear Challenges and Responses

Understanding the Present Situation

- 30 countries worldwide are operating 444 nuclear reactors, and 63 new nuclear plants are under construction in 15 countries
  - Most reactors on order or planned are in the Asian region, though there are major plans for new units in Russia
  - Significant further capacity is being created by plant upgrading
- Despite regulated new build in the Southeast, three compounding drivers continue to present challenges for the U.S. nuclear industry:
  - Decreasing wholesale revenues
  - Elevated costs
  - Ambiguous value
- The domestic response has been three-fold:
  - Advocate for policy solutions and market reform to clarify value and increase revenues
  - Initiate the 'Delivering the Nuclear Promise' program to cut costs
  - Decommission unprofitable plants as a last resort

U.S. Nuclear Capacity Retirements and Additions since 2010



Under Construction

C – Vogtle 3 & 4 (2,234 MWs)
G – V.C. Summer 2 & 3 (2,234 MWs)
M – Watts Bar 2 (1,123 MWs)

Retired Due to Operational Issues

B – Crystal River (860 MWs)
E – San Onofre (2,150 MWs)

Retired Due to Market Conditions

D – Kewaunee (566 MWs)
F – Vermont Yankee (620 MWs)

Announced Retirement Due to Market Conditions

A – Oyster Creek (625 MWs)
H – Pilgrim (680 MWs)
I – FitzPatrick (838 MWs)
J – Clinton (1,069 MWs)
K – Quad Cities (1,871 MWs)
L – Fort Calhoun (476 MWs)
N – Diablo Canyon (2,240 MWs)

Source: POWER Magazine
World Nuclear Association

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Policy Solutions and Market Reforms

Proposed ratepayer financial support of existing nuclear units: Two cases, two outcomes	
New York's Clean Energy Standard (CES)	**Illinois' Next Generation Energy Plan (NGEP)**
Status: Passed	Status: Failed to Pass
Description: • The CES provides some, but not all, out-of-market nuclear plants zero emissions credits (ZECs), which are to be issued under 12-year contracts beginning April 2017 in two-year tranches • The value of the ZECs is based upon EPA's social cost of carbon, which is calculated by netting out the carbon and capacity market value of the plant; over time, ZECs escalate in value (like the federal construct) • The cost of the credits is estimated to total $250 to $400 million in annual subsidy for upstate NY plants; downstate interests have objected to underwriting power that they do not believe they receive	Description: • The NGEP sought to create a zero emission standard under which state regulators would review each nuclear plant annually to determine whether it was entitled to a modified compensation rate • If the plan had been approved, the additional compensation would have been dispersed only when market revenues failed to cover operating costs and risks; however, if revenues or costs were different than forecasted, there would have been no true-up mechanism • The bill also proposed mandatory demand charges for nearly four million customers and additional funding for low-income assistance programs, solar deployments, and energy efficiency initiatives
Estimated ratepayer impact: $2 per month	Estimated ratepayer impact: $0.25 per month
Number of Units Affected: 4	Number of Units Affected: 3

- Regulatory and legislative environments differ…and matter
- Other states including New Jersey and Pennsylvania are also exploring solutions modeled after New York's CES

