



The ScottMadden
**ENERGY
INDUSTRY
UPDATE**

IT'S THE END OF THE WORLD
AS WE KNOW IT
(AND I FEEL FINE)

Volume 17 - Issue 1

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VIEW FROM THE EXECUTIVE SUITE

EXECUTIVE SUMMARY

It's the End of the World as We Know It (And I Feel Fine).

The Energy World, as We Know It, Is Changing

The coming of a new presidential administration portends a significant shift in energy, environmental, and economic policies and priorities. Major forces are in play that can reshape our industry, e.g., the growth of distributed energy resources, the advent of new technologies that can transform the grid, changing central station generation economics, and continued low natural gas prices, to name but a few.

Our world is changing, significantly and for the long term. We are seeing growing baseload plant retirements and their replacement with increasing amounts of gas-fired and renewable resources in many regions. Solar energy penetration in the power supply portfolio may soon reach a tipping point, where effects of the “duck curve” and even curtailment of solar resources may become mainstream.

Utilities are responding and adapting. We are seeing innovation with strategies, customers, technologies, processes, and regulatory paradigms. Bellwether energy regulatory jurisdictions like California and New York are pursuing changes in regulation to promote and accommodate more distributed resources on the grid. Energy and utility companies are piloting efforts to test and shape the new regulatory regimes.

Utilities are substantially increasing investment in utility-scale solar resources. They are also pursuing new agreements with stakeholders and adaptations to traditional regulation, such as performance-based ratemaking, to encourage grid modernization, limit lag in cost recovery, and promote customer-centric outcomes. Many are investigating new technologies, such as blockchain, and are seeking to play a greater role in technology-enabled “smart city” infrastructure.

Indeed, it may be the end of the world as we know it, but by the same token, it is a time of unparalleled opportunity and possibilities, and so there is much to accomplish and feel fine about.

VIEW FROM WALL STREET: OUTLOOK FOR THE ENERGY UTILITY INDUSTRY

Companies seek to put capital to work with a focus on improving earnings, but in a challenging environment. Each sector is positioned differently, but there are common themes.

Sector Investment Themes



Combination Utilities

Position for Growth



Vertically Integrated Electric Utilities

Shifting Asset Mix, with Rate Implications



Electric Delivery

Increasing Capex, with Interest in "Regulated-Like" Assets



Merchant Power and IPPs

Cost Cutting and Deleveraging



Midstream Gas

Coming off of a Low Point in the Cycle



Local Gas Distribution Companies

Potential for Strategic Activity

Cross-Cutting Themes and Related Observations by Sector

Increasing capital spending and allocating capital between projects and sectors

Combination Utilities	<ul style="list-style-type: none"> • Emphasis on capex to offset short-term headwinds anticipated with tax reform
Vertically Integrated Electric Utilities	<ul style="list-style-type: none"> • Exploring alternative capex categories, such as electric vehicle infrastructure, to maintain rate base growth • Many looking at spending on wires/grid transformation and examining "smaller bets" like peakers
Electric Delivery	<ul style="list-style-type: none"> • Continued transmission and distribution capex generally, hoping for higher ROEs from FERC but unclear outcomes • Transmission spend is mostly for reliability and hardening, with transmission capex expected to peak in 2017 • Distribution capex for grid modernization, including upgrades to accommodate distributed energy resources and less publicized spending on distribution "blocking and tackling" • Interesting potential for transmission spend to bring in offshore wind
Merchant Power and IPPs	<ul style="list-style-type: none"> • Capital allocation is key: what portion of debt to paydown vs. what to invest in existing and future growth capex • Peakers increasingly attractive for retail hedging as combined cycles now operate more as baseload
Midstream Gas	<ul style="list-style-type: none"> • Beginning to recover from period of reduced and delayed capex to match the declining production environment; however, with rig counts up as well as their productivity, we are already seeing signs of a recovery
Local Gas Distribution Companies	<ul style="list-style-type: none"> • More capex injections from parents looking for gas-related growth opportunities, especially infrastructure upgrades • Net-zero earnings per share effect possible from tax reform and increased capex

VIEW FROM WALL STREET

Making strategic moves and pursuing opportunities for growth

Combination Utilities	<ul style="list-style-type: none"> • Executing on recent merger and acquisition (M&A) activity, holding off on future M&A • Revisiting LNG projects, clarifying international strategy in the face of depressed returns in the United States, and growing investments in midstream gas • Increasing exposure to “diversified,” non-rate base opportunities in gas and renewables
Vertically Integrated Electric Utilities	<ul style="list-style-type: none"> • Continued expansion into renewables, especially in regions with ambitious renewable portfolio standards, but IRRs are struggling • Fuel switching from coal to gas seen as an opportunity for increased spend
Electric Delivery	<ul style="list-style-type: none"> • Exploring competitive opportunities with unregulated (but “regulated-like”) investments in midstream and renewables • FERC Order 1000 spending has not materialized as originally expected
Merchant Power and IPPs	<ul style="list-style-type: none"> • Cost cutting and strategic action (e.g., pivots toward renewables and retail) are drawing interest • Retail presence emerging as a focal point and seen as ultimate hedge for long generation position, with commercial and industrial seen as margin “adder”
Midstream Gas	<ul style="list-style-type: none"> • Acquisitions and expansion • Divesting commodity-exposed businesses (e.g., natural gas processing plants) and firming up commitments to new and existing pipelines—also expanding existing liquefied natural gas
Local Gas Distribution Companies	<ul style="list-style-type: none"> • Customer growth remains steady • Potential for additional consolidation in the group lifts valuations (watch foreign investment)

Cutting costs and raising cash

Combination Utilities	<ul style="list-style-type: none"> • Looking for operating and maintenance cost savings and asset sale prospects
Merchant Power and IPPs	<ul style="list-style-type: none"> • Deleveraging by selling down prized assets • Leverage still an issue—asset sales aren’t keeping pace with declining revenues from capacity auctions, oversupplied energy markets
Midstream Gas	<ul style="list-style-type: none"> • Deleveraging is an issue for a few; investments will likely be more than 50% equity based • Significant cost reductions for some

Preparing for rate cases and regulatory activity

Combination Utilities	<ul style="list-style-type: none"> • Gearing up for rate cases to drive earnings per share growth
Vertically Integrated Electric Utilities	<ul style="list-style-type: none"> • As distribution spend increases to bolster reliability and expand smart metering, tension growing between low load growth and meaningful ratebase spend, with possible pushback on spending, particularly in lower-income regions • Gearing up for rate cases; looking to ratebase energy efficiency and, in some cases, tie ROE to 30Y Treasuries via formula rate
Electric Delivery	<ul style="list-style-type: none"> • Regulatory hurdles (e.g., permitting) for interstate transmission lines, as well as interregional planning processes, remain top issues • Innovative rate structures are emerging in distribution to address grid modernization and increased DERs
Midstream Gas	<ul style="list-style-type: none"> • Regulatory environment is brightening under new administration, though concern with protests still palpable • State regulatory climate very problematic for some
Local Gas Distribution Companies	<ul style="list-style-type: none"> • Emphasis on reducing regulatory lag

ENERGY SUPPLY, DEMAND, AND MARKETS

STRESSING THE SYSTEM: BASELOAD GENERATION RETIREMENTS ACCELERATE

**Who decides whether to add or subtract generation? How?
Open to debate: What, if anything, needs to be done?**

Creative Destruction, a Sign the Markets Are Working or Road to Ruin?

