GENERATION TO GENERATION

AN ENERGY EVOLUTION

Webinar

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Today's Agenda and Your Presenters

Cristin Lyons
Partner and Grid Transformation Practice Leader

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- Grid Modernization Distributed Investment
- Transmission Investment – Trends and Drivers
- What Could Change – Transmission Return on Equity
- Competition for Scarce Dollars

Stuart Pearman
Partner and Energy Practice Leader

Competition at the Crossroads: So…What Is Going on with Wholesale Electricity Markets?

- The Macroeconomics
- The Microeconomics
- What Is FERC Saying?
- What Is Being Done to Address These Issues?
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Paul Quinlan
Clean Tech Manager

The Solar Trifecta: A Path to Smart Utility-Scale Solar

- Smart Utility-Scale Solar: An Even Better Way
- The Solar Trifecta: The Path to Get There
- The Dawn of Smart Utility-Scale Solar

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

Questions and Answers

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Cristin Lyons
Partner and Grid Transformation Practice Leader

Cristin Lyons is a partner with ScottMadden and leads the firm's Grid Transformation practice, which helps clients adapt to the operational, planning, customer, and regulatory changes driven by the increasing penetration of distributed energy resources. Since joining the firm in 1999, Cristin has consulted with myriad transmission and distribution clients on issues ranging from process and organizational redesign to merger integration to project and program management. She is also a frequent speaker and panelist at conferences across the country.

Introduction

- There are many drivers impacting transmission and distribution grid investment
- While transmission spend remains robust, investment in grid modernization is increasing
- The industry is likely to see ongoing competition for scarce capital as both transmission and distribution are modernized
- This discussion will cover the following:
  - Grid modernization and investment in distribution
  - Investment in transmission – current and changing drivers
  - How the interplay between transmission and distribution may change due to:
    - Reducing transmission ROEs
    - Focus on grid modernization
    - DERs

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Grid Modernization and Distributed Investment

Grid Investment in a Distributed World

- Utilities are proposing grid modernization initiatives to increase reliability and resiliency
- There is no universal definition of grid modernization; however, a broad definition includes both physical assets and policy developments

Policy Elements	Physical Elements
Business model reform Rate reform Market access	Advanced grid technologies Microgrids Non-wires alternatives

Illinois: A Case Study

- Illinois' Energy Infrastructure Modernization Act (2011) was enacted to promote transformative grid modernization
  - Investment in AMI and distribution automation
  - IT and communication upgrades
- Future Energy Jobs Act (2016) is expected to encourage renewables and DERs
  - Addresses issues in RPS implementation and expands energy efficiency and creates a carve out for DERs
  - Creates a pathway for compensating distributed generation based on grid value
- Proactive regulatory environment has facilitated grid investment
  - Performance-based, formulaic ratemaking
- The early focus on infrastructure, reliability, and customer has provided the foundation for expanding renewables and DER

Approaches to Grid Modernization Differ

- States have differing approaches to grid modernization, some of which extend past the deployment of advanced grid technologies and address operations and rate design
  - Reform of the utility business model and use of alternative rate designs
    - Performance-based rate making
    - Decoupling
    - Time-varying rates
    - Residential demand charges
  - Change to utility planning and market access
    - Integrated resource planning
    - Distribution system planning
    - Changes to state or wholesale markets