Source: Industry news, NYPSC, nextgenerationenergyplan.com

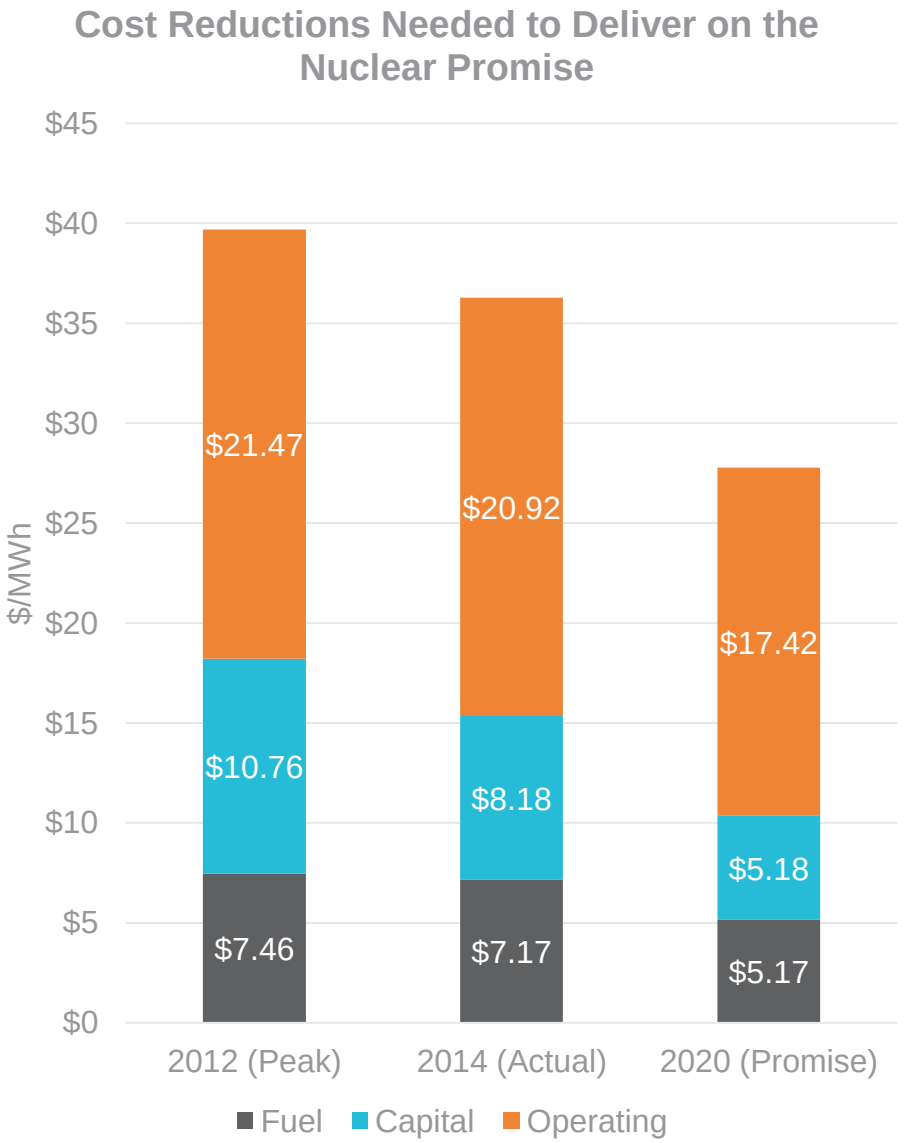
Delivering the Nuclear Promise

- Coordinated by the NEI, INPO, and EPRI, 'Delivering the Nuclear Promise' aims to:
  - Maintain safety and reliability
  - Increase revenues by addressing market design issues, e.g.:
    - Capacity price suppression
    - Inaccurate day ahead energy pricing signals
  - Significantly reduce reactor operating expenses by:
    - Implementing innovative technologies
    - Redesigning or simplifying plant and administrative processes

- Case Study: Nu-PathNET Implementation
  - A fully integrated network of automated radiological monitoring devices improved the capability, reliability and flexibility of the off-site network to respond to a Beyond Design Basis Event

- Case Study: Advanced Outage Management Implementation
  - Advanced communication and networking and analytical technologies allowed operators to conduct outages with fewer people in management roles while the remaining people became more effective and more productive
  - Net Zero NPV Investment Estimate: $48.96M

- Case Study: Mobile Work Packages Implementation
  - A selection of mobile work packages reduced the effects of cumulative impacts while improving work efficiency and mitigating human error
  - Net Zero NPV Investment Estimate: $21.73M



Source: NEI, Idaho National Laboratories

Decommissioning as a Last Resort

- The decommissioning process is long and has only been seen to completion 10 times in the United States; the industry is still figuring things out
  - Currently, 18 commercial power reactors are in decommissioning, and several more will transition over the next few years
  - As of August 2016, licensees had set aside nearly $53 billion for decommissioning, a 15% increase from the previous reporting cycle two years earlier
  - Plant owners are obligated to produce a remediated brownfield site within 60 years of retiring a plant
  - Generally, plants will spend 50 years in SAFSTOR and the remaining 10 in DECON

- In addition to demolition and deconstruction, the decommissioning process requires plant owners to:
  - Transform organizational staffing and skill sets
    - Retain knowledge of historical processes while decreasing staffing levels
    - Change the mentality of employees from an operations mindset to a heavy project management and oversight focus
    - Ensure adequate levels of regulatory safety expertise remains throughout the process
  - Transition workloads
    - Streamline work for ongoing projects
    - Administer an emergency response organization
  - Address community and regulatory needs
    - Manage the community with proactive communications
    - Integrate prudency specialists
    - Ensure appropriate contract setup

The impact of looming retirements on federal and state decommissioning funds is unknown.

Source: NEI

Chris Vlahoplus
Partner and Clean Tech & Sustainability Practice Leader

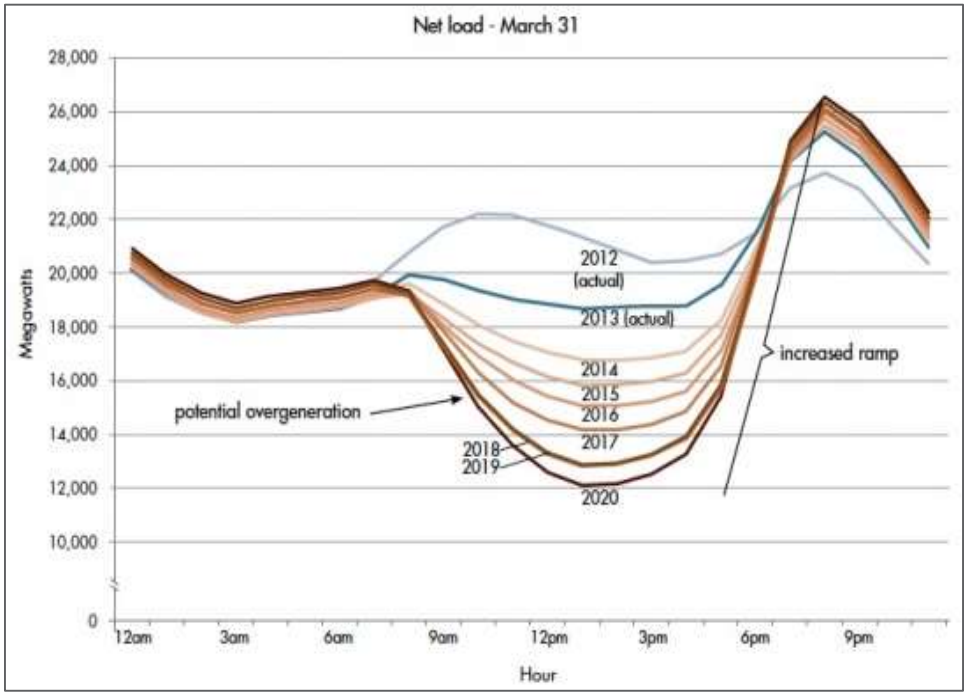
Chris Vlahoplus has been a management consultant to the energy and utility industry for 25 years. He leads ScottMadden's clean tech & sustainability practice area, including a role as co-leader of the firm's nuclear consulting practice. He has assisted more than 40 companies focusing on electric generation business management, merger integration, strategic and business planning, organizational restructuring, and management models. Chris earned a B.S. in mechanical engineering from the University of South Carolina, an M.S. in nuclear engineering from the Massachusetts Institute of Technology, and an M.B.A. from the University of North Carolina at Chapel Hill. Prior to joining ScottMadden, Chris worked in nuclear safety at Duke Power Company.