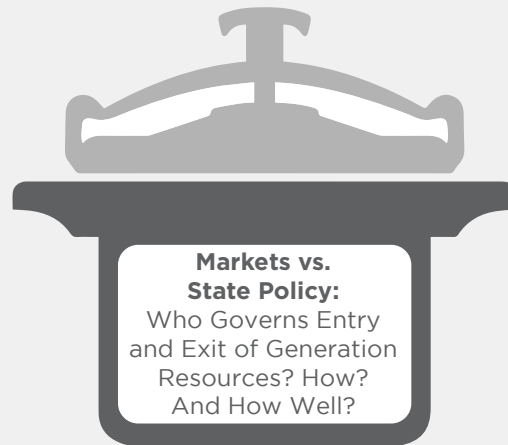
- Continuing economic pressures caused by generation capacity oversupply (fueled in part by public policy), low gas prices, shifting market rules, competing regulatory priorities, and changing technology costs and preferences have brought fundamental questions to the fore about the relationship between markets and states
- As Lynn Good, CEO of Duke Energy, recently noted, investing in generation is now the toughest decision a power company makes

Energy Markets “Under Pressure”

Ingredients: Business Environment Factors

- Natural Gas Prices
- Regulatory Priorities
- Market Rules
- Competitive Pressures
(e.g., distributed energy resources, low demand growth)
- Aging Generation Resources, Capex Decisions, and Reliability Needs

The “Pressure Cooker”: Market and Policy Rules



The Menu: Potential Outcomes



More Questions than Answers

- Baseload generation, much of it coal and nuclear, is exiting and is being supplanted by the entry of gas-fired and variable renewable generation. Many questions remain about the future of the power generation fleet in the United States—and how markets, states, FERC, and the courts should respond
 - › Markets – There are really two wholesale market domains, the market to clear hour-by-hour power and the market to clear generation entry/exit. The latter is at issue
 - › Some say it is working well and these baseload retirements are the proof. In economics, this would be called “creative destruction” by some economists, in which lost traditional generation capacity is simply a cost of progress just like the buggy whip maker gave way to General Motors
 - › Others say market design is flawed for generation entry/exit; efficient long-term asset decisions should not be based on a market overly grounded in short-run time horizons and marginal costs. And this has been exacerbated by the oversupply of renewable portfolio standard-incented renewables, which have zero marginal cost. They would contend that we are experiencing the loss of irreplaceable nuclear and coal generation capacity that provides critical grid reliability support and risking more such loss—thus requiring urgent intervention and corrective measures
 - › Which is it?
 - › States
 - › Some state policy makers, unconvinced that organized markets are driving the right outcomes (at least as they apply to their particular jurisdictions), are seeking legislative means to save jobs and achieve carbon goals by extending economic aid to faltering plants and extra-market intervention
 - › Others say these extra-market measures are creating distortions, making things worse, and creating a tilted, unfair playing field
 - › Which is it?
 - › FERC
 - › FERC has yet to comment on these recent developments as it awaits a quorum, but incumbents are becoming more vocal, with some declaring the independent power producer model obsolete and suggesting market pricing models must “evolve”
 - › But what does that really mean?
 - › The courts
 - › Rulings have been narrow, and the bright line between FERC and state jurisdiction is nowhere to be seen
 - › Where is it?

The Emerging Picture of Baseload Generation - Golden Oldies Heading to the Grooveyard?

- Aging coal, oil, and gas steam turbine generators continue to be retired while combined cycles, gas turbines, and variable renewables are taking their place
- The average age of baseload units at retirement has increased gradually since 1990 (Figure 1)
- The average size of retired plants has been increasing, with retired coal plants more than tripling since 2000, while the average size of retired gas steam turbine plants has doubled
- There are nearly 706 GWs of current operating baseload capacity, 63% of all generating capacity in the United States. A significant portion is aging and potentially at risk to retirement. Almost 7% of operating baseload capacity is over the age of 50, and more than 23% is over the age of 40
- The past decade has been the first time that baseload retirements outpaced baseload additions (23 GWs of net retirements since 2010) (Figure 2)
- There have been 84.2 GWs of baseload retirements since 2010, driven primarily by coal (61%) and gas (29%) steam turbine plants
- The 61.1 GWs of baseload additions since 2010 have been primarily combined cycles (74%) and coal steam turbines (24%)