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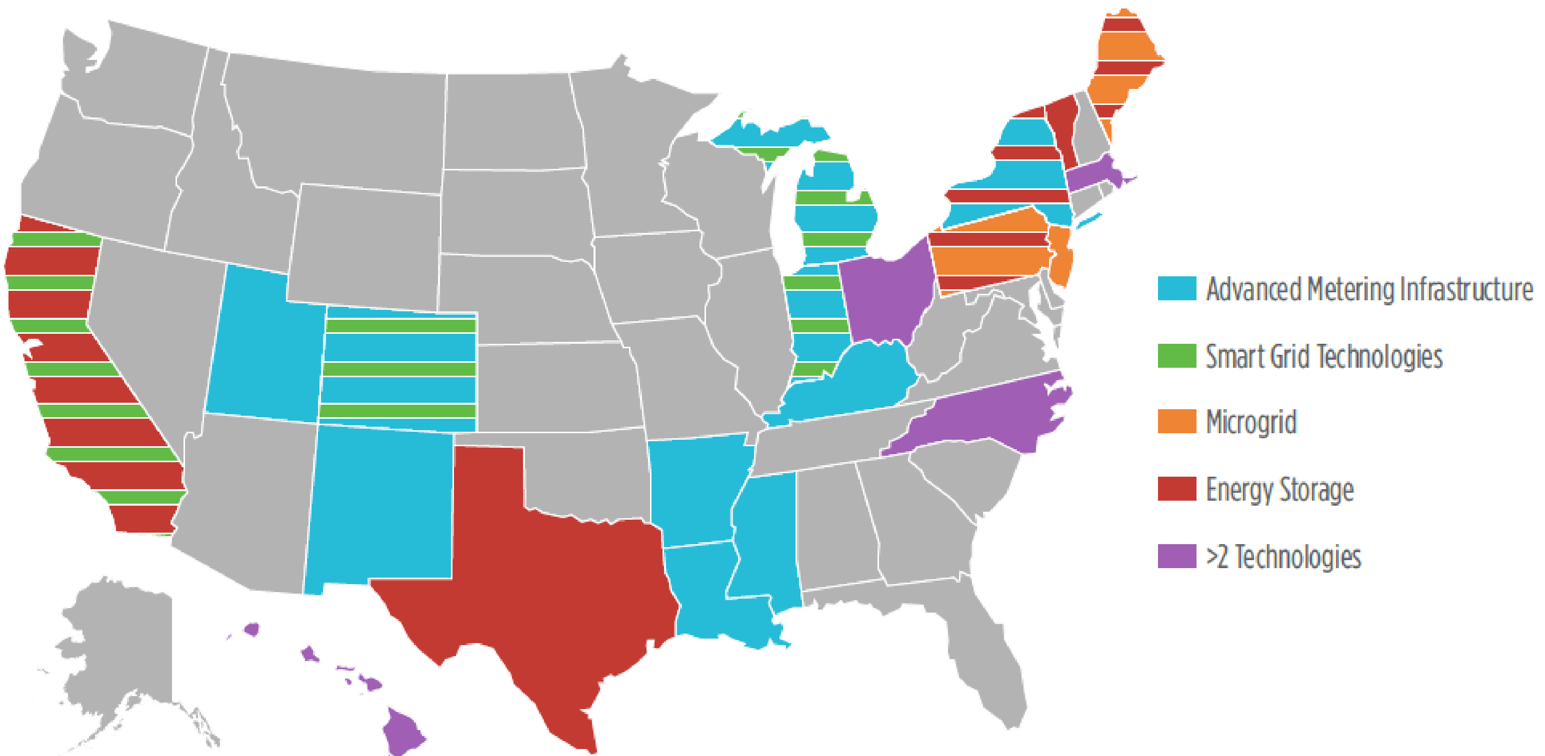
Grid Modernization and Distributed Investment (Cont'd)

States and utilities are increasingly pursuing actions to advance grid modernization efforts

- 14 states saw 22 activities in rate design restructuring or utility business model change
- Polices on grid modernization (e.g., energy storage targets/interconnection standards, advanced metering) were seen in 19 states
- Three RTOs and 15 states considered changes in wholesale market access or the utilities' planning process

Activity in Q2 2017 on Deployment of Advanced Grid Technologies by Technology Type



Source: NC Clean Energy Technology Center

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Transmission Investment – Trends and Drivers

"With increased intermittency on both sides of the grid, we need a strong backbone system more than ever!"

Driving Forces

- Transmission is needed to maintain reliability with increased renewables and intermittency
- The backbone system is still required to move large-scale generation to load; most generation is still central-station
- Ongoing investment is needed due to the age of the infrastructure
- The United States is seeing increased focus on resiliency/storm hardening

Restraining Forces

- Increasing demand response and energy efficiency are reducing peak load
- Siting and permitting are more difficult than ever; stakeholders are forum shopping
- ROEs are declining
- FERC Order 1000 has not yielded hoped for benefits; the level of competition in transmission remains low

"With declining demand growth and DER, we don't ever have to build another transmission line!"

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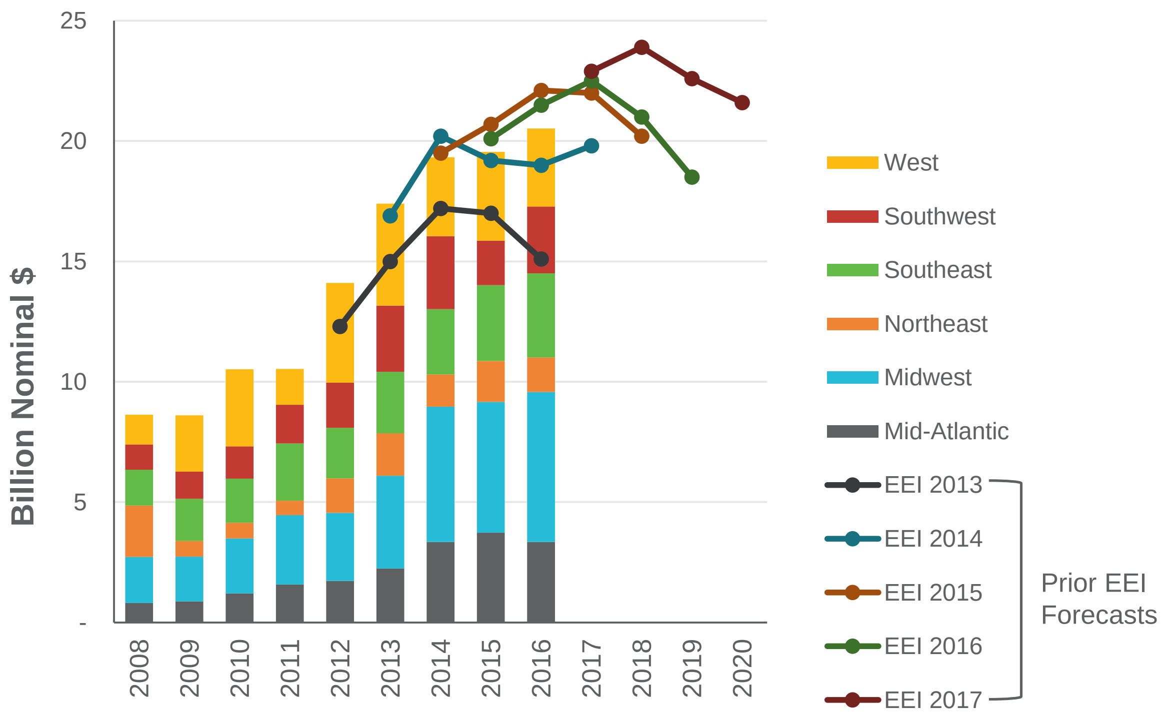
Transmission Investment – Trends and Drivers (Cont'd)

