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THE SCOTTMADDEN ENERGY INDUSTRY UPDATE

Webinar

June 1, 2018

Volume 18 - Issue 1

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Stuart Pearman
Partner

Welcome and Introduction

Preston Fowler
Director

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- No Paris Agreement. No CPP. No Worries, Some Say
- But Will It Matter?
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Paul Quinlan
Clean Tech Manager

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- Virtual or Synthetic PPA Structure
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Kevin Hernandez
Director

Energy Storage

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- Utility Energy Storage Maturity Model

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

Questions and Answers

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Clean Tech Manager

Paul Quinlan assists clean energy and utility clients with market research, strategic planning, business planning, and due diligence evaluations. Prior to joining ScottMadden, he worked as managing director of the North Carolina Sustainable Energy Association, a nonprofit organization focused on renewable energy and energy efficiency policy issues. He has also taught energy courses at North Carolina State University and served on the board of directors of Clean Energy Durham. Paul earned a master of public policy and a master of environmental management from Duke University and a B.S. from the University of Notre Dame.

Renewable Energy Procurement Options

Purchase Renewable Energy Certificates (RECs)

Procure On-Site Generation

Participate in Utility Green Tariff

Sign Power Purchase Agreement (PPA) with Renewable Project

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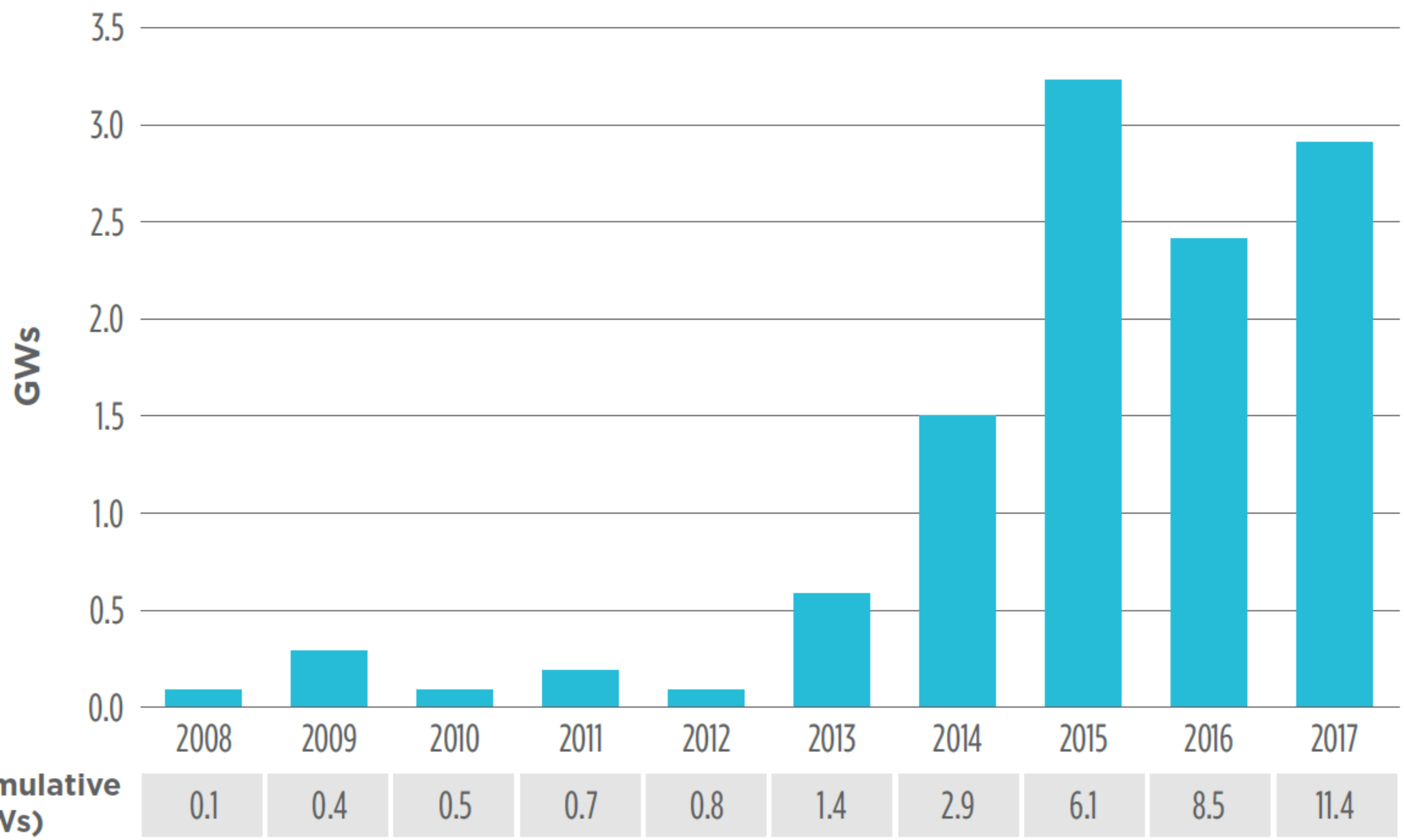
Trends in Corporate Renewable PPAs

Annual U.S. Renewable Capacity Contracted by Corporations



Source: BNEF

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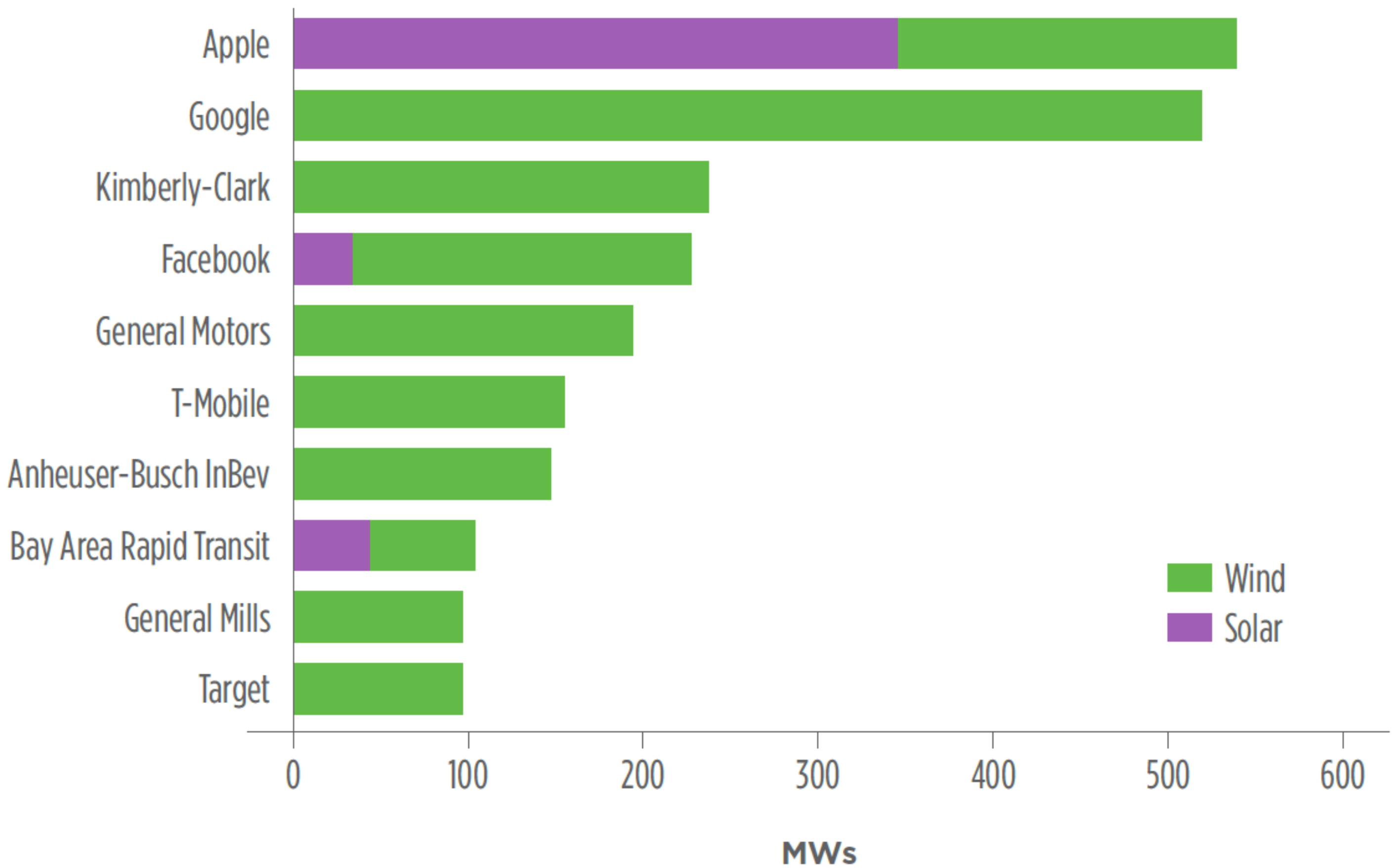
Trends in Corporate Renewable PPAs (Cont'd)