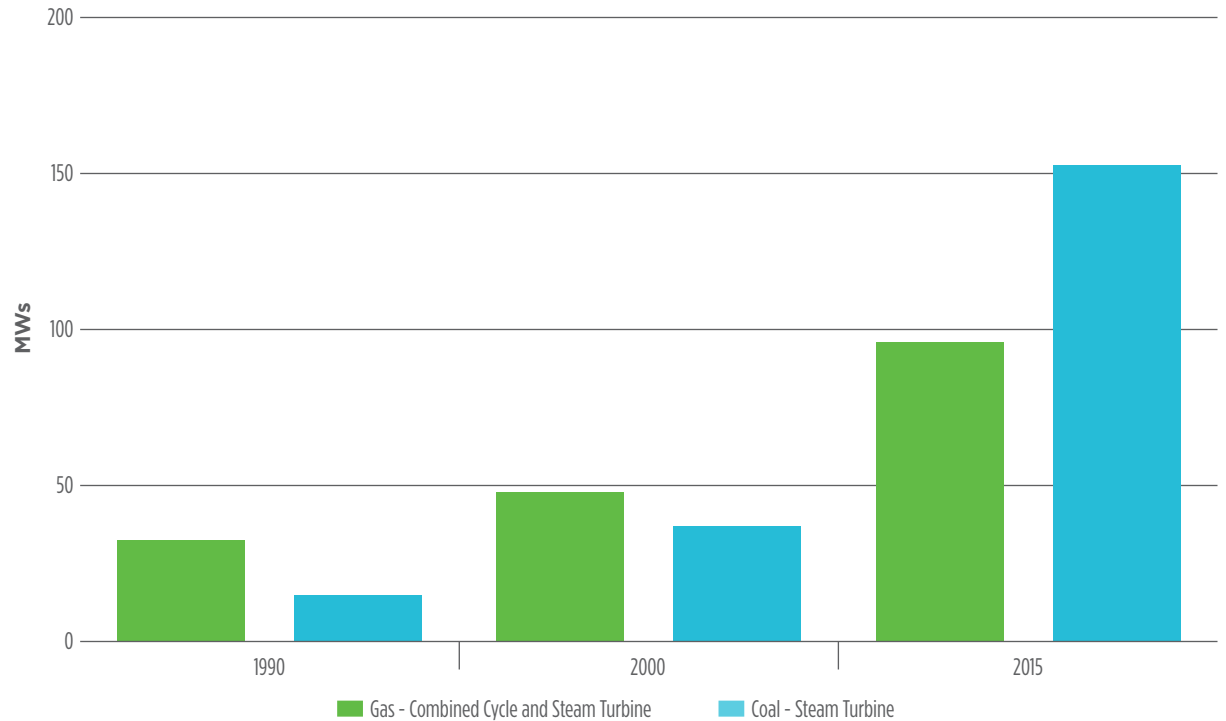
Figure 1: Retiring Units Are Getting Older and Bigger

Average Age of Retired Generating Unit by Technology Type (in Years)

	1990	2000	2015
Gas <i>Combined Cycle and Steam Turbine</i>	31	33	41
Coal <i>Steam Turbine</i>	46	48	55

Source: SNL; ScottMadden analysis

Average Size of Retired Generating Unit by Technology Type

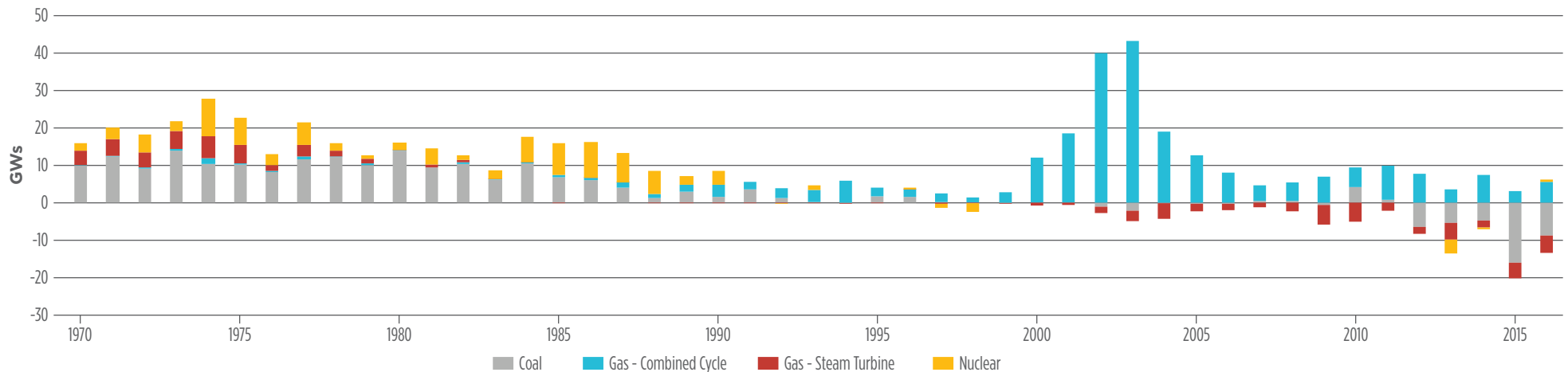


Source: SNL; ScottMadden analysis

“At Some as Yet Unidentified Penetration Level”: The Curious Relationship between Gas and Renewables

- Newer combined cycle and gas turbine generators are more capable of cycling than their predecessors, but the oversupply generated from increasing variable renewables is depressing their run rates and revenues
- This is problematic because as oversupply increases, ramp rates will also increase. This will require more peaking capacity. But that peaking capacity has limited incentive to participate in the market, given the low power prices due to oversupply, primarily due to renewables, and low gas prices
- The question, then, is at what penetration level would these conflicting trends collide and result in reliability issues for the grid?
- NERC states in the latest reliability assessment that there may be issues “at some as yet unidentified penetration level.” But what is that level? Recent activity in CAISO may provide some initial clues:
 - › CAISO’s curtailments of renewable generation from wind and solar jumped 46% over the course of the first two months of 2017 compared with the final two months in 2016, and the frequency of negative prices rose to 13% of all hours in February
 - › Also in February 2017, Calpine announced that it was retiring four gas turbine plants in CAISO, each less than 15 years old, and La Paloma Generating LLC, which owns the 1,022-MW gas-fired La Paloma facility, declared bankruptcy. Both events come less than a year after Calpine placed its 672-MW Sutter Energy Center into “cold lay-up” and Dynegy announced its intention to retire 1,500 MWs at its Moss Landing facility—both for economic reasons
 - › CAISO has recently indicated that another 10 GWs of gas-fired generation may be at risk for retirement for economic reasons
- Interestingly, the surplus of solar in CAISO of late has not only affected CAISO’s gas portfolio. This oversupply, exacerbated by particularly high hydro levels, lower demand due to temperate spring temperatures, and existing market rules, has also caused increasing curtailment of existing solar and wind resources in CAISO’s system during the midday solar peak
- A key question: How long will the surge of renewables last if they end up “eating their own”?