- Investment in power transmission has been growing; from 2011 to 2016, investment grew more than 16% (on a compound annual rate) for listed electric and diversified utilities
- Moving renewable resource power to load centers and ensuring grid flexibility with those resources continue to be areas of interest for transmission investment
- However, transmission development is focusing on more than planning for peak
- Other themes (both traditional and new) driving transmission investment include the following:
  - Replacement of aging infrastructure
  - Congestion relief
  - Voltage upgrades
  - Expansion to new resources/markets
  - Connecting geographically diverse, complementary resources
  - Achievement of clean energy goals

Historical and Projected Transmission Investment*



*EEI figures are from respective annual financial reviews, which show projected spending for report year and subsequent three years

Sources: SNL; EEI

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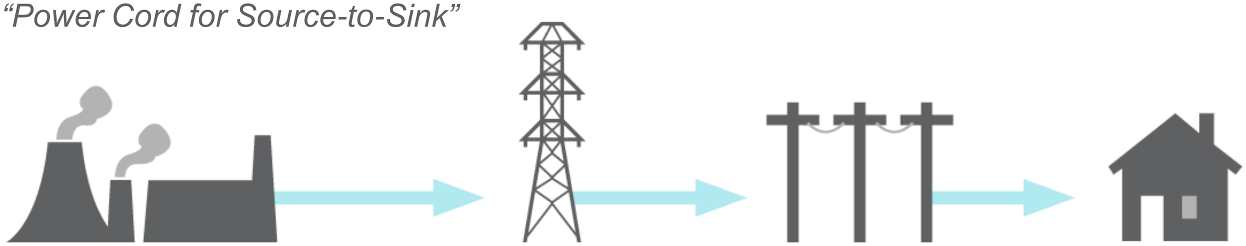
Transmission Investment – Trends and Drivers (Cont'd)

Grid Development Drivers Are Changing

Historical Model:
"Power Cord for Source-to-Sink"



Developing Model:
"Backbone for Bidirectional and Intermittent"

Model	Features	Grid Implications
Historical Model	• Large-scale units • Fuel diversity • Source-to-sink transmission • Built-in redundancy • Less complexity	• N-2 planning criteria • Planning for peak demand • Focus on line-loading, vegetation management
Developing Model	• Intermittency and "duck curve" effects • Less fuel diversity (gas)—single point vulnerability • Need for cyber resilience • Complex input-outputs, including backfeed	• Planning for low demand and intermittency • Increased need for frequency response, awareness, and essential reliability services • More detailed risk assessment and operational readiness

While the grid is changing across the country, the pace of change is very different state to state.