Revisiting the "Duck Curve"

Does It Mean What We Think It Means?

- In 2013, the California Independent System Operator (CAISO) conducted an analysis to understand how increasing penetrations of renewable resources would impact grid conditions
- The result was the iconic "duck curve" chart, which predicted that as variable generation grows so too will the trough of load served by conventional supply in midday
- This iconic chart has become a mainstay of the conversation on integrating renewables but do our interpretations align with reality?
- ScottMadden analyzed average hourly production data from CAISO from January 2011 through June 2016 to understand if actual results align with the original forecast and to see what new insights could be learned from the data behind the curve
- If we are to effectively address the challenges of the Duck Curve, we must understand the reality of its cause and behavior

The California Duck Curve Chart



Source: CAISO

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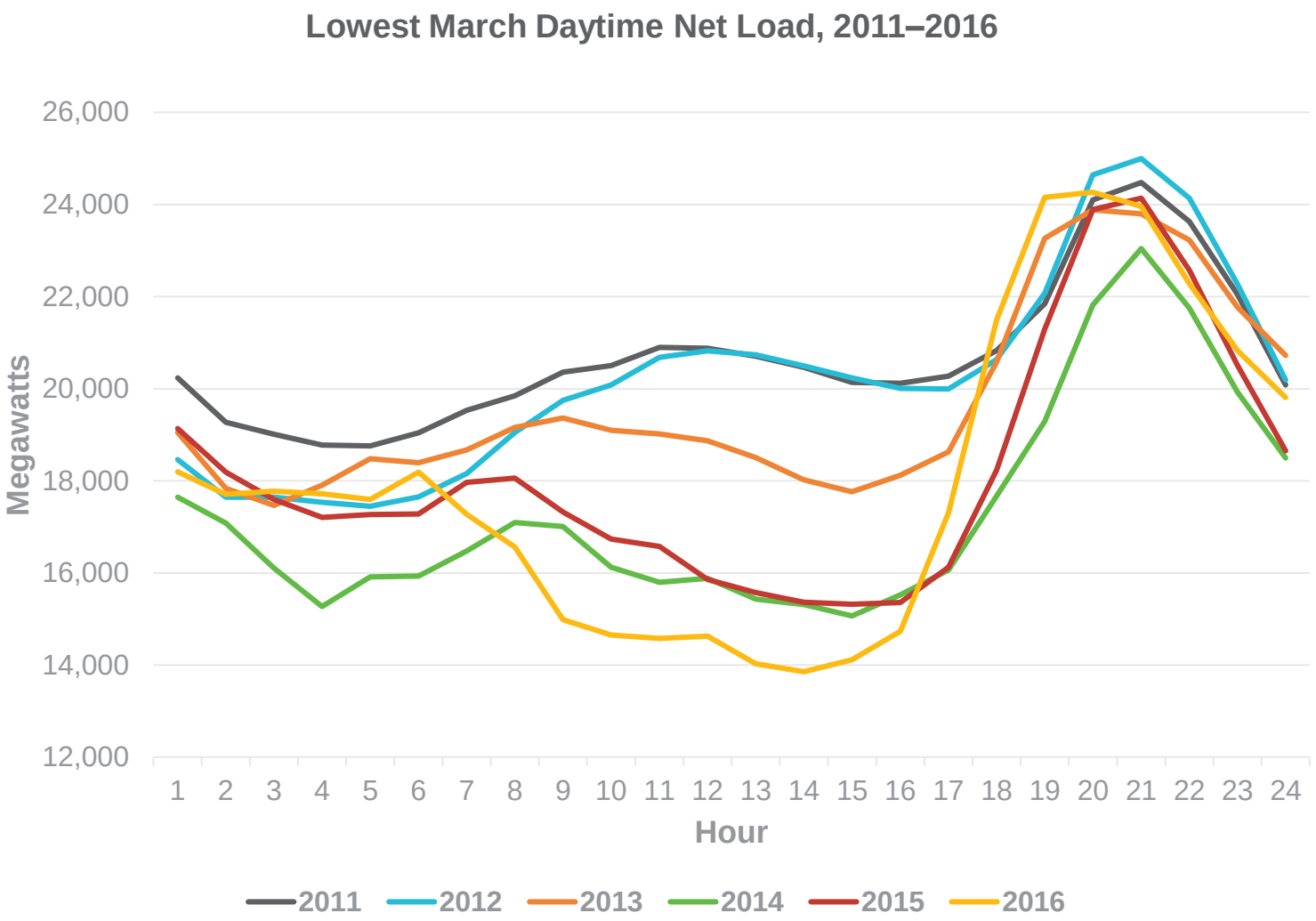
Duck Curve Is Real – and Growing Faster than Expected