Figure 2: Net Baseload Additions



Source: SNL; ScottMadden analysis

NOTES:

FERC is the U.S. Federal Energy Regulatory Commission; CAISO is the California Independent System Operator

SOURCES:

Industry news; SNL; NERC; CAISO; ScottMadden analysis

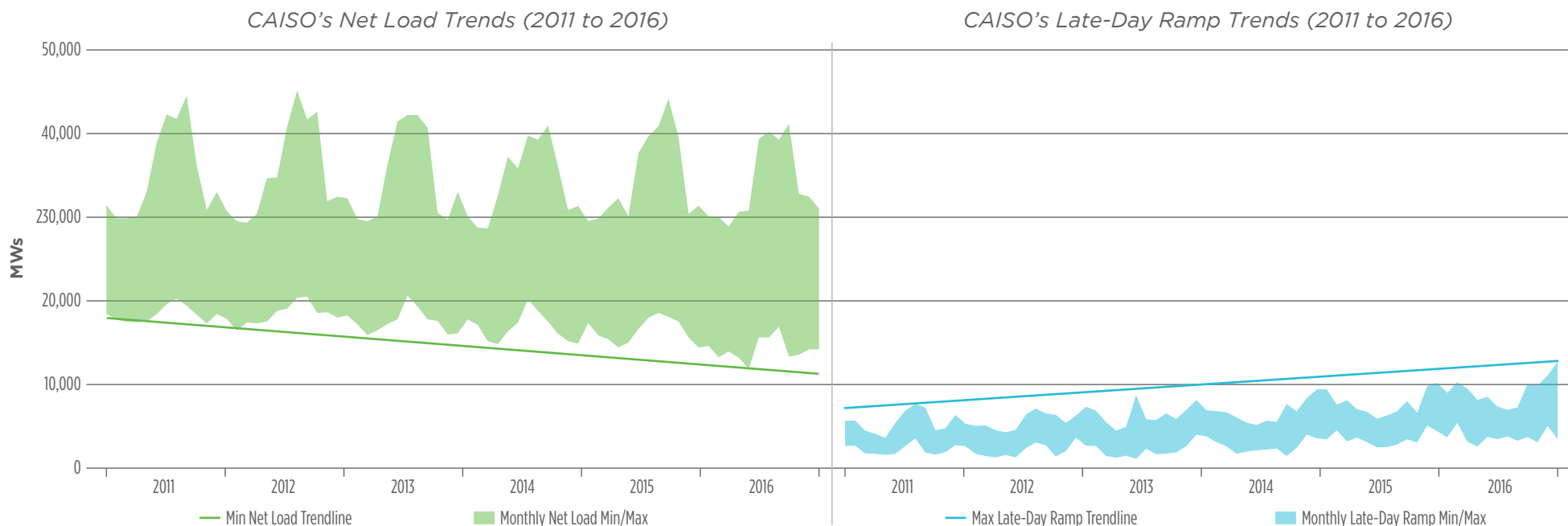
FLYING EAST: PREPARING FOR THE DUCK CURVE MIGRATION

As solar penetration increases, system planners try to understand “tipping point” effects and over-generation risk. What “SPF” will they see?

The Duck Curve Grows Fatter in California

- ScottMadden reviewed data from CAISO to assess the impact of the duck curve* in 2016. Driven primarily by utility-scale solar, we found the duck curve continues to rapidly expand
 - The annual minimum midday net load (i.e., the belly of the duck) declined 22% from 14,335 MWs in 2015 to 11,761 MWs in 2016—four years ahead of schedule
 - The annual maximum late-day, three-hour ramp (i.e., the neck of duck) increased 25% from 10,091 MWs in 2015 to 12,628 MWs in 2016—also four years ahead of schedule
- Trendlines indicate that each year the deepest belly of the duck displaces an additional 1,400 MWs of conventional generation midday, while the increasing size of its neck requires more than 1,000 MWs of additional ramping capacity (see Figure 1)
- With robust hydro resources this spring, CAISO anticipates that it may need to curtail, or decline delivery, of generating output from 6,000 MWs to 8,000 MWs of renewables, and this figure could jump to 13,000 MWs by 2024

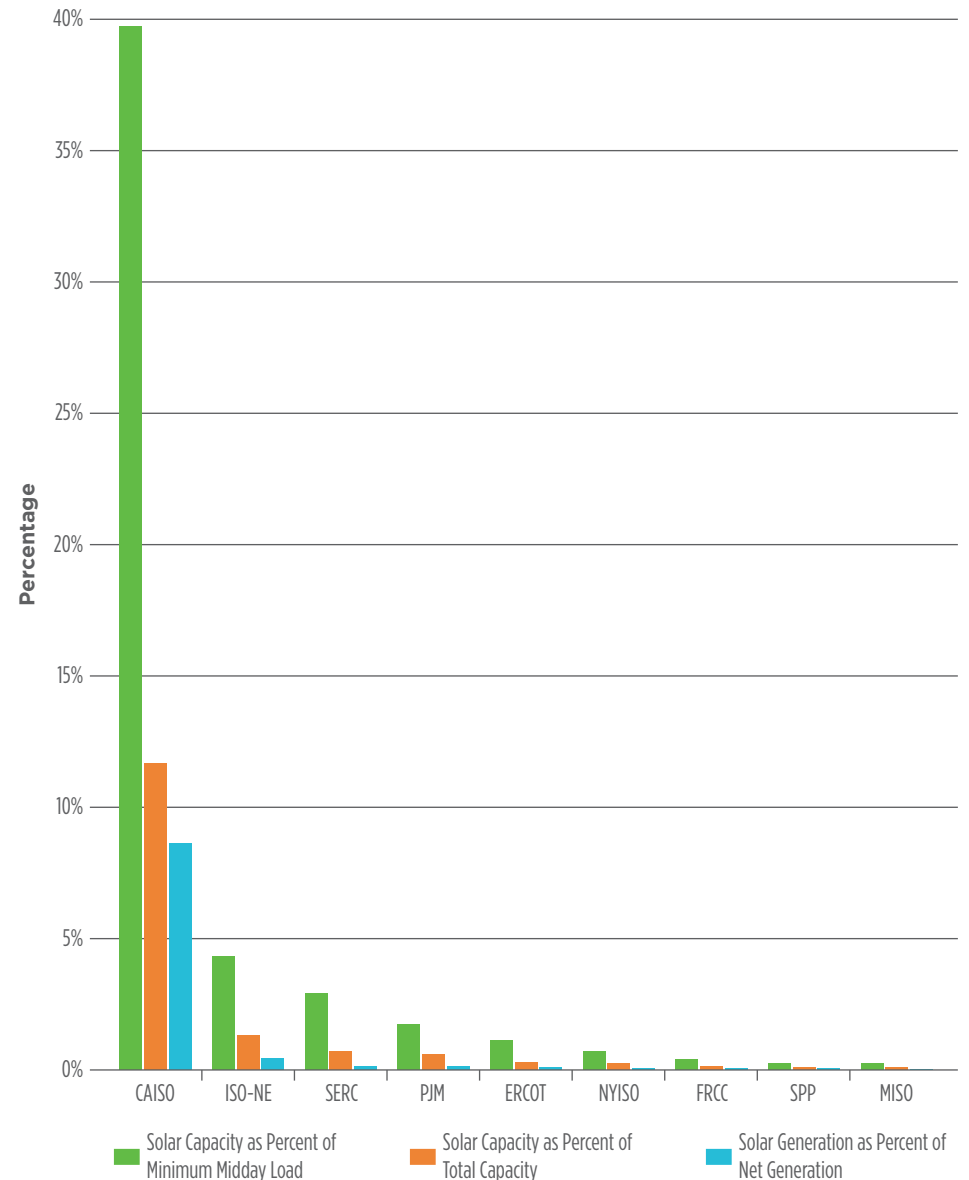
Figure 1: Evidence of Growing Duck Curve in California



If Solar Penetration Is Generally Small, Why Are Its Operational Impacts So Significant?