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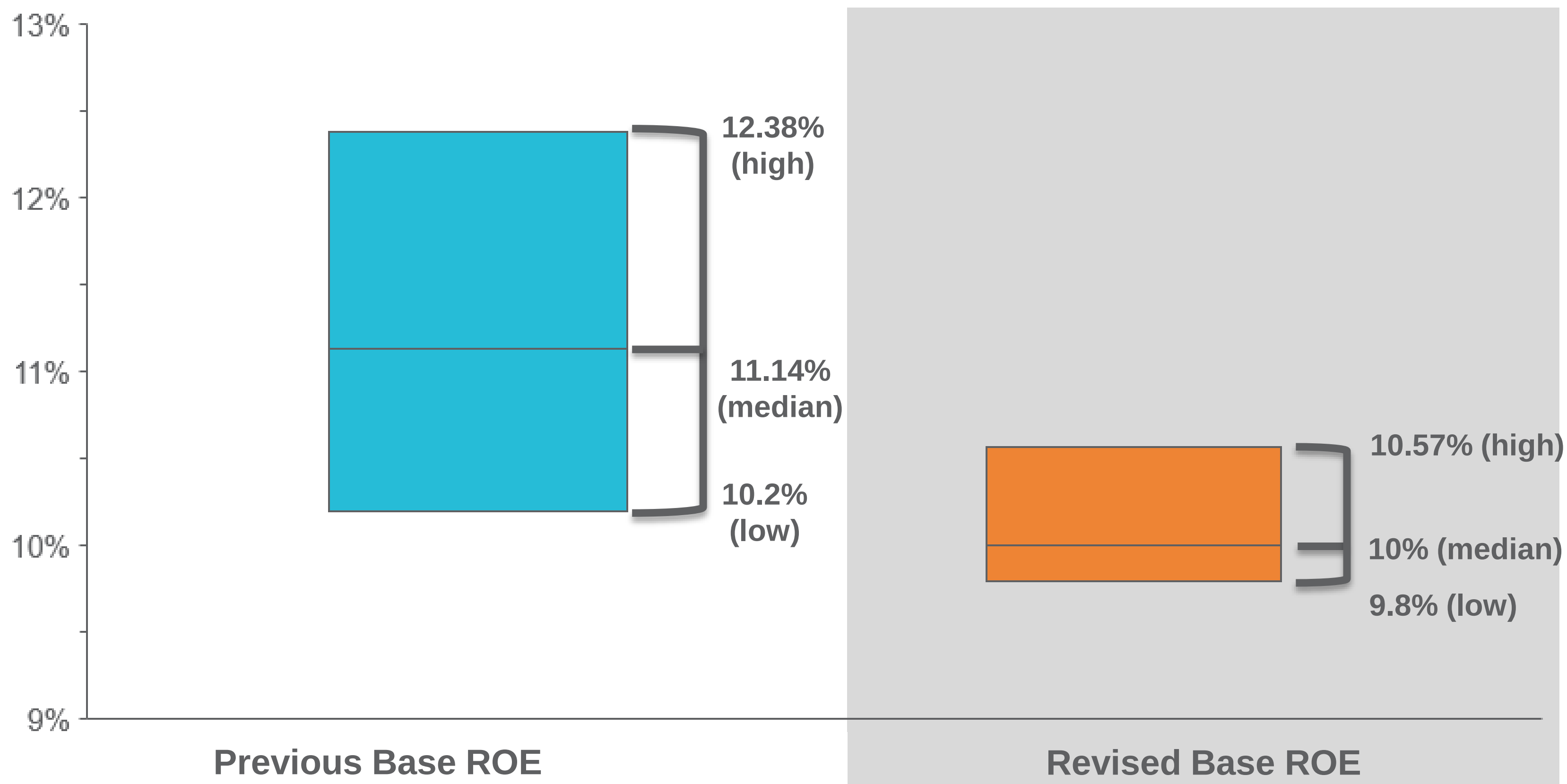
What Could Change – Transmission Return on Equity

Returns on equity in transmission appear to be converging with utility returns on equity

- Returns on equity approved by state commissions for electric utilities fell from 10.3% in 2006 to 9.6% in 2016
- Transmission returns on equity did not follow suit initially, but have recently been challenged and are being revised downward