Sources: CAISO, ScottMadden analysis

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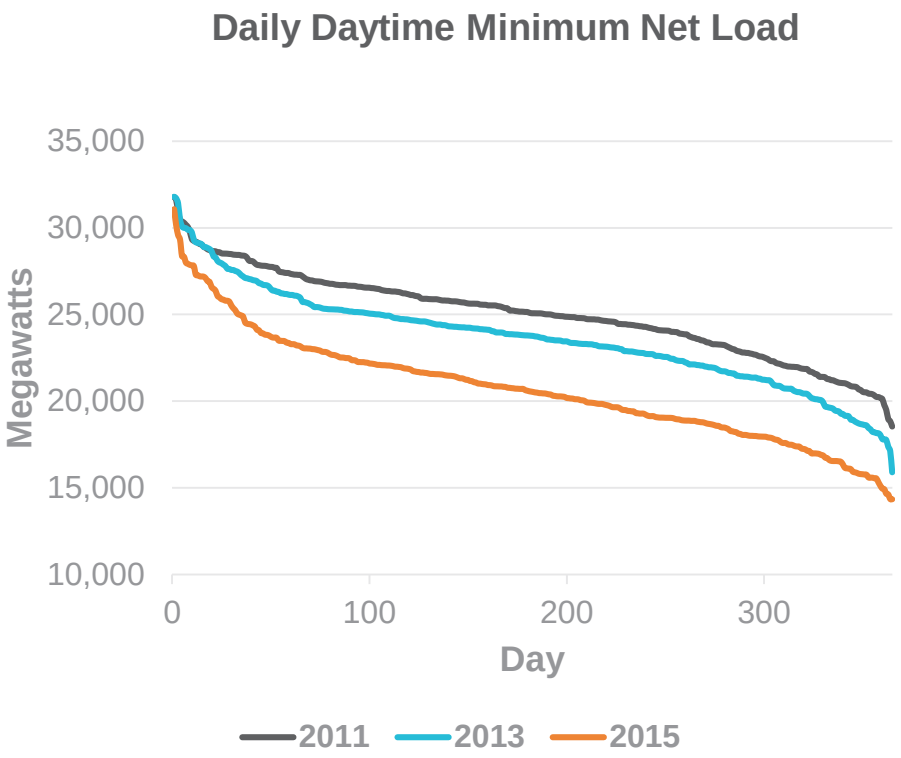
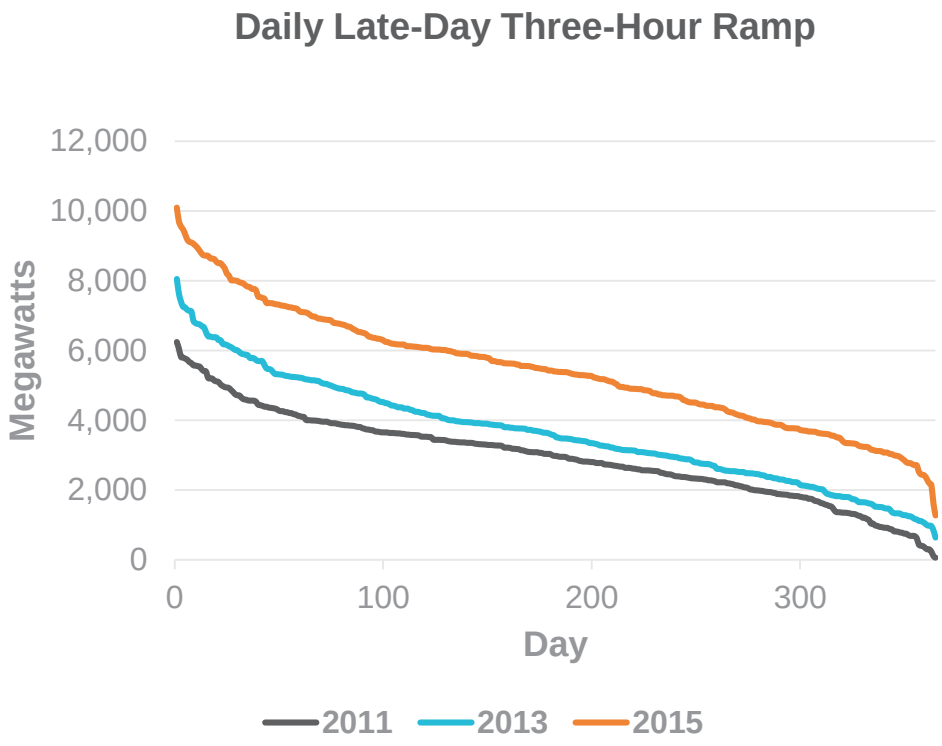
Shrinking Net Loads and Increasing Ramps (2011–2015)