- Solar as a percentage of annual net generation is often exceptionally low
 - › Utility-scale solar accounted for just 0.9% of U.S. generation in 2016
- The percentage is larger when measured as a percentage of nameplate capacity, but still remains exceedingly small
 - › Utility-scale solar accounted for 2.0% of nameplate capacity at the end of 2016
- While these metrics are commonly used, they mask the true operational impacts of solar on grid operations. What matters is when that solar capacity and output is available in comparison to load, i.e., when the system actually needs capacity and output
- A more instructive metric is solar as a “percentage of minimum daytime load,” which we define as the installed solar capacity divided by the lowest daytime load in a given year. This metric assumes the stress case operating scenario (e.g., solar generating at 100% on a low-load spring or fall weekend)
- Gauged by this metric, solar penetrations loom much larger, as seen by the nearly 40% penetration of utility-scale solar as a percentage of minimum daytime load in CAISO in 2015

Figure 2: Comparative Solar Penetration Metrics (as of EOY 2015)

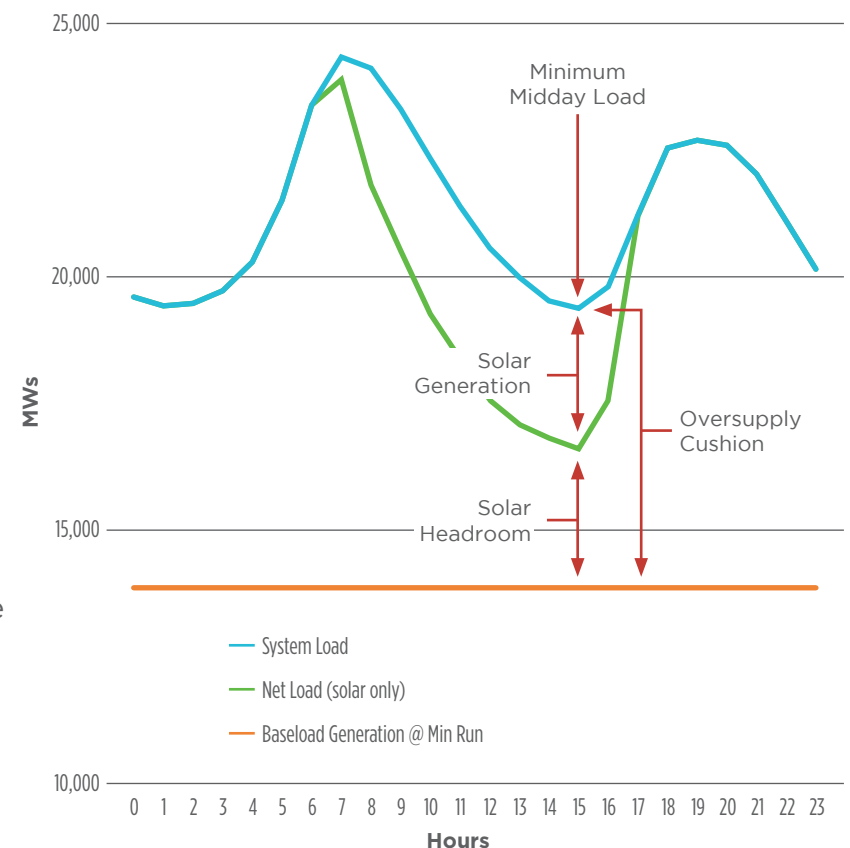


Source: SNL; ScottMadden analysis

Gauging the Tipping Point: The Solar Protection Factor (SPF) – A New Rule of Thumb to Assess Solar Oversupply Risk

- A region’s baseload capacity at minimum run must be considered in comparison to its lowest daytime load in order to assess oversupply risks caused by utility-scale solar
 - › Minimum run represents the minimum capacity at which a baseload plant can be run for economic, environmental, and efficiency reasons
 - › The power system can be difficult to operate if the minimum daytime load is close or even below the minimum run of baseload capacity. This can lead to negative prices in the hopes of exporting the surplus
- With this information, a utility’s or region’s “oversupply cushion” can be calculated as an estimate of the amount of non-baseload generation that can operate during the minimum midday load
- We can also estimate a region’s “solar headroom” or the amount of solar capacity that can be added to the system before experiencing solar oversupply risks
- Finally, these figures can be simplified into the SPF.** This figure signals how close a region may be to experiencing oversupply risk from solar generation
 - › $SPF = \text{Solar Generation} / (\text{Minimum Midday Load} - \text{Baseload Generation at Minimum Run})$
 - › A value greater than one provides directional evidence of oversupply risk during the minimum midday load
 - › Just as in the solar-as-a-percentage-of-minimum-daytime-load metric, the SPF assumes the stress case operating scenario in which peak solar generation coincides with the lowest midday load
- Like all heuristics, the SPF has limitations
 - › One limitation is that it does not account for trading between systems or the operational effects of variable wind generation
 - › The value of the heuristic, however, lies in its ability to approximate the likelihood of a tipping point using a stress-case scenario
 - › In reality, systems may be able to handle much greater penetrations of solar
- But system planners and operators, resource planners, regulators, and developers will continue to seek indications, like this ratio, to inform their investment decisions

Figure 3: Illustrative Minimum Midday Load Scenario



Source: ScottMadden analysis

NOTES:

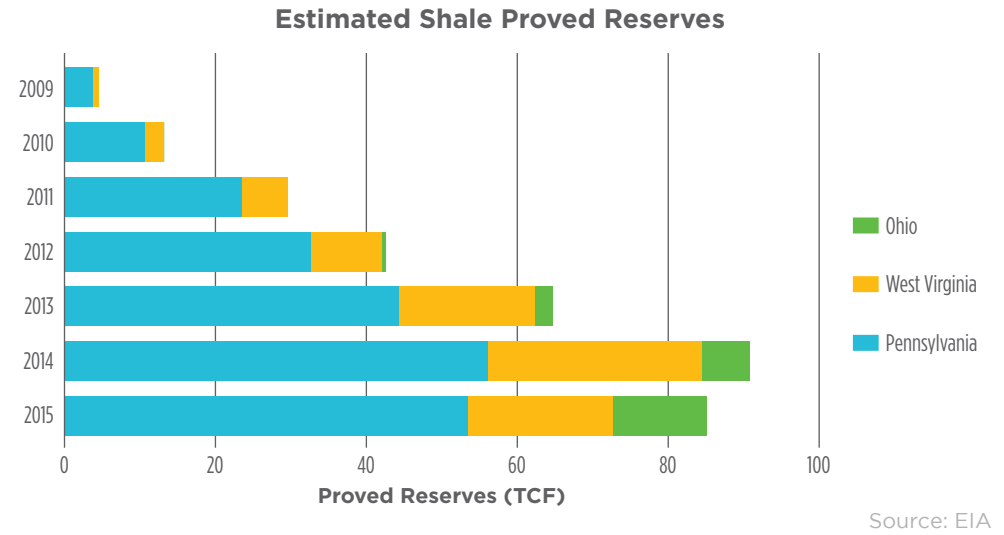
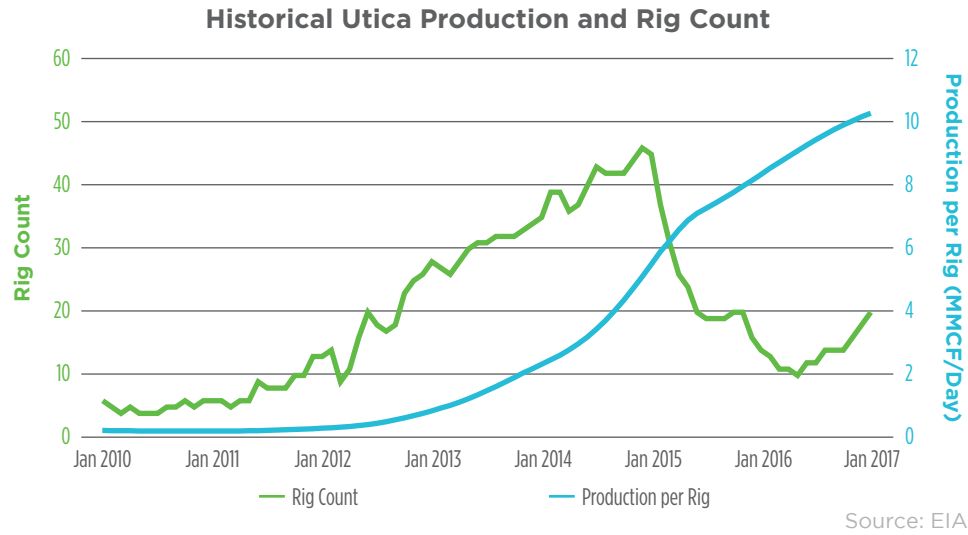
*Per CAISO, the duck curve is a graph of net load, which is the difference between system load and generation from variable resources (i.e., solar and wind). At certain times of the year, this curve produces a “belly” appearance in the mid-afternoon that quickly ramps up to produce an “arch” similar to the neck of a duck. **The SPF will be discussed in further detail in a forthcoming article in *Solar Industry* magazine.

SOURCES:

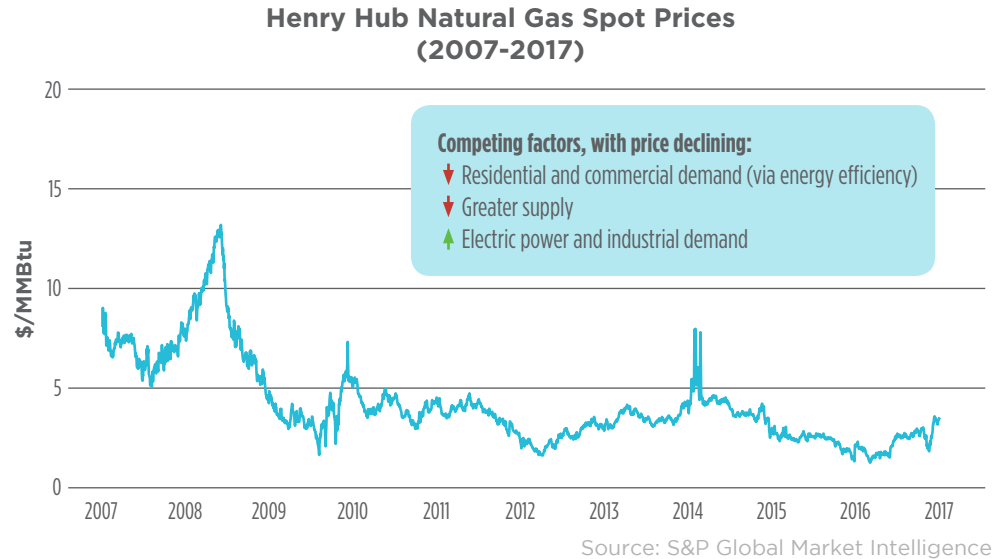
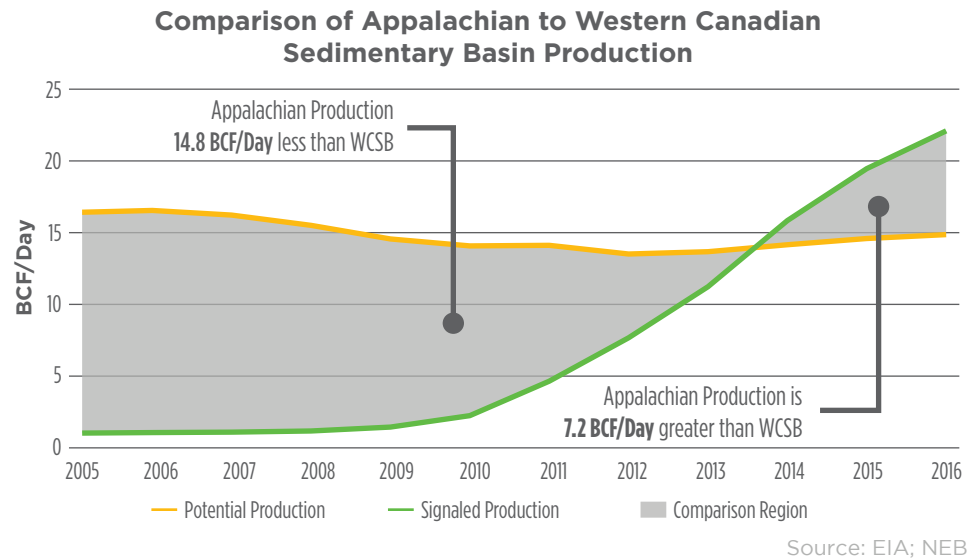
CAISO; Utility Dive; EIA; FERC; SNL; ScottMadden analysis

GAS PRICE RISK MANAGEMENT: HEDGING IN A TIME OF PLENTY

Increasing reserves, higher well productivity mean growing gas supplies in North America.
Onshore Gas Rig Productivity in Shale Plays Is Remarkable...As Proved Shale Reserves Have Grown



Shale Gas Is Outstripping Some Long-Standing Supply Sources...Pushing Natural Gas on Its Continued Low-Price Trajectory



Against this low-price backdrop, many gas and electric utilities are seeking to hedge natural gas price risk. But how to strike an appropriate balance?