Renewable Contract Volume By Largest U.S. Corporate Offtakers in 2017



Source: BNEF

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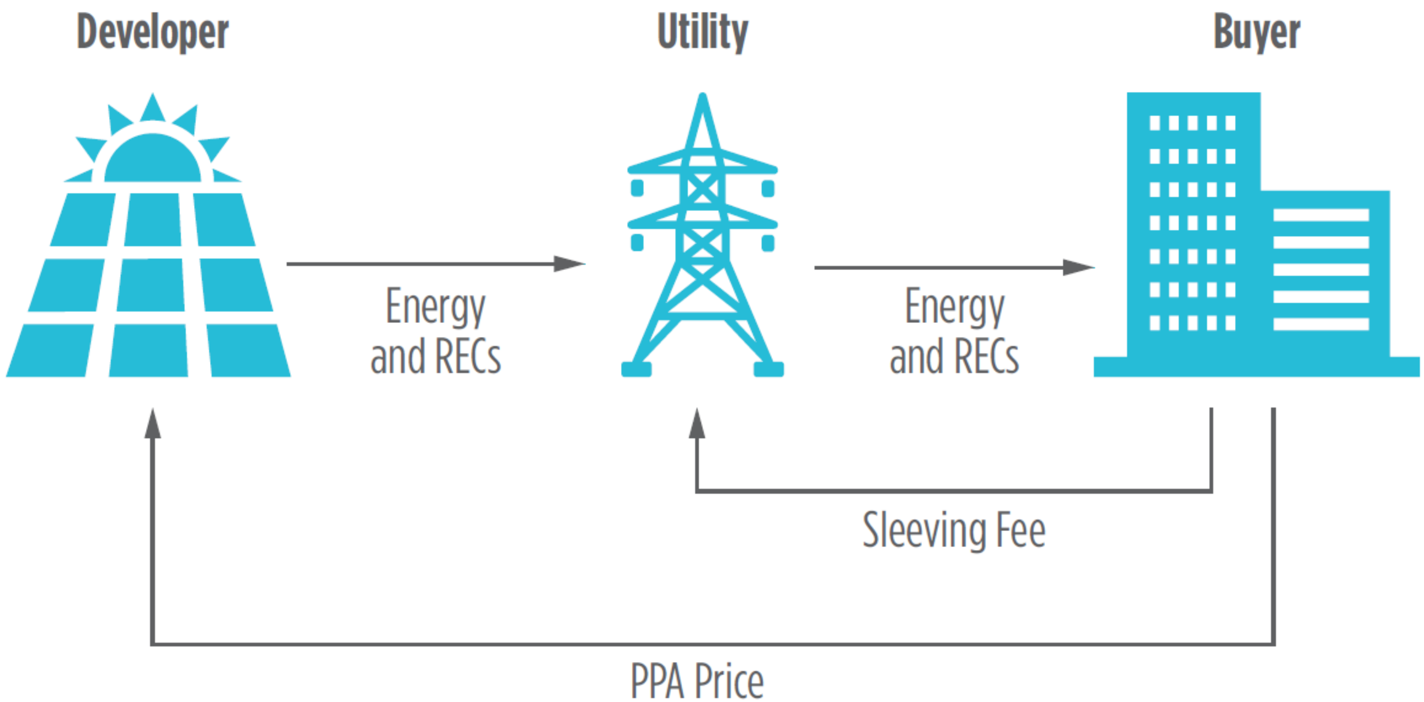
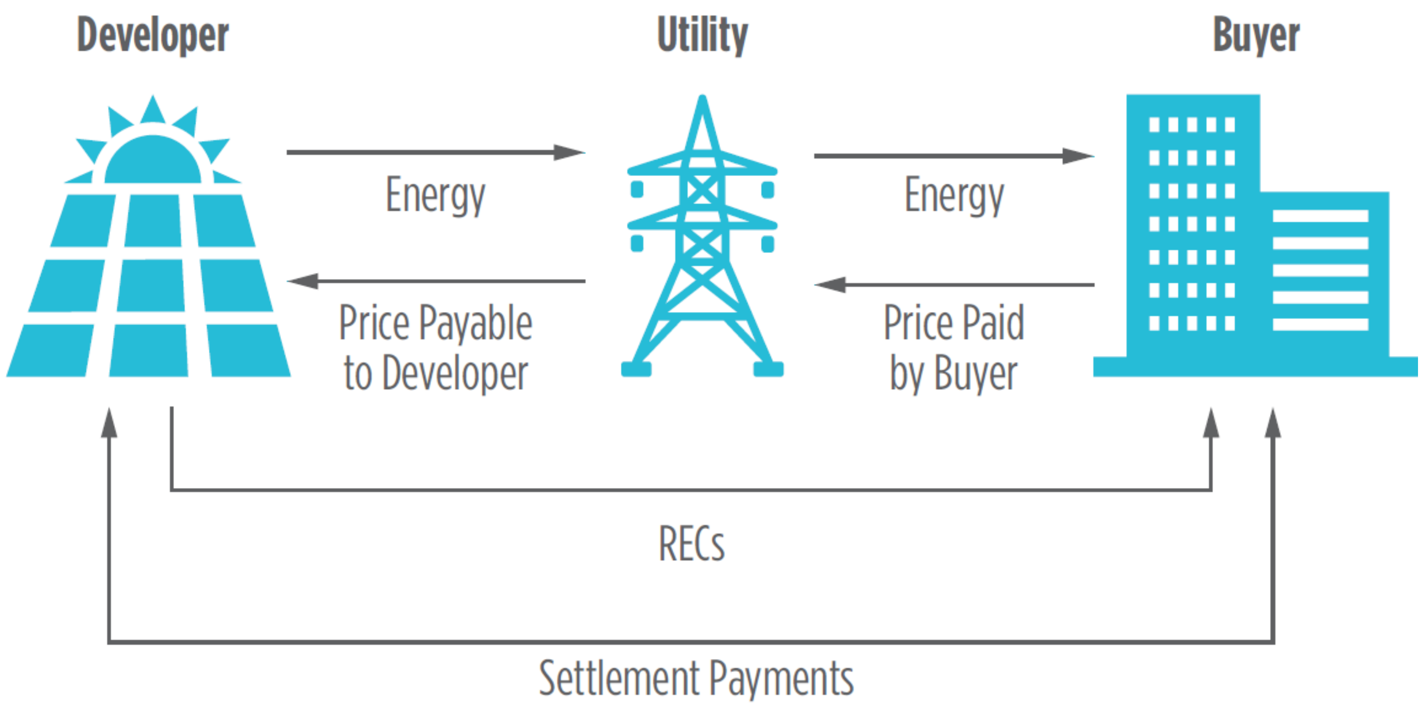
Physical or Sleeved PPA Structure