Change in Transmission Returns on Equity
Sample of 13 Recent FERC Decisions



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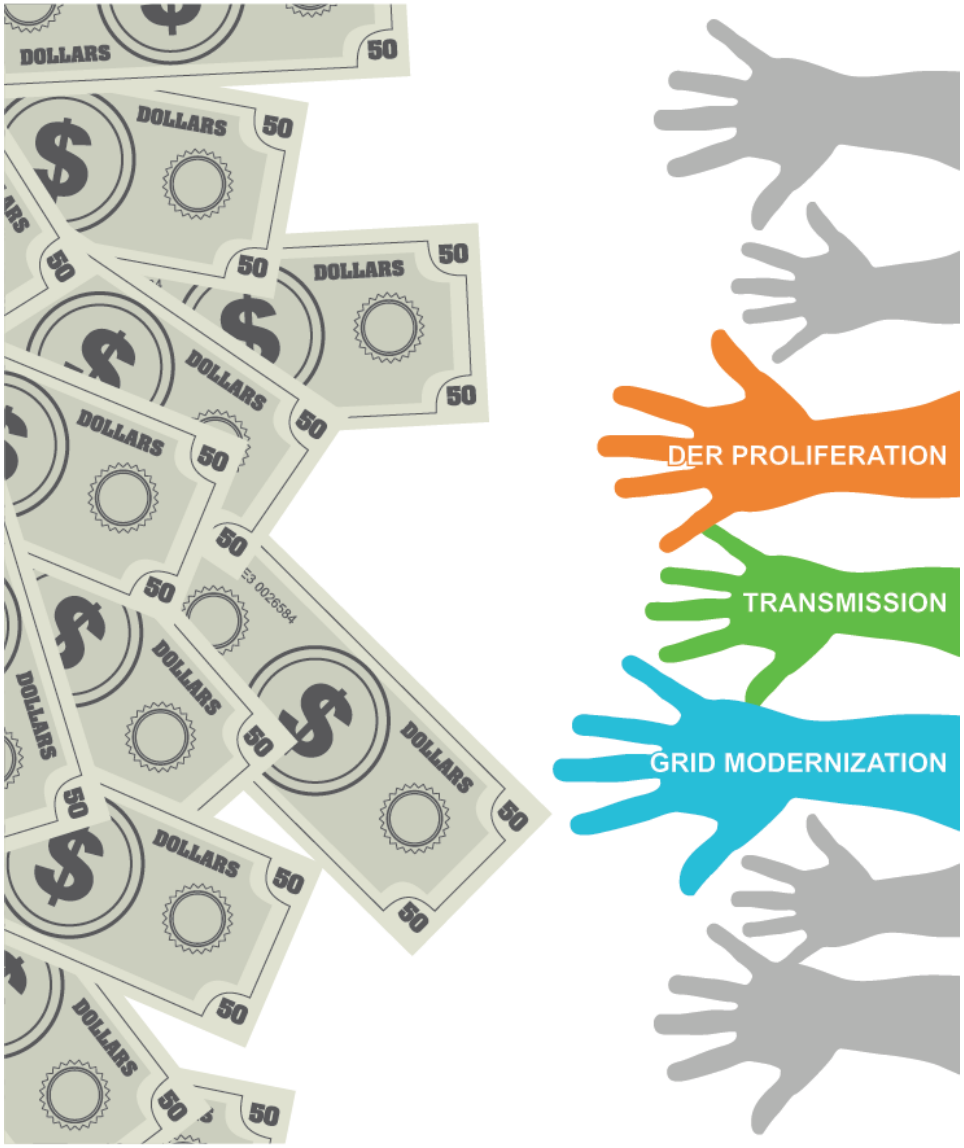
Competition for Scarce Dollars



What does this all mean??

- Assuming limited capital, utilities are facing more and more difficult capital allocation discussions
- When transmission ROEs were high, capital flowed to transmission
- As ROEs for T&D converge, utility investments are moving toward distribution
- State grid modernization programs and proliferation of DER are driving investment to distribution as well

What should the industry do?

- Ensure all parties are focused on the ongoing reliability of the grid
- Provide fair returns for parties; ensure the incentives drive behaviors in the right direction

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Smart Utility-Scale Solar: An Even Better Way

Moving from "Traditional" to "Smart" Utility-Scale Solar Power

- Traditional utility-scale solar is designed and operated to generate and deliver the maximum amount of electricity in real time. At high penetrations, these systems create significant operational challenges for the electric grid operators (e.g., California duck curve)
- A common response to this challenge is to simply pair traditional utility-scale solar with flexible natural gas generation. However, this is not the only option as utility-scale solar has the potential to become smarter and provide significant value to the electric grid

"Traditional" Utility-Scale Solar

- Utility-scale solar systems designed and operated to generate and deliver the maximum amount of electricity in real time
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- In the near term, "controllable" utility-scale solar may trades some energy output to cost competitively offer operational attributes comparable to conventional generation

"Traditional" Utility-Scale Solar

- Utility-scale solar systems designed and operated to generate and deliver the maximum amount of electricity in real time
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"Controllable" Utility-Scale Solar

Utility-scale solar systems that use existing technology to provide additional value and flexibility through targeted curtailments, smoother output, and expanded ancillary services.

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- In the near term, "controllable" utility-scale solar may trades some energy output to cost competitively offer operational attributes comparable to conventional generation
- Over the long term, "smart" utility-scale solar could emerge as a flexible and dynamic grid asset

"Traditional" Utility-Scale Solar

- Utility-scale solar systems designed and operated to generate and deliver the maximum amount of electricity in real time
- At high penetrations, these systems create significant operational challenges for the electric grid operators

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"Controllable" Utility-Scale Solar

Utility-scale solar systems that use existing technology to provide additional value and flexibility through targeted curtailments, smoother output, and expanded ancillary services.

→

"Smart" Utility-Scale Solar

Utility-scale solar systems capable of cost competitively offering comparable operational attributes as conventional generation assets. Smart utility-scale solar consists of PV+S.