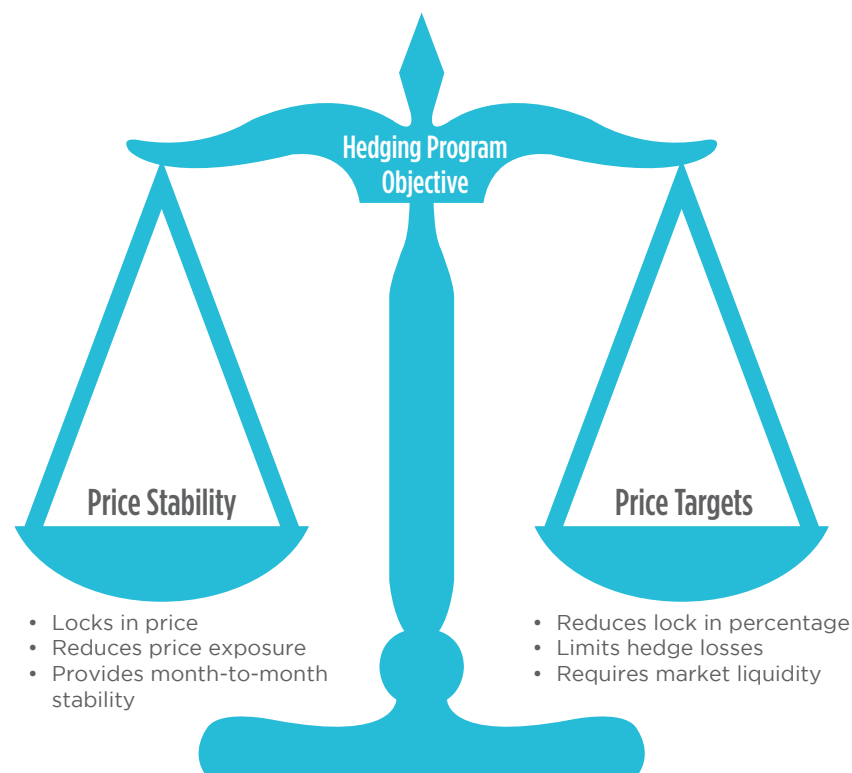
Utilities Seeking to Manage Gas Price Risk Must Strike a Balance between Price Stability and Lower Market Prices

- Companies, regulators, and customers are torn between price stability and lowest possible prices
- Regional energy market circumstances will likely influence how regulators and utilities approach price risk management, influenced by:
 - › Blend of LDC customers and demand characteristics
 - › Power generation usage patterns
 - › Proximity and access to gas resources, including pipeline capacity
 - › Weather
- The volatility and variability in regional natural gas prices leads to customized approaches to risk management, not a “one-size-fits-all” approach
- Stakeholders will likely play an active role in determining risk management strategy, so engagement and process is essential to successful implementation

Bottom Line

Both objectives of price stability and limiting hedging losses have advantages, and finding the right balance for these objectives should be based on the specific situation (i.e., utility objectives, regional natural gas supply/demand dynamics, and regulatory environment).

Balancing Hedging Program Objectives



Sample of Canadian and U.S. Jurisdictions' Approaches Regarding Natural Gas Hedging Programs

Selected Regulatory Activity Regarding Hedging Programs: Divergent Outcomes

State/Province	Policy/Plan	Regulatory Activity
Alberta: <i>Government Ceiling Rate</i>	<ul style="list-style-type: none"> Regulated electricity rates have experienced volatility – the Alberta government is taking steps to prevent high price spikes “...the government’s rate ceiling will ensure that Albertans pay no more than 6.8 cents per kilowatt hour—an available long-term contract rate—for electricity over four years. 	<ul style="list-style-type: none"> Beginning in June 2017, the Alberta government is implementing a four-year cap; specifically, consumers on the regulated plan (the majority of Albertans) will pay the market rate or the government’s ceiling rate, whichever is lower
Florida PSC Staff: <i>“Reasonable Plans” to Address Volatility</i>	<ul style="list-style-type: none"> “[S]taff believes that continuing fuel price hedging activities in an economically efficient manner is in the consumers’ best interest...IOUs should have reasonable plans for dealing with market volatility and unexpected price shocks...strive to balance the risk of price spikes with customers’ concerns about hedging losses.” 	<ul style="list-style-type: none"> In November 2016, the Commission instituted a moratorium on new natural gas hedges through 2017 by the state’s major electric utilities Commission-sponsored workshops in 2017 in which stakeholders are reviewing different approaches to protect consumers against price risk In March 2017, FPSC Staff recommended that utilities should continue to have a gas hedging program
Louisiana: <i>Five-Year Price Stability</i>	<ul style="list-style-type: none"> In June 2015, the LPSC issued General Order R-32975, requiring Louisiana IOUs to “design a long-term natural gas procurement program plan...[that] shall be designed to provide gas price stability...for a minimum of five years.” 	<ul style="list-style-type: none"> In January 2017, American Electric Power Service Corporation, on behalf of Southwest Electric Power Company, issued an RFP in compliance with R-32975
Washington: <i>“Risk-Based” Hedging</i>	<ul style="list-style-type: none"> The Commission “adopt[s] an affirmative policy that natural gas company hedging programs must adapt to constantly changing market risk conditions, and that utilities should seek to, [implement the most economically superior strategy] that produces a cost-mitigation tolerance with the smallest hedge-loss exposure.” 	<ul style="list-style-type: none"> Utilities must submit a plan in 2017 for moving to a risk-based hedging strategy and a path to build all necessary expertise and systems In 2018, utilities must have comprehensive hedging plans in place that should be implemented over no more than 30 months By 2020, the risk-based hedging programs should be fully underway

Case study: Louisiana-jurisdictional electric investor-owned utilities are required to propose at least three long-term natural gas procurement programs.