Sources: WBCSD, ScottMadden

Virtual or Synthetic PPA Structure



Sources: WBCSD, ScottMadden

Risks and Implications of Virtual PPAs

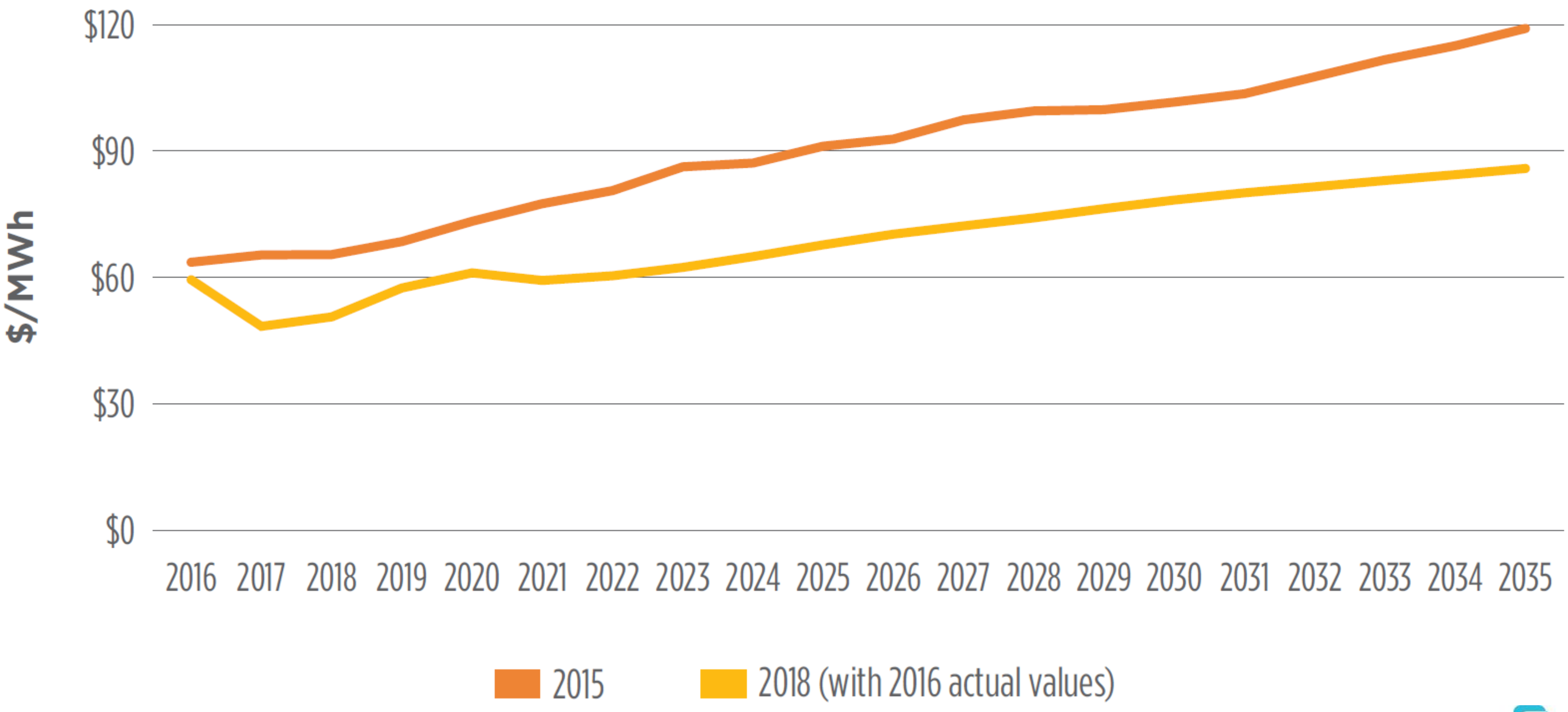
Unique Risks

- Accounting treatment
- Basis risk
- Power price risk

Notable Implications

- Movement into supply chain
- Increasing service providers
- Impacts on system planning

Power Price Risk: Generation Service Projections for Texas Regional Entity



Source: EIA

Marketing Renewable Energy Claims

	Scenario 1	Scenario 2	Scenario 3
What Was Done	• Manufactured and assembled with on-site solar capacity • RECs retired	• Manufactured with non-renewable electricity, but assembled with renewable electricity • RECs retired	• Manufactured and assembled with on-site solar capacity • RECs sold to third party
Valid Claim	"Made with 100% renewable electricity"	"Assembled with 100% renewable electricity"	No valid marketing claim about renewable electricity

Preston Fowler
Director

Preston Fowler is a director with ScottMadden and co-leads the firm's fossil practice. Preston joined ScottMadden in 2006 after obtaining an M.B.A. in finance and organization and management from the Goizueta Business School of Emory University. Since joining ScottMadden, he has primarily worked on electric utility projects focusing on process improvement, business planning, strategy development, benchmarking, and project management. While pursuing his degree, Preston interned at EarthLink, serving as an internal consultant and working on creating a new process map for improved project management for the customer support organization. Prior to business school, he worked as a project and design engineer for Delphi Corporation. In addition to an M.B.A., Preston holds a B.S.E. in mechanical engineering from Duke University.