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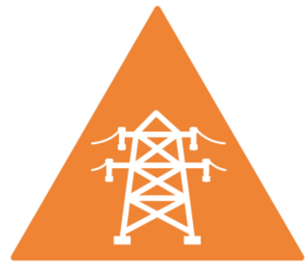
The Solar Trifecta: The Path to Get There

Three market requirements give a generation asset a competitive advantage

- Smart solar could become a reality with the convergence of the three market requirements that we call the “solar trifecta”



Value from Good Grid Citizenship
With smart inverters, utility-scale solar PV systems provide smoother, more predictable output; a broad suite of ancillary services; and targeted curtailment

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Energy When You Need It
Utility-scale solar PV plus storage (PV+S) allows a system to dispatch energy and capacity to meet evening and nighttime load

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Cost-Competitive Resource
Advances in operating intelligence coupled with declines in cost of utility-scale PV and batteries bring promise for cost performance competitive with other options

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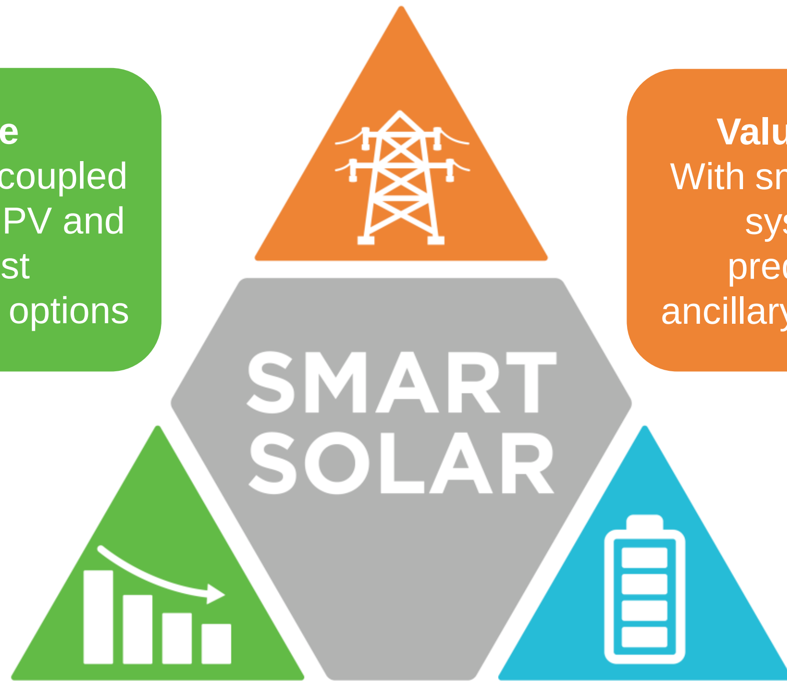
The Solar Trifecta: The Path to Get There

Three market requirements give a generation asset a competitive advantage

- Smart solar could become a reality with the convergence of the three market requirements that we call the “solar trifecta”
- In combination, these requirements address the constraints of traditional utility-scale solar and advance the deployment of smart utility-scale solar

Cost-Competitive Resource
Advances in operating intelligence coupled with declines in cost of utility-scale PV and batteries bring promise for cost performance competitive with other options



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The Dawn of Smart Utility-Scale Solar

The solar trifecta provides a clear pathway for smart utility-scale solar to offer tremendous benefits to consumers, the environment, and grid management.

- Advancements within all three pillars of the trifecta will be needed to ensure scalable deployment of smart utility-scale solar
- The opportunity and potential for smart utility-scale solar would be dampened if advancements in any one of the pillars of the trifecta fail to materialize
- In this context, a critical intermediate step will be the emergence of controllable solar

How Utility-Scale Solar Evolves to Meet Solar Trifecta Requirements*

Type of Solar	Value from Good Grid Citizenship	Energy When You Need It	Cost-Competitive Resource**
Traditional	✘	✘	✓
Controllable	✓	✘	✓
Smart	✓	✓	✓

* Table reflects requirements met by each type of solar; not necessarily current state of market.
** Cost competitiveness is dependent on location and available solar resource.

Several market developments and regulatory decisions could either hamper or accelerate advancement of the solar trifecta and ultimately the deployment of controllable and smart utility-scale solar. Key signposts to watch include:

- **Recognition of good grid citizenship** – New and innovative PPA structures and market rules could accelerate the learning curve and encourage future utility-scale solar systems to be model grid citizens
- **Success of early PV+S systems** – PV+S systems must prove their ability to reliably and consistently deliver energy and capacity during evening load periods
- **Continued Learning Curve Effects** – Continued declines in technology will be important if smart solar is to become cost competitive

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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 23 years and a partner for 17, he has performed more than 200 projects for more than 60 clients. Stuart has expertise across the energy utility ecosystem. 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.

Competition at the Crossroads: So…What Is Going on with Wholesale Electricity Markets?

So…What Is Going on with Wholesale Electricity Markets?

Plants are closing and their owners say the market is flawed, or worse.
The FERC is looking into price formation.
A lot is being said about wholesale electricity markets, but what is really going on here?

A difficult problem that evades a simple solution

- Least marginal cost hourly dispatch
  - Does not necessarily ensure a diverse set of capacity resources nor long-run total cost recovery of long-lived assets
- Capacity markets in several (but not all) competitive wholesale markets were formed to solve the problem of “missing money”
  - But have they?

What’s different now and what’s the concern?