Sources: CAISO, ScottMadden analysis

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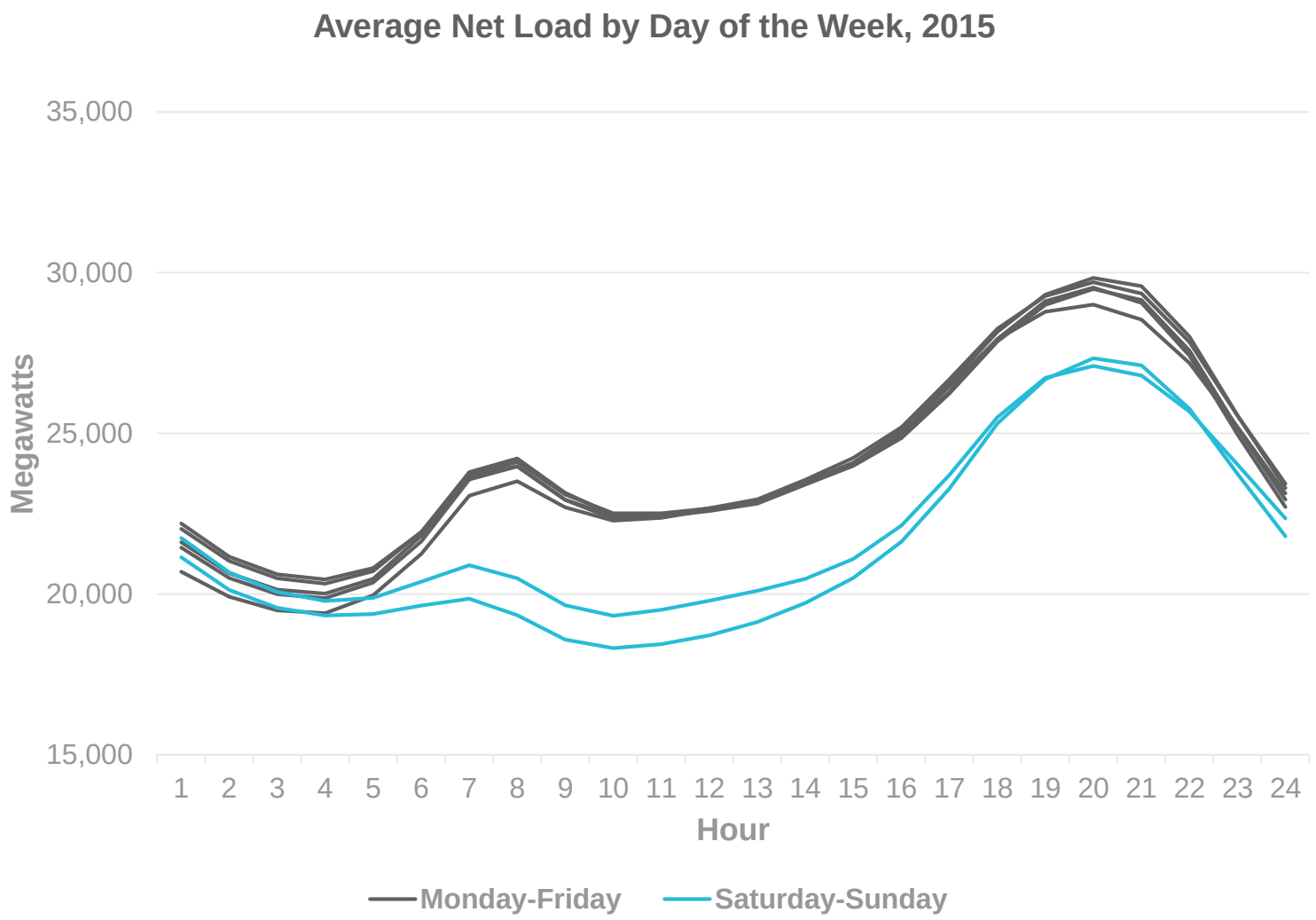
Revisiting the "Duck Curve"

Most Severe on the Weekends



Sources: CAISO, ScottMadden analysis

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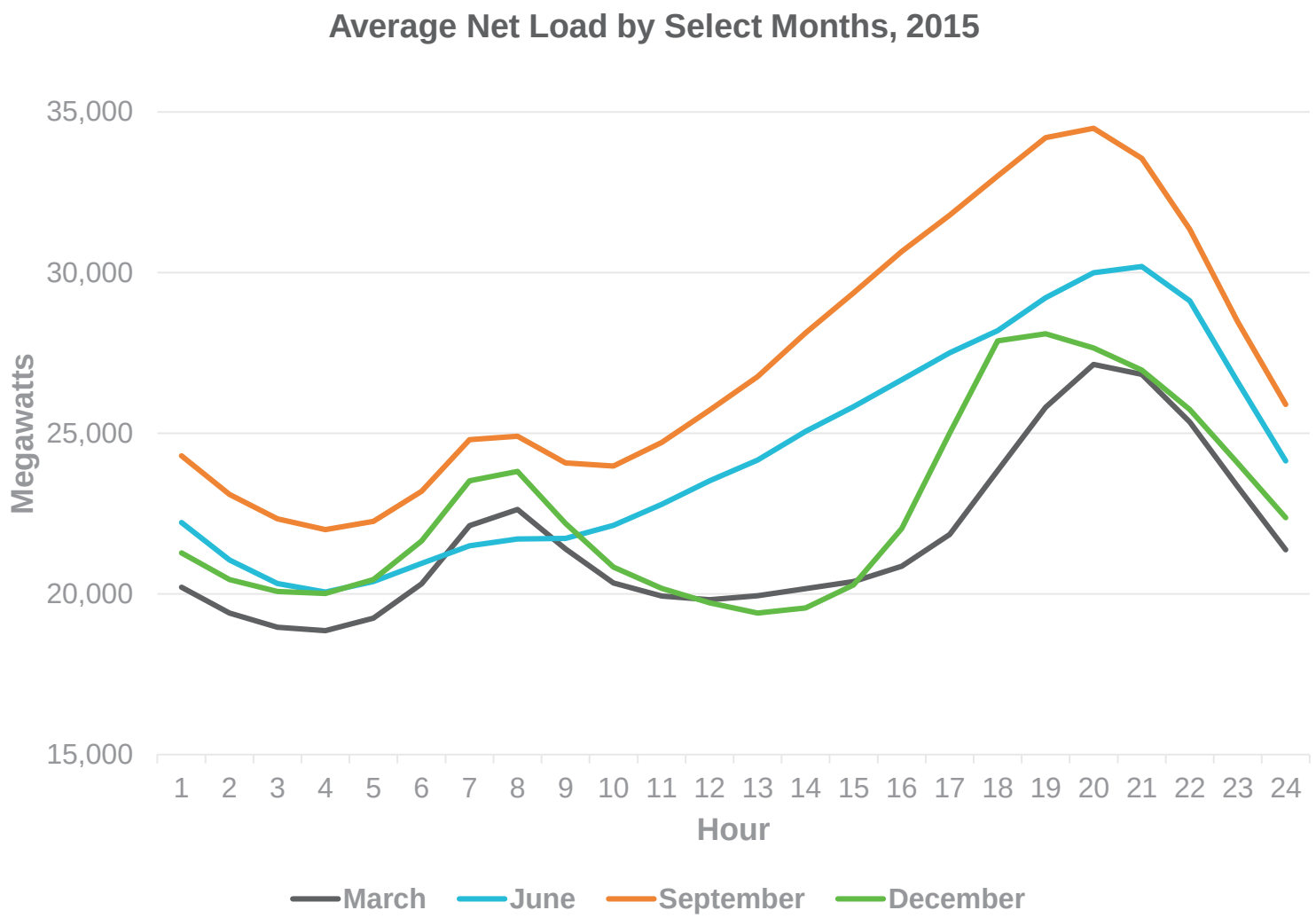
Occurring in Multiple Seasons, Not Just Spring Months