What a Long, Strange Road It's Been

2006

April 2, 2007
Massachusetts vs. EPA

December 15, 2009
Endangerment finding

June 20, 2011
American Electric Power vs. Connecticut

August 3, 2015
Clean Power Plan (CPP) promulgated

February 9, 2016
CPP challenged and Supreme Court stays implementation

September 2016
West Virginia vs. EPA en banc hearing

2019+

March 2017
Executive order to revisit "burdensome" regulation

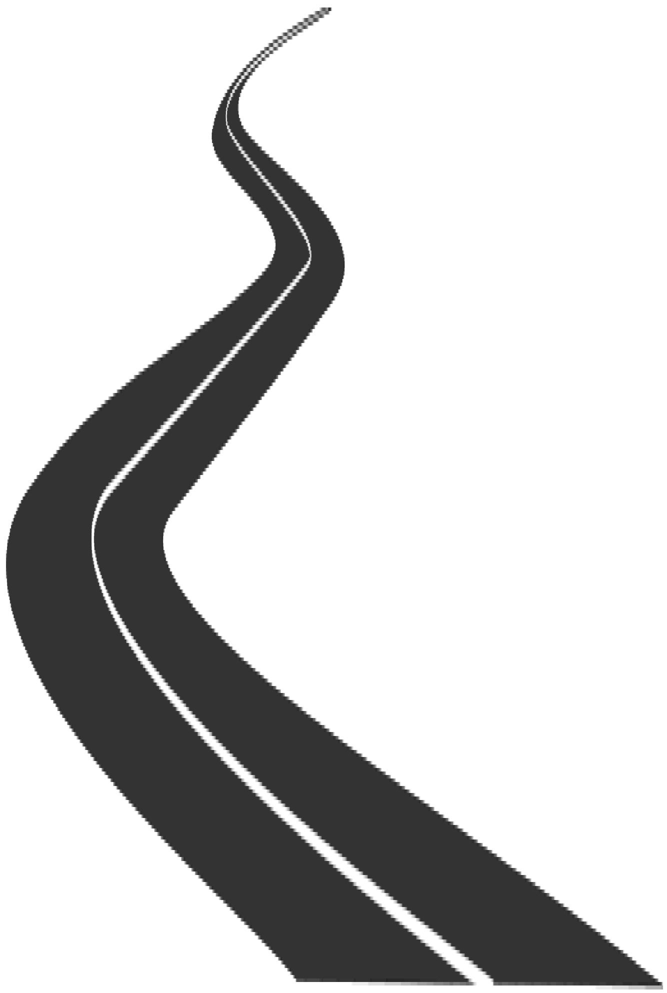
October 2017
EPA proposes repeal of CPP (NOPR)

December 2017
EPA solicits comments on possible successor to CPP (ANOPR)

February 26, 2018
Deadline for comments on CPP replacement ANOPR

April 26, 2018
Deadline for comments on CPP repeal NOPR

December 2018
Possible date for action on NOPR and ANOPR?



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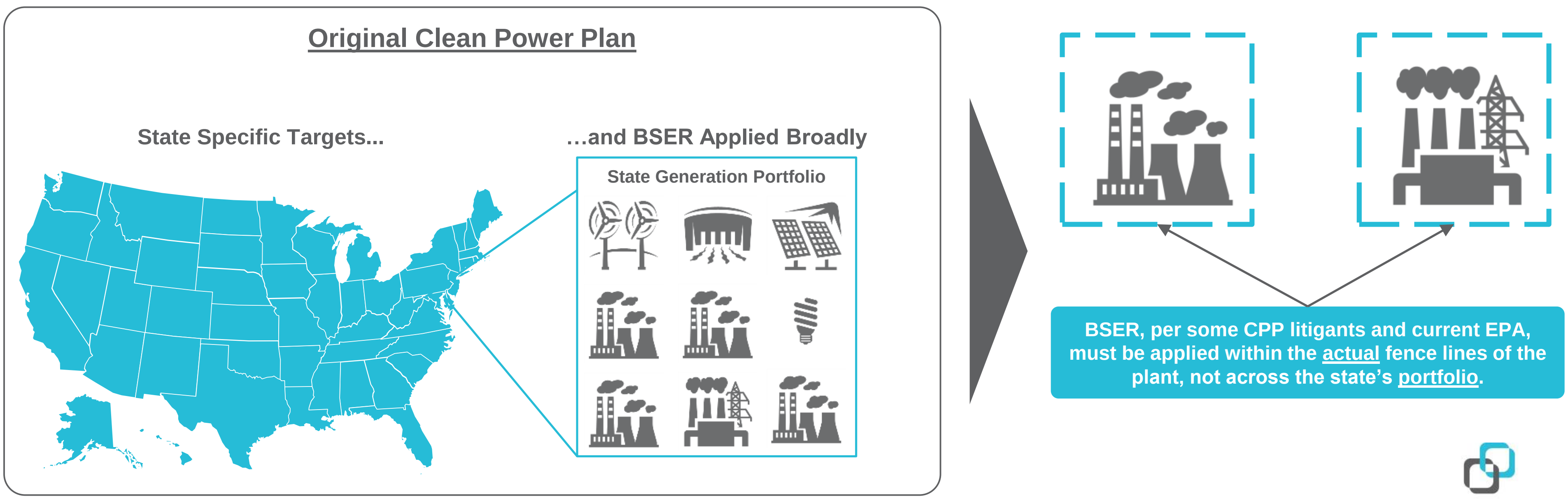
EPA’s Proposed Clean Power Plan Repeal

Key Points of Contention with Clean Power Plan (CPP)

- The key issues in litigation, as well as among the current EPA Administrator’s objections:
  - Inside the fence as best system of emissions reduction (BSER)
  - State energy policy prerogatives and jurisdiction
- Per EPA, repeal is necessary
  - CPP can only work with generation shifting
  - Removing those “outside the fence” building blocks will not ensure compliance
- Debate over the propriety of repeal continues
  - Environmental organizations and some states challenge the sufficiency of analysis behind repeal
  - Others will await the outcome of both repeal and replacement activity

Original CPP-Asserted Jurisdiction Subject to Debate



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EPA's Proposed Clean Power Plan Repeal (Cont'd)

A Matter of Accounting: Some Areas of Divergence for Impact Analysis

	Original CPP Analysis	CPP Repeal Analysis
Is EE cost savings or forgone benefit?		
Reduced demand/ climate impact from demand-side EE	Cost savings	Forgone benefit
Do co-benefits* count?		
Forgone health benefit	Higher $PM_{2.5}$ and SO_2 co-benefits	Lower $PM_{2.5}$ and ozone risks and lower forgone benefits below existing $PM_{2.5}$ and ozone targets (e.g., NAAQS)
How broadly should benefits be counted?		
Forgone climate benefits outside of United States	Global social cost of carbon	U.S.-only social cost of carbon

*Benefits from emissions reductions outside the scope of targeted emission

Tallying Costs and Benefits

- Key in EPA's regulatory impact analysis, which is being finalized, is its divergence from the Obama EPA's cost-benefit analyses supporting the CPP
- In proposing repeal, EPA performed incremental cost-benefit analysis from repeal (forgone benefits vs. avoided costs) in a required regulatory impact analysis (RIA)
- In particular, EPA analyzed costs and benefits differently in it repeal analysis (see table at left)
- EPA, in its RIA, acknowledged non-monetized costs and benefits, including ocean acidification and ecosystem effects

These changes up the costs from \$8.4B to \$33B in 2030, upending cost-benefit ratio.

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…And People Are Talking

ANOPR Issued with Comments on a Short Fuse

- In December 2017, EPA released an advance notice of proposed rulemaking, seeking input into GHG guidelines for existing generating units that would succeed the Clean Power Plan
- The ANOPR contemplates replacing the CPP with a possible new existing source GHG regulation under 111(d) of the CAA

Preparing to Play Defense?