- There are an increasing number of “outside of market” mechanisms to address state policy preferences
- Subsidized entry can affect price formation, changing market outcomes for other resources
- Key concern: The amount of capacity priced using “outside of market” mechanisms might reach a tipping point

	Price	Reliability	Resource Mix/Attributes	Other Social Goods
What FERC-Regulated Wholesale Markets Are Designed to Provide	▪ Just and reasonable rates ▪ Economically efficient prices	▪ Reliability ▪ Resilience	▪ Technology neutrality ▪ No “undue discrimination” – level playing field	
What States Want from Their Power Sector	▪ Affordable (low) prices	▪ Reliability ▪ Resilience	▪ Renewables goals ▪ Fuel diversity ▪ “Baseload” attributes ▪ CO_2 non-emitting resources ▪ Distributed energy resources ▪ Energy efficiency	▪ Economic development ▪ New energy technologies (electric vehicles, energy storage, etc.)

Decreasing alignment between states and wholesale markets and among different states

The issue can be framed as one of economics, both macro and micro.

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The Macroeconomics

- Power generation, unlike transmission and distribution, is not a natural monopoly, meaning a competitive market could, in theory, produce efficient allocation of resources and lower energy costs
  - But it was thought prices would only go down and we would never run out
  - In most competitive markets, prices can spike and there can be “stockouts”
  - So, to prevent that, electricity markets were tweaked with administrative overlays, multiple times, e.g., price caps and floors in lieu of scarcity prices
  - But some claim that as a result of these tweaks, current centralized, administered markets may have issues with price formation
- Competitive electricity markets are also criticized for not accounting for certain social costs and benefits, such as fuel diversity, resilience, and environmental attributes
  - This is the perspective of the states that have provided policy support for nuclear plants
    - IL and NY have acted
    - CT, NJ, IH, and PA are considering them
  - Some believe that participants are instead given to maximizing near-term individual benefit rather than system-wide, long-term benefit

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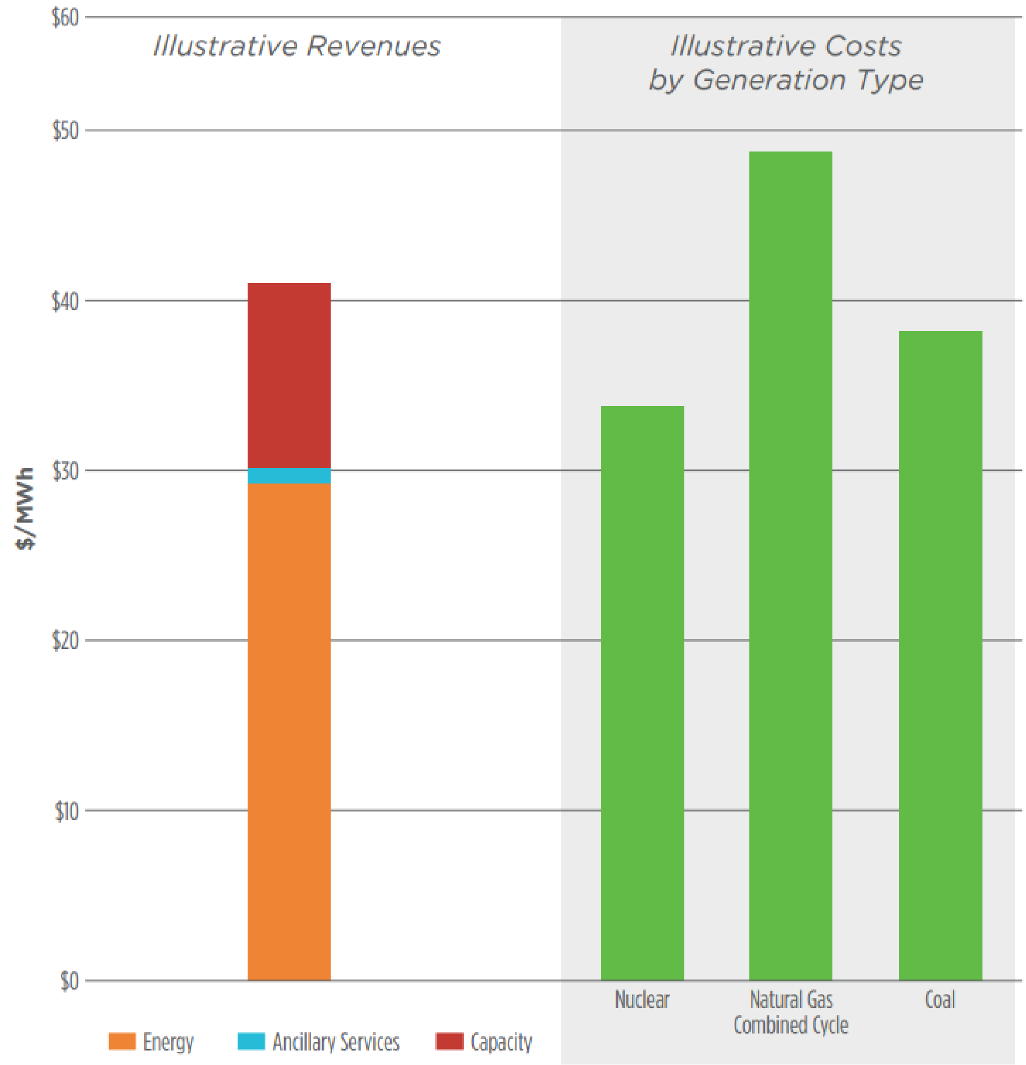
The Microeconomics