Sources: CAISO, ScottMadden analysis

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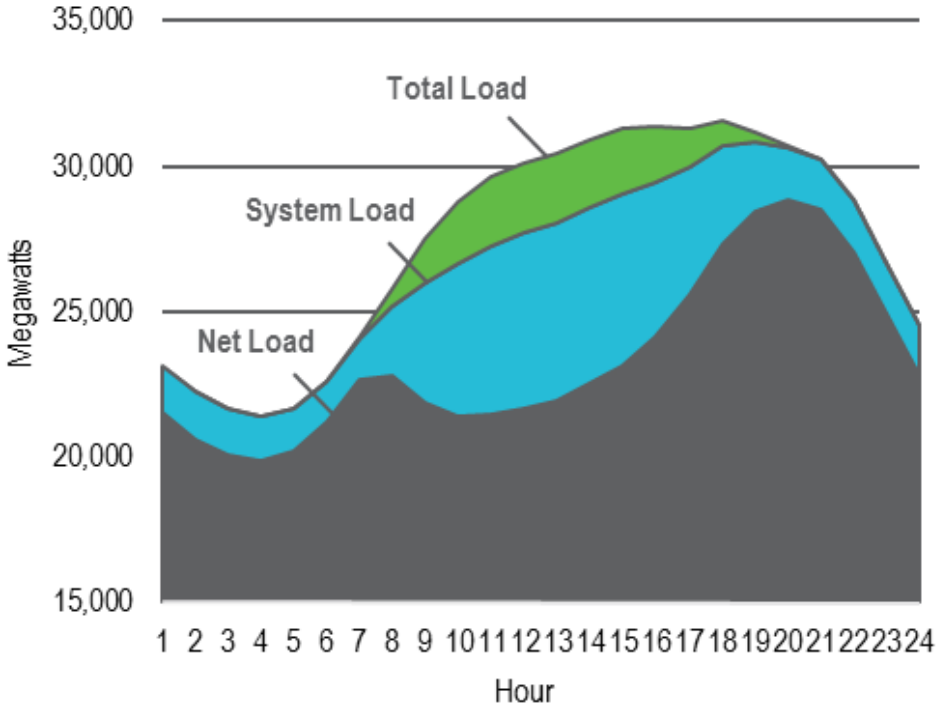
Revisiting the "Duck Curve"