- Supporters of the Obama-era CPP are expected to challenge any successor rule that;
  - Gives states too much discretion under a federal standard
  - Does not materially reduce emissions, which is ironically more challenging given recent reductions in power sector GHG emissions
- Some industry observers believe that EPA hopes to complete "repeal and replace" by the end of 2018

Considerations for New Guidelines for Existing Generating Units

- ❑ Roles and responsibilities of the states vs. EPA
- ❑ "Best system of emission reduction" definition
- ❑ "Presumptively approvable" emission guidelines
- ❑ "Affected sources" criteria (e.g., minimum MWs, technology type, etc.)
- ❑ Tailored, unit-by-unit standards and possible subcategorization
- ❑ Heat rate improvement, impact of variable demand, and potential "rebound effect"
- ❑ Rate-based vs. mass-based standards and any requirements to facilitate trading

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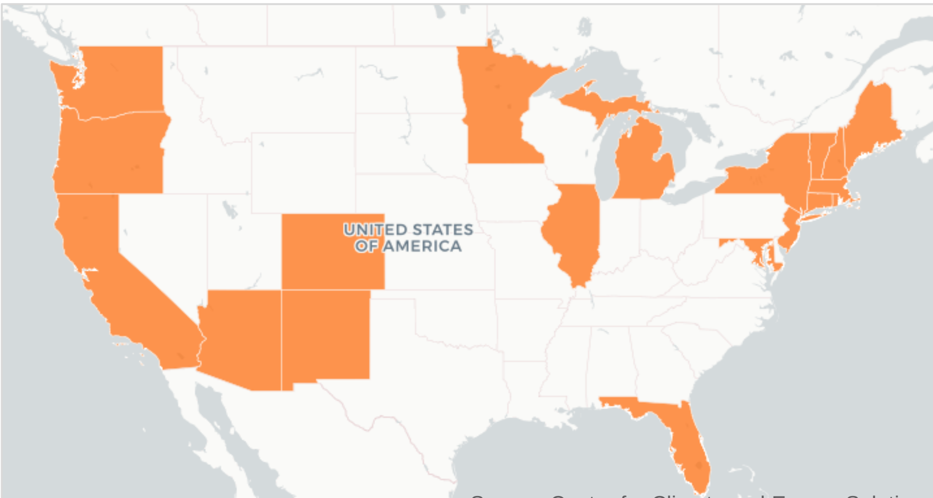
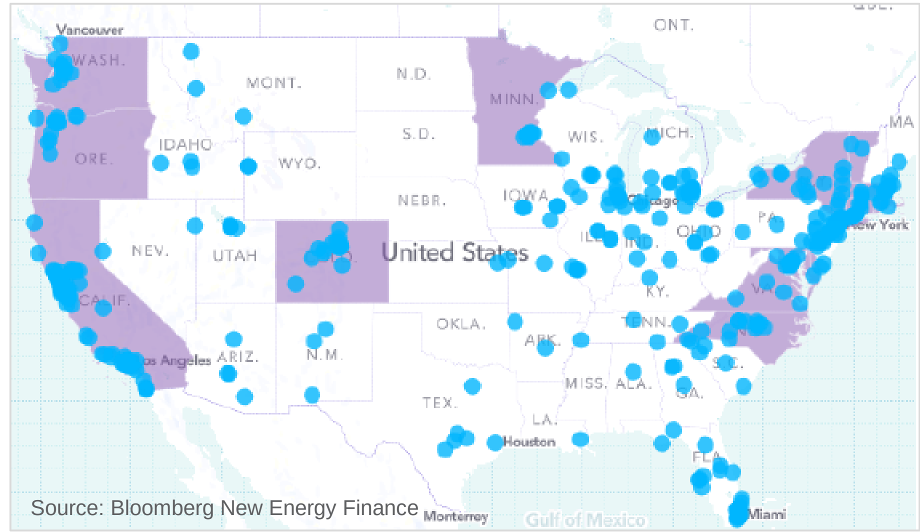
No Paris Agreement. No CPP. No Worries, Say Some

U.S. States with Greenhouse Gas Emissions Targets



Source: Center for Climate and Energy Solutions

State Members of the U.S. Climate Alliance and City Members of Climate Mayors



Source: Bloomberg New Energy Finance

Moving Ahead with More Local Approaches

- States and cities have continued to pursue both GHG reduction
- As of October 1, 2017, 20 U.S. states and 110 U.S. cities have enacted GHG targets

Some Notable Recent Activity

- California extended the GHG cap-and-trade program
- New Jersey and Virginia: Regional GHG Initiative
- Virginia’s Governor proposed State GHG regulatory initiative
- Renewable Portfolio Standards (RPS) continue to drive reductions in GHG

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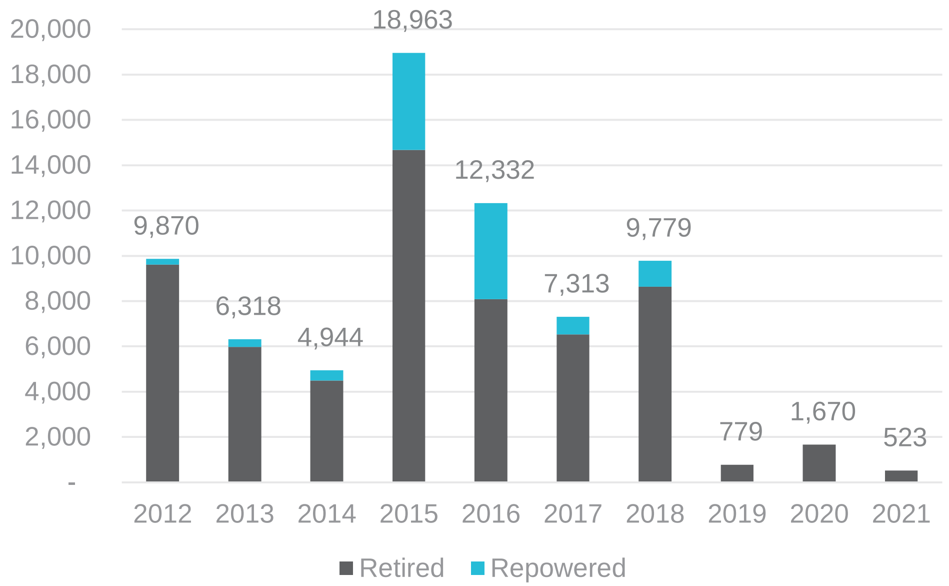
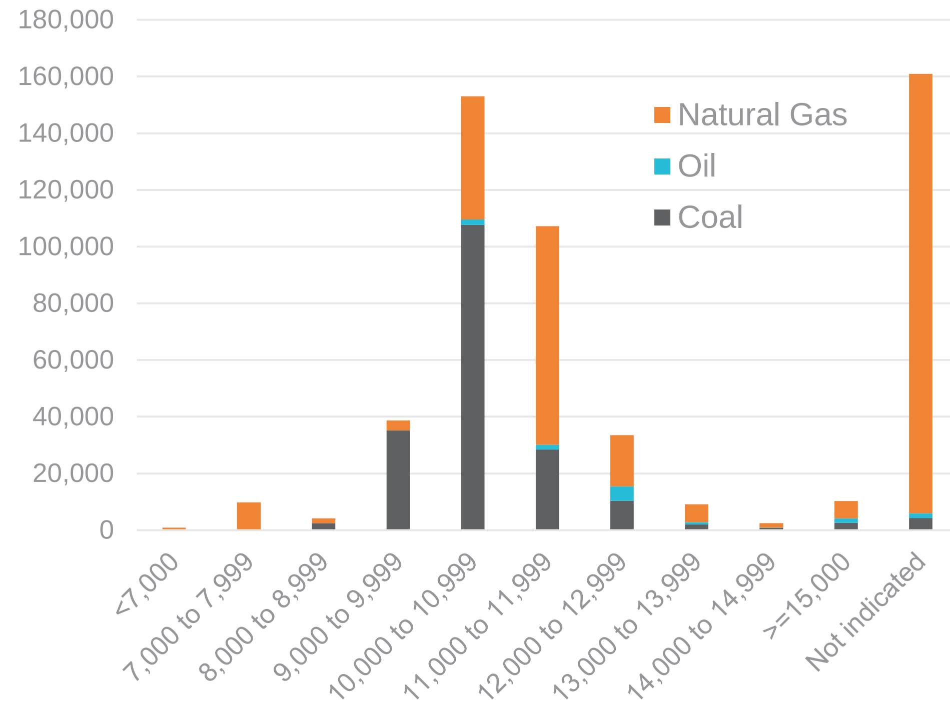
But Will It Matter?