- Through RPS, states have added renewables like solar and wind to the mix for public policy reasons
- And this supply is often at zero short run marginal cost (SRMC)
- Because markets were born out of the dispatch system, SRMC is their "center of gravity"
- Microeconomics tells us that long run marginal cost (LRMC) is the proper basis for capital investment decisions like generation entry and exit
  - Pouring zero SRMC generation into an oversupplied market exacerbates the problem
  - Price signal may already be too low due to oversupply
- Market players with higher fixed costs, many of whom provide useful grid services and fuel diversity, find themselves disadvantaged by this set of circumstances
- So FERC, again, finds itself looking to solve the issue of the "missing money"
- (DOE is pushing FERC to properly compensate fuel secure plants with higher fixed costs which provide grid reliability)

Comparison of Costs and Revenues for Selected Generation Types



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What Is FERC Saying?

- In May 2017, FERC held a technical conference to discuss state policies and wholesale markets operated by ISO New England, New York Independent System Operator, and PJM Interconnection

Big Questions Proposed at FERC's May 2017 Technical Conference

Do you expect the markets will have to **attract new unsubsidized resources in the future based on market price signals**, or do you see **all resources from now on being chosen out of the markets by the states** beyond the resources we already have in the markets?

Are you ready to **negotiate a new market solution** or do you expect the **states to not procure resources** or pay subsidies required by legislation?

Do you anticipate **relying on the capacity markets to attract investment** in the future, or do you see **all future resources being chosen by the states** to meet state goals?

Does that include **resources to replace resources that are in the markets now** that might not be able to survive a hybrid structure?

Potential Paths Forward

Status Quo	Limited or No MOPR	Expanded Minimum Offer Price Rule	Accommodation of State Actions	Pricing State Policy Choices
Rely on existing tariff provisions applying MOPR to some state-supported resources and continuing case-by-case litigation	Limit MOPR only to state-supported resources where federal law pre-empts state action or do not apply MOPR at all to state-supported resources	Expand existing scope of MOPR to apply to new and existing resources that participate in capacity market and receive state support	Allow state-supported resources to participate in wholesale markets and, when needed, obtain capacity obligations subject to adjustments to market prices consistent with market results if resources had not been subsidized	State values targeted attributes (e.g., resilience) or externalities (CO_2 emissions) in a way that can be integrated into markets in a resource-neutral way (e.g., carbon price adder)

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What Is Being Done to Address These Issues?

Some themes have emerged in stakeholder discussions

- States will preserve their sovereignty and pursue their own policies
- Some stakeholders are interested in an accommodation of state goals, but are also concerned that this approach will lead to revisiting these same issues in a few years
- There is potential for spillover effects between states with different policy priorities
- Market operators believe they can tailor market mechanisms to accommodate state-driven resource interests by monetizing their impact
- States generally want centralized markets, but may not trust FERC solutions, especially where they might run counter to state public policy goals

Issues for Stakeholders to Consider

- Principles and objective to guide the path forward
- Degree of urgency for reconciling wholesale markets and state policies and whether separate near-term and long-term approaches are required
- Expected relative roles (long term) of markets and state policies in shaping quantity and composition of resources for reliability and operations
- Procedural steps FERC should take

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DOE Gets into the Act

- DOE directed FERC to increase compensation for baseload generators with a secure fuel source
  - Rule aims to enhance grid reliability
  - Attempt to provide “full cost recovery” for plants
  - Eligible plants:
    - Not subject to cost-based rate recovery
    - In an ISO or RTO with a capacity market
- FERC acknowledged DOE’s request for action
- FERC announced that it aims to hold true to DOE’s timeline
  - FERC denied the request of energy groups to extend the comment period from the scheduled 45 days
  - Market operators would have 15 days to submit compliance filings
- A questionnaire consisting of 30 questions was posted the beginning of FERC’s meeting on October 4
  - The questionnaire covers multiple topics both covered by DOE’s NOPR and topics not included
  - Topics include: Need for Reform, Eligibility, Implementation, and Other
  - In addition to general eligibility, the Eligibility section includes question about the 90-day fuel requirement and fuel supply requirements
- FERC’s May Technical Conference may be the event for final rule-making
  - Conference description: “Technical conference to discuss certain matters affecting wholesale energy and capacity markets operated by the Eastern Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs).”

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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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Smart. Focused. Done Right.

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Smart. Focused. Done Right.

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