Driven by Utility-Scale Solar, Not Distributed Resources

Relationship Between Total, System, and Net Load

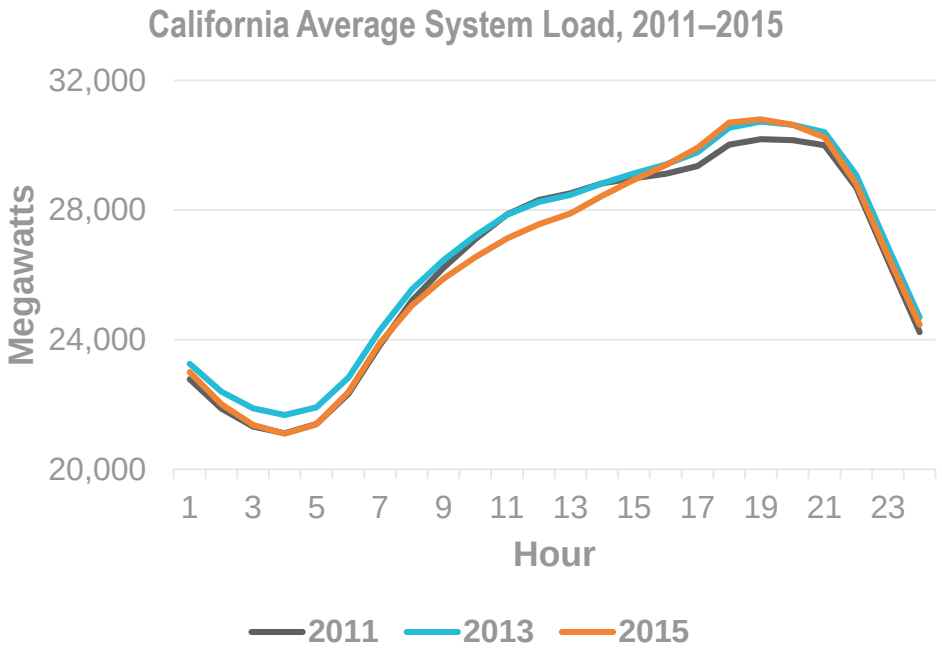


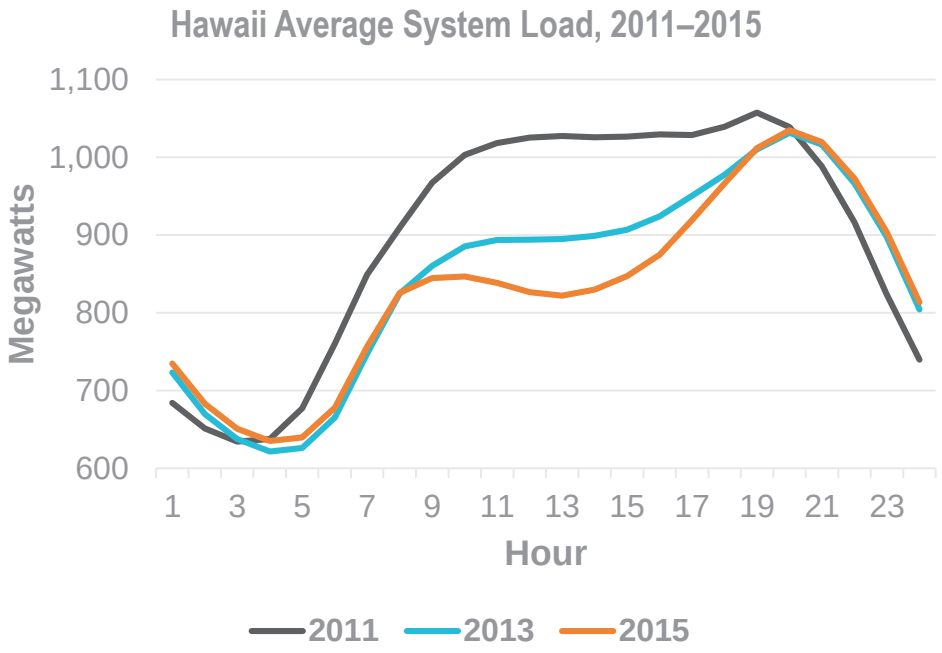
- ***Total Load:*** Total load regardless of supply source (behind-the-meter systems [e.g., rooftop solar PV] and the electric system [i.e., dispatchable generation, variable generation, and electricity imports])
- ***System Load:*** Load required to be supplied by the electric system (i.e., total load minus load served by behind-the-meter systems)
- ***Net Load:*** Load required to be supplied by electric system from dispatchable resources, including imports (i.e., system load minus load served by utility-scale variable generation – wind, solar PV, and solar thermal)

Source: ScottMadden

Driven by Utility-Scale Solar, Not Distributed Resources (Cont'd)

California and Hawaii Average System Load, 2011–2015





Sources: SNL Financial, ScottMadden analysis

Implications

Operational data suggests that projections of the duck curve effect in California are real and in some cases occurring sooner than expected

- Producing net loads lower than forecast
- Increasing ramps throughout the year
- Most severe on the weekends
- Occurring in multiple seasons, not just spring months
- Driven by utility-scale solar in California, not distributed resources

Understanding the unique causes and behavior can help inform mitigation strategies

- Mitigation strategies should recognize differing behavior depending on the day of the week and the time of the year
- Operational challenge associated with utility-scale solar present the potential for more targeted utility-scale solutions
- But, if you have a distributed solar issue like Hawaii, you will need a solution targeted to distributed resources

Lack of distributed solar does not make you immune: The duck curve may migrate to other regions sooner than expected

- States to watch in the near term include: Arizona, Georgia, Nevada, North Carolina and Texas
- Each of these states are forecasted to have more than 3,000 MWs of utility-scale solar by the end of 2021

Rick Starkweather
Partner and Regulatory Practice Leader

Rick Starkweather has been a management consultant for more than 25 years and leads ScottMadden's regulatory practice. His areas of expertise include strategic and business planning, budgeting and forecasting, regulatory compliance and rate case support, and organizational and operations improvement. Prior to joining ScottMadden, Rick was a consultant with Deloitte Consulting. He also has experience in the healthcare and chemical industries and helped lead the start-up of two companies. Rick received a B.S. in mechanical engineering from Northwestern University and an M.B.A. from the University of Chicago Graduate School of Business. He is also a Certified Measurement and Verification Professional (CMVP) and Certified Energy Auditor (CEA) through the Association of Energy Engineers.

Federal and State Energy Jurisdictions

Federal Policy Prescriptions

- Dis-integration of wholesale power generation and transmission
  - Order 888, RTO/ISO formation, market-based rates
  - Objective: unleash market forces to help drive down prices in an “inherently competitive” power generation sector
- Early outcomes and growing pains
  - Economic obsolescence of many generating units
  - Shifting fuel mix and “dash to gas”
  - Energy market price spikes
  - Low capacity prices and financeability challenges
  - Merchant boom and bust
- Over time, pure energy-only markets have been adjusted through a number of administrative (rules-based) mechanisms, including:
  - Price caps
  - Minimum offer price rule
  - Administratively drawn demand curves
  - Capacity markets
  - Capacity performance products

States Assert Their Interests

- States have overlapping but additional interests other than “just and reasonable rates”
- Increasingly, states are trying to manage energy sector outcomes
  - Renewables and distributed energy resources
  - Price
  - Generation development and retention of existing power plants
  - Environmental and carbon policies