U.S. Announced and Actual Retired and Repowered Coal-Fired Generating Capacity by Effective Year (MWs)



Sources: S&P Global Market Intelligence; ScottMadden analysis

Selected U.S. Operating Coal-, Gas-, and Oil-Fired Units* by Heat Rate (MWs)



*includes combined cycle, steam turbine, and integrated gasification technologies only; does not include about 125 GWs of gas turbines
Sources: S&P Global Market Intelligence; ScottMadden analysis

Fossil Units Are Still under Pressure

- Despite uncertainty around the Clean Power Plan, about 49 GWs of coal-fired generation have been retired between 2012 and 2017, with an additional 11.6 GWs scheduled from 2018 to 2021
- A majority of the remaining units have a heat rate greater than 10,000 BTU/KWHr
- Grid stability remains an unknown driver for retention of fossil assets

Things to Watch

- Details of the final regulatory impact analysis
- How states with diverse constituencies on GHG regulation react in response to the outcome of these rulemakings
- Continued development in the power generation sector given continued uncertainty
- Whether a successor existing source GHG rule is released and what it will contain
- Outcome of FERC resilience proceeding and consideration by FERC and RTOs of price formation and market rules
- Potential litigation or legislative follow-up to any EPA repeal

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Kevin Hernandez
Director

Kevin Hernandez is a director with ScottMadden where he specializes in grid transformation and energy storage. Since joining the firm in 2012, he has consulted with a variety of transmission and distribution utility clients on issues ranging from post-merger integration to distributed energy resources. Kevin earned a B.A. from the University of Tennessee, Knoxville, an M.A. from the U.S. Navy War College in Newport, Rhode Island, and an M.B.A. from the Fuqua School of Business at Duke University. He is also an eight-year veteran of the United States Navy.

Energy Storage

Grid Energy Storage Applications

Energy storage can provide value to the grid across a wide variety of applications as a Front-of-Meter (FTM) capacity or T&D resource and as a Behind-the-Meter (BTM) resource—often at the same time.

< 1 MW	1–100 MWs	> 100 MWs
C&I and Residential BTM	**Utility Scale**	**RTO/ISO**

Customer Energy Management Services

- Solar self-consumption
- Power quality
- Power backup
- Retail electric energy time-shift
- **Demand charge management**

Transmission & Distribution Infrastructure Services

- **Upgrade deferral**
- Renewable integration
- **Peak load shaving**
- Hosting capacity
- **Ancillary services**

Bulk Energy Services

- Energy arbitrage
- Spinning/non-spin reserves
- **Electric supply capacity**
- Congestion relief
- **Peaker replacement**
- Capacity deferral
- Reserve capacity

Duration →

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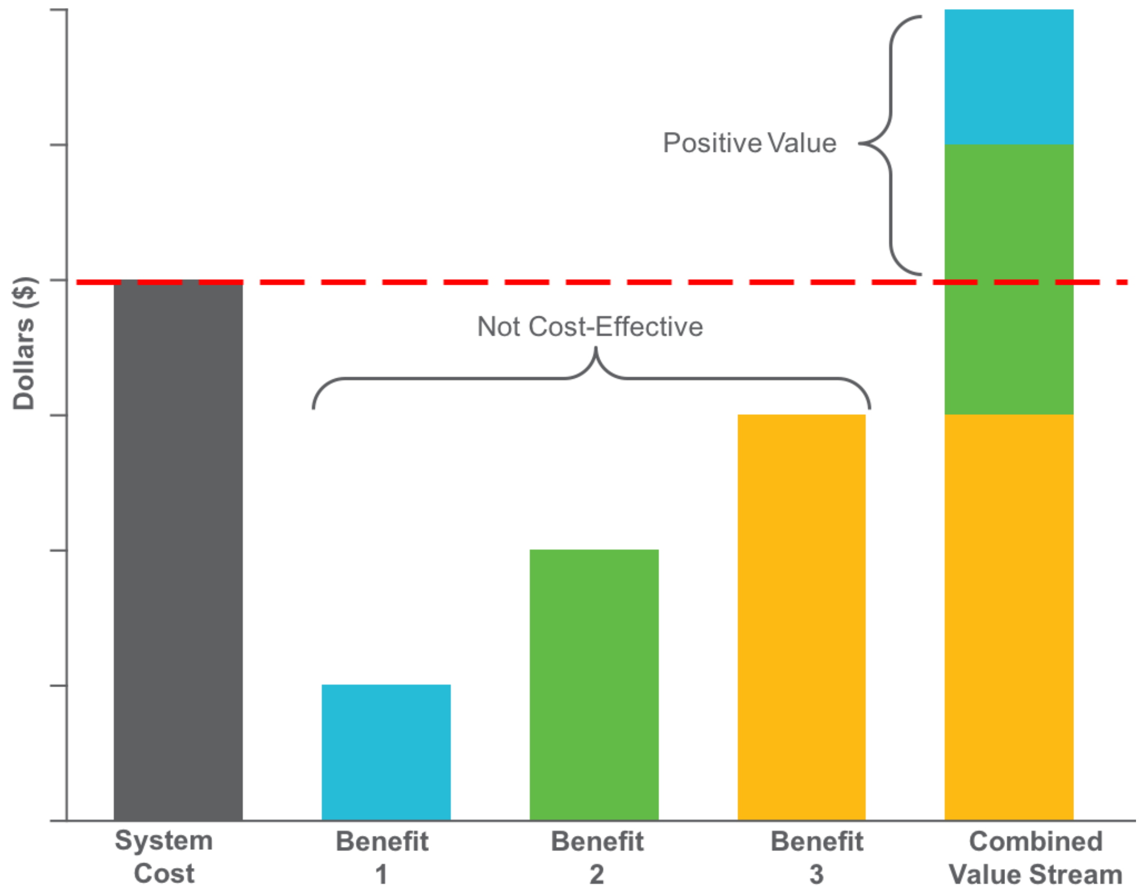
Value Stacking Ain't What It Used to Be

The value of storage lies in its ability to support multiple applications—and value streams—at the same time.

- In many energy storage applications (e.g. peak reduction), the primary application may only use between **1%–50%** of the storage system's lifetime capacity
- Using the **remaining capacity** in other applications allows the system to provide multiple, stacked services
- Stacking benefits distributes the cost of energy storage across multiple revenue streams, greatly **enhancing its cost effectiveness**
- The ability to control how a system supports multiple applications depends heavily on energy storage management systems (ESMS)
- However, **value stacking is still in its infancy** and most storage systems in use today are single application
- Moreover, in more and more instances, **single applications are proving to be cost-beneficial**
- Even in these cases, storage owners are looking to **stacking to increase revenues**

Stacking Energy Storage Benefits



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When Will Energy Storage Be "In the Money"?

Some applications are "in the money" today, although it is highly specific to location and application.

Ancillary Services

- PJM RegD frequency regulation market for fast responding resources was the largest storage market in the United States in 2016
- Changes to market rules have recently cooled the market
- FERC 841 requiring RTOs/ISOs to create markets for storage will increase wholesale market participation including for ancillary services

Demand Charge Reduction

- The BTM market driven primarily by C&I demand charge reduction in California
  - Storage providers share demand charge savings with C&I customers by installing storage BTM to reduce consumption at peak times
    - Potential future opportunities to aggregate the BTM resources into wholesale markets

Solar + Storage

- Tucson Electric Power (TEP) recently signed a 20-year solar + storage PPA for $0.045/kWh
- The previous record was set by Kauai Island Electric Cooperative and AES Energy Storage in January 2017 for $0.11/kWh
- NREL forecasts that storage combined with solar may be cost-competitive with standalone solar by 2020

T&D Deferral

- Energy storage can be used to defer costly system upgrades that would otherwise be needed in order to meet load requirements
- Beyond the immediate cost savings of delaying upgrades, waiting to make significant investments in the grid allows grid planners to get better clarity regarding future load growth, which reduces risk and enhances the effectiveness of the future investments

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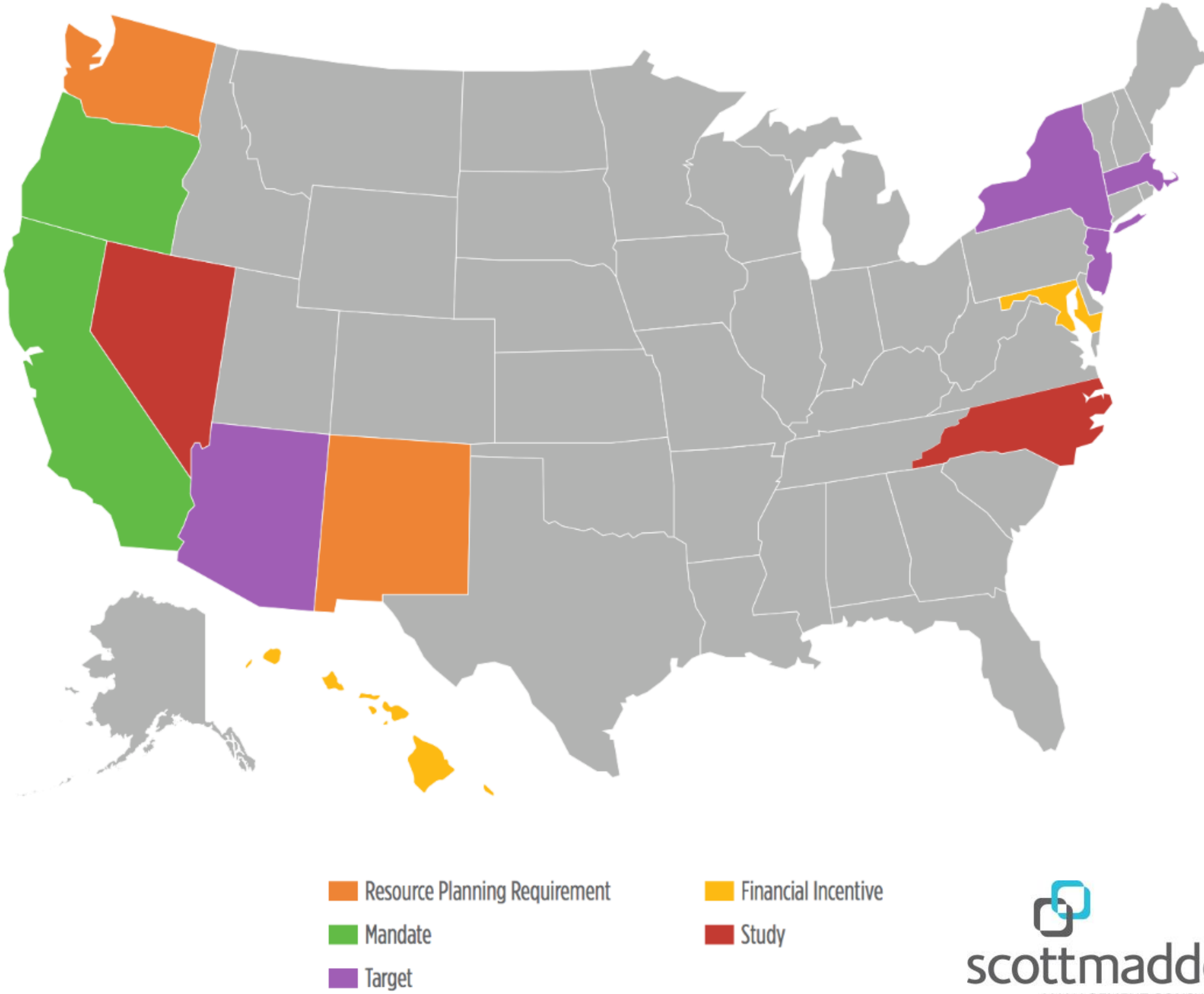
Storage on the Move

The center of gravity for energy storage in the United States is on the move

- There are a few key states really driving storage deployments. The elephant in the room is California which was the first state to have a mandate for energy storage, but also enjoys sufficient demand charges to drive the BTM market
- Now we're seeing similar targets/mandates in the Northeast (i.e., New York and Massachusetts) and recent growth in the South (i.e., Texas and North Carolina)

Geographical drivers

- Regulators driving growth in energy storage in key areas
- CA: First mandate; now rooftop is a building code requirement
- NJ: Energy storage target signed into law on May 22, 2018
- CA, AZ, and MA: Possible Clean Peak Standard?
- NM and WA: Storage included in IRPs
- TX and NC: large jumps in FTM storage



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Why 2018 Will Be the Year for Storage in NY (and Why It May Matter Everywhere Else)