Some Recent State Actions Drawing State-Federal Conflict into Focus

PURPA and Community Solar Rates	Ohio Power Plant Income Guarantees	New York Zero Emissions Credits (ZECs)
• Maryland implements pilot community solar (CS) regulations • Local utility "must use" excess CS generation and compensate it at retail rate • Regulation applied to cooperatives as well as investor-owned utilities • Utilities argue that: — They can only use excess CS by reselling to customers, thus it is a wholesale sale, subject to Federal Power Act — CS generator must be a QF — So CS generation offtake should be at wholesale avoided cost rate per PURPA, not retail rate per MD	• Ohio eight-year subsidy plan with income guarantees for utilities for their share of the output from certain "vital" power plants (largely aging coal plants) that face economic challenges • Costs recovered through non-bypassable distribution "rider charge" assessed to all end-use customers • Power suppliers challenged the guarantees as possibly distorting wholesale prices if bid into market	• New York has proposed awarding ZECs to certain nuclear plants, incenting rewarding their carbon-free characteristics and incenting them to remain online • ZECs are based upon the federal social cost of carbon, carbon emissions credit values, and an avoided energy cost based upon a forecast $39/MWh reference price • Some power suppliers and fossil fuel providers oppose the plan, claiming it will suppress prices in the New York ISO
• Pending before FERC • Could implicate issues that led to Order 745 (DR compensation), upheld by the Supreme Court in early 2016 • FERC can regulate wholesale markets and other matters "directly affecting" wholesale rates even if this "affects—even substantially—the quantity or terms of retail sales"	• Pending before FERC; decision expected early 2017 • FERC requires PPA filing and approval before implementation, alleges concern over benefits transfers from captive customers to shareholders from PPAs • Compare Maryland plan rejected by Supreme Court	• No challenge before FERC has been lodged • Some observers believe that the ZECs will pass muster because they do not adjust a wholesale rate, but rather reward a clean attribute, like other emissions credit schemes

The Latest "Workaround:" PJM Demand Curve Adjustment

Assessing the Proposal

- **In short**: Attempt to bolster capacity prices by acting as if subsidized units had not participated in the auction
  - **Stage 1**: Remove any subsidized capacity and commensurate demand (SC&CD) before executing the capacity auction mechanism
  - **Stage 2**: Once executed, re-insert the SC&CD at a reference price approximating each source's "going forward cost"*
- **Proposed Benefits**: Subsidized resources would not receive revenues from the capacity market, thus increasing the subsidy cost for the associated public policy regions, thus incenting them to pull themselves out of the auction
- **Anticipated Drawbacks**: The reference price of certain subsidized resources in Stage 2 could be lower than the clearing price determined in Stage 1, yet those resources would be prevented from securing a capacity commitment
- **The most significant questions that PJM would address going forward include**:
  - What's deemed subsidized?
  - How are reference prices determined?

Figure 1. Offered Supply and Demand Curve

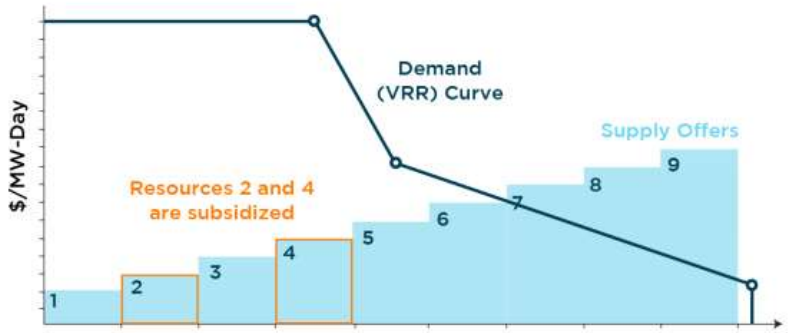
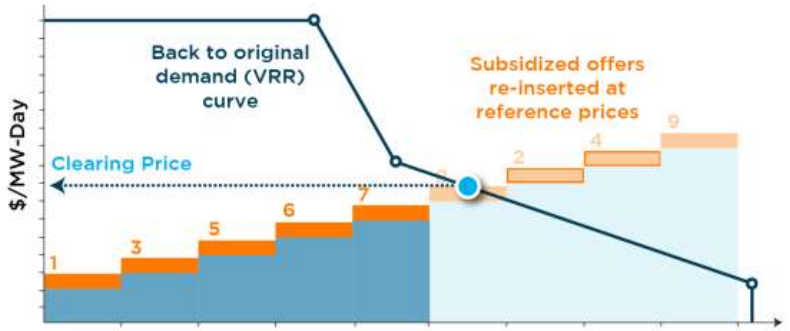


Figure 2. Stage 1: Subsidized Supply Offers and Equivalent Demand Removed

Figure 3. Stage 2: Subsidized Offers Re-Introduced at Reference Prices; Original Demand Curve Used



*Costs that would be avoided if the unit did not operate for a year

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Implications

- Market adjustments and responses have created hybrid system
- Recent Supreme Court decisions have been narrowly tailored to avoid categorically affording federal or state primacy
- This also has the effect of making the so called “bright line” between state and federal jurisdiction harder to see
- The uncertainty about whether a state policy or incentive crosses into FERC regulatory turf could lengthen lead time and increase risk and related costs for power resource investment
- Jurisdictional conflict also being felt in natural gas, e.g., PA-NY constitution pipeline

Greg Litra
Partner and Energy, Clean Tech, and Sustainability Research Leader

Greg Litra is a partner with ScottMadden, with principal expertise in financial, economic and regulatory analysis, strategic planning, corporate governance, risk management, and transaction support. He specializes in the energy and utilities business sectors. He also leads the firm's energy, clean tech, and sustainability research activities and spearheads publication of ScottMadden's Energy Industry Update. Prior to joining the firm in 1995, Greg was a corporate lawyer and business litigator on Wall Street and in Atlanta. As a lawyer, Greg worked with utilities, investment banks, and other companies in equity and debt offerings, project and secured financings, corporate litigation, and transaction due diligence. Greg earned a J.D. from the University of South Carolina School of Law, where he was editor-in-chief of the South Carolina Law Review, and an M.S. in industrial administration from Carnegie Mellon University. Greg is a Phi Beta Kappa graduate of Wofford College, where he earned a B.A. in economics and philosophy.

Questions and Answers

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See the link below for the latest Energy Industry Update
http://bit.ly/2dIVmWQ

Thank You for Attending!

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http://bit.ly/2dIVmWQ

See the link below for more information about the upcoming executive fact-finding mission to Australia

http://www.scottmadden.com/news/scottmadden-partner-sepa-executive-fact-finding-mission-australia/

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