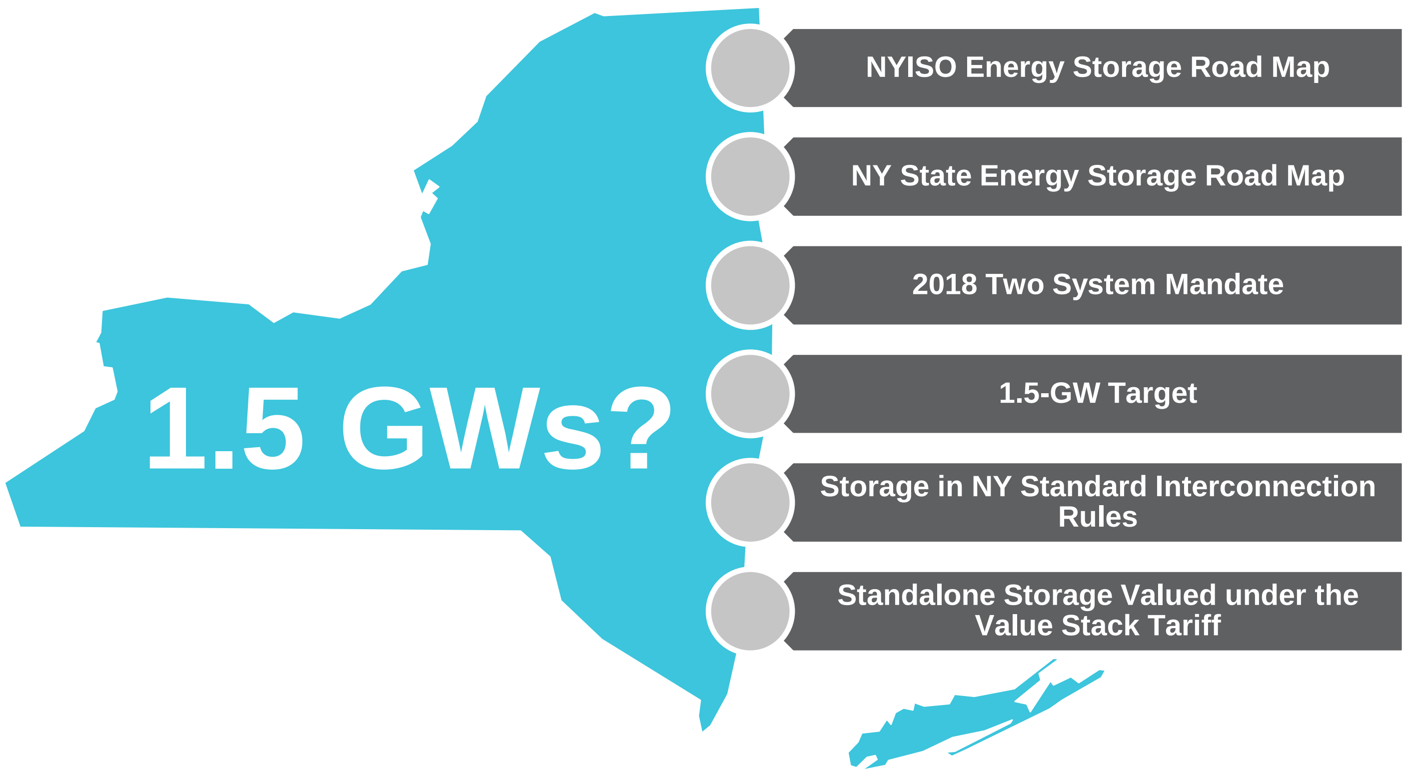
Second

The Biggest Target in the Country

- On January 2, 2018, as part of a “comprehensive agenda to combat climate change,” New York Governor Andrew Cuomo announced a shocking target of 1.5 GWs of energy storage by 2025
- A mandate is expected by the end of the year which, if holds to the same levels, would make it the largest in the country
- Adds to the existing mandate that each IOU in the state place two distribution-connected energy storage systems on their networks by the end of 2018

Value of Storage?

- Perhaps the most overlooked of these developments may be the inclusion of standalone energy storage in the state’s Value Stack tariff, which would compensate energy storage for energy exported to the distribution system according to locational and temporal values



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Storage as a Non-Wires Alternative (NWA)

Deploying storage to meet grid needs and defer traditional infrastructure is a rapidly expanding opportunity for energy storage

- Storage is being used more and more often to offset the need for traditional utility infrastructure projects. In some areas, implementing an energy storage asset is proving to be much more cost-effective than traditional upgrades
- For example, in Arizona, APS's Punkin project leveraged an energy storage solution to defer a transmission upgrade at a much lower cost than otherwise would have been incurred
- In other areas, such as New York, utilities are being challenged to evaluate alternative investments to traditional grid solutions and energy storage is at the forefront of many of those conversations, often replacing or deferring costly substation upgrades or new build

Challenges

- Procurement of storage resources
- Understanding benefit-cost analysis
- Integrating NWAs into utility capital planning processes

NWAs

- **Non-Wires Alternatives (NWAs) are solutions to distribution system constraints that either defer or eliminate the need for traditional infrastructure projects**
- **Energy Efficiency, Demand Response, and other Distributed Energy Resources (DERs) can either individually or in combinations be employed as NWAs**
- **In many cases NWAs represent a new way of doing business for a utility, and the processes to successfully develop and execute an NWA program can span many different organizations**

Simplified NWA Process

Identify System Need → Screen against NWA Criteria → Identify Candidate NWA Project → Issue RFP → Conduct Benefit-Cost Analysis → Procure NWA Solution

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Energy Storage Procurement

The Energy Storage Value Chain (simplified)

	Battery Manufacturers	Balance of System	Software Developers	Integrators/ Developers	Customers
	OEMs			Intermediaries	End Users
Description	Perform R&D and produce Li-ion batteries for a variety of end-uses	Produce non-battery energy storage system components	Develop energy storage management software controls	Develop and integrate renewable energy and storage projects	Bring together various energy storage components to bid on potential projects
Products	Li-ion cells, battery packs	Housing, HVAC, fire suppression, invertors, power electronics and conversion equip	Energy Storage Management Systems, optimization algorithms, API	RFP response, Project origination	BTM and FTM energy storage systems
Representative Companies	Samsung LG Chem Panasonic BYD	SMA S&C ABB Ideal Power Siemens Parker Hannifin	Geli Tesla* Stem* Siemens Greensmith* Doosan* Younicos*	Cypress Creek Tesla* SunRun Stem* E.ON Fluence Younicos*	Utilities (FTM) C&I (BTM) Residential (BTM) Military (Microgrid)

Consolidation has been occurring within the energy storage industry and is expected to continue as systems integrators expand upstream in an effort to differentiate.

Not pictured: Upstream battery component origination or EPC

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Common Storage Business Models

Turnkey/Utility Ownership

- The utility purchase of a turnkey system provided by a developer or integrator
- All rights go to the utility/owner
- In some cases, may include O&M agreement with the seller

Tolling Agreement (Storage-as-a-Services)

- Typically provides fixed capacity and variable O&M payments for utility-scheduled and operated storage,
- Subject to availability guarantees – often during peak periods
- Dispatch rights to the utility during pre-determined periods aligned with system needs. Rights to other periods may go to the developer
- Developer typically responsible for owning, operating, maintaining the asset

PPA/Capacity Agreement

- Like traditional Power Purchase Agreements (PPA) this model involves a long-term contract with the utility for the capacity of the resource
- Dispatch rights for the asset typically align with capacity
- Developers own the asset and are responsible for O&M

Merchant Storage

- The developer/integrator builds and operates the energy storage system as a merchant storage provider
- The owner typically retains all rights to dispatch of the battery
- Most commonly deployed in wholesale markets such as ancillary services where there are standalone business cases for energy storage participation

Across all models, issues such as dispatch rights, charging costs, participation in wholesale and retail markets, and product guarantees/warranties drive the effectiveness of the business model.

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Utility Energy Storage Maturity Model

Utilities are uniquely positioned to capture the full range of benefits from energy storage

- As the link between electricity systems and customers, utilities are well-positioned to aggregate energy storage benefits and distribute them to their customers
- Through improved operations, increased efficiency, and reduced system costs, etc. the benefits of energy storage can be passed on to customers through lower rates and improved service

Utilities are maturing in their understanding and ability to leverage energy storage as part of their normal operations

Early-Stage — **Today** — **Mid-Stage** — **Late-Stage**

Early-Stage
- Demonstration projects to determine technical, use cases, O&M, knowledge, experience, understand benefits, revenue models, ownership models
- Developing understanding of the energy storage ecosystem and procurement
- PPAs or tolling agreements with developers or integrators

Mid-Stage
- Improved understanding of the value proposition of energy storage
- Transitioning from individual projects to management of a portfolio of storage assets
- Exploring additional revenue streams (benefit stacking)

Late-Stage
- Full wholesale market participation (market dependent)
- Multiple benefit stacking
- Views energy storage as a system asset and a revenue opportunity
- Managing energy storage as a program

Third-party ownership → **Utility ownership**

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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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Thank You for Attending!

See the link below for the latest Energy Industry Update

https://www.scottmadden.com/energy-industry-update/

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