Each of the Three Programs Below Must Utilize One of the Identified Instruments

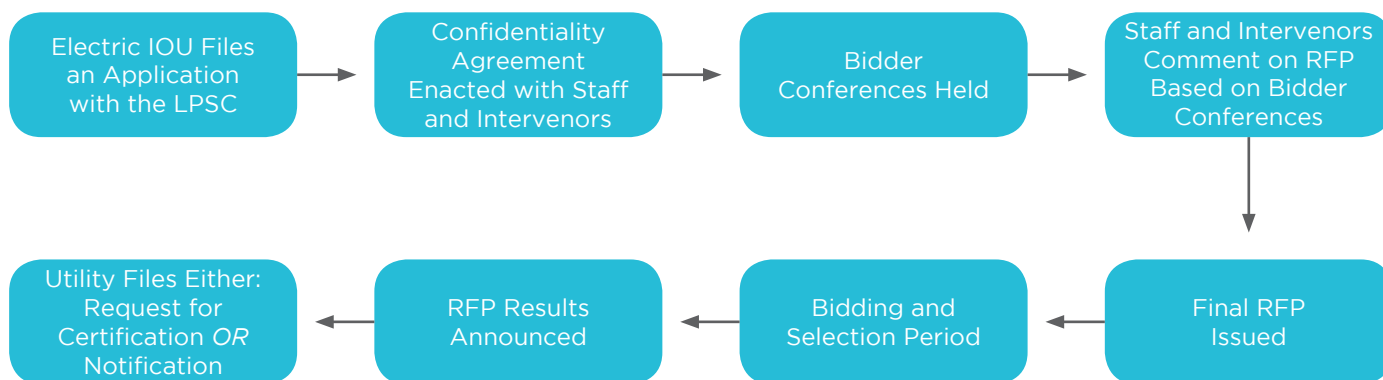
Program	Instruments
RFP Process	<ul style="list-style-type: none"> • Fixed price • Indexed contracts • Upstream supply acquisition/joint ventures at field level
Bilateral Negotiations	<ul style="list-style-type: none"> • Fixed price • Indexed contracts • Upstream supply acquisition/joint ventures at field level
Futures	<ul style="list-style-type: none"> • Futures contract based at Henry Hub • Indexed contracts

Key Takeaways/Observations for Utilities

Utilities should focus on:

- Tailoring the hedging program to their regional market dynamics
- Structuring the hedging program to complement the physical portfolio
- Identifying the required skills and resources to execute the program
- Ensuring effective regulatory processes to perform internal compliance and filing activities

Louisiana’s Multi-Step RFP Process for Long-Term Natural Gas Hedging Pilot Program



SOURCES:

Industry news; NERC; CAISO; ScottMadden analysis; Docket No. R-32975. Louisiana Public Service Commission, ex parte. In re: Examination of long-term natural gas hedging proposals. June 24, 2015. Page 23.; Docket UG-132019, Policy and Interpretive Statement on Local Distribution Companies’ Natural Gas Hedging Practices, March 13, 2017. Page 15.; <https://www.alberta.ca/release.cfm?xID=4487283D35A59-070B-5A1F-76A7FB63D2CA149D>; Do. Number 170057-E1, Analysis of IOU’s Hedging Practices Memorandum, March 27, 2017, at 26

INFRASTRUCTURE AND TECHNOLOGY

GAS PIPELINE DEVELOPMENT: UNLEASHING SHALE GAS RESOURCES

Industry is cheered by renewed infrastructure focus, but hurdles remain.

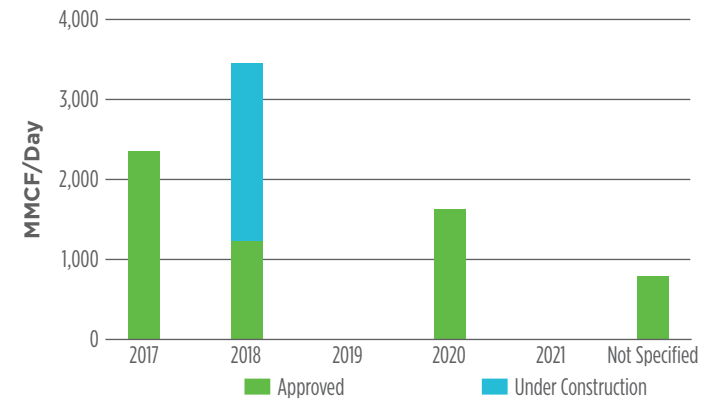
Forecasted Gas Supply and Demand Continue to Grow

- Marcellus and Utica production continues to grow despite relatively low gas prices
 - › Some hope for a recovery in price emerged in 2016, but that has been muted: Current outlook for 2017 prices at the Henry Hub is in the \$3.10 to \$3.70 per MMBtu range
 - › Range Resources tallied approximately 14 BCF/Day proposed additional takeaway pipeline capacity for SW Marcellus after 2016 (based upon announced projects), a bullish outlook
- U.S. natural gas supplies are beginning to displace some Canadian imports, which are expected to gradually decline
- In tandem with increasing supply, strong gas demand is expected
 - › Latest EIA estimates have power generation comprising about 8.5 TCF of gas demand (31%) by 2020
 - › Industrial gas demand is expected to grow about 2% per year through 2020
 - › With the expected completion of five LNG export facilities (including the Sabine Pass terminal which began operations in 2016), approximately 2.9 TCF of demand (11%) (vs. 0.03 TCF or 0.1% in 2015) is expected to be exported as LNG and another 1.83 TCF as dry gas to Mexico, also by 2020 (compared with 1.05 TCF in 2015)
- Moving gas in greater quantities from production to demand areas or liquid pricing points will drive pipeline development

Plans Continue for Additional Pipeline Capacity for Shale Gas

- More than 7 BCF/day in U.S. pipeline capacity was placed in service in 2016, down from nearly 7.8 BCF/day in 2015, but FERC certificated more than 18 BCF/day, up from 15.7 BCF/day in 2015, signaling potential future growth in capacity
- In Ohio alone, about 6.8 BCF/day of additional pipeline capacity out of the Utica region has been certificated and could be in place by the end of 2018 (although certification does not mean that all capacity will get built)

Selected U.S. Pipeline Capacity Approved and Under Construction by Status and Projected In-Service Date



Source: EIA; ScottMadden analysis

Moving Gas North: Several Proposed Pipelines Could Increase Flows to Ontario and Quebec



Source: Canada National Energy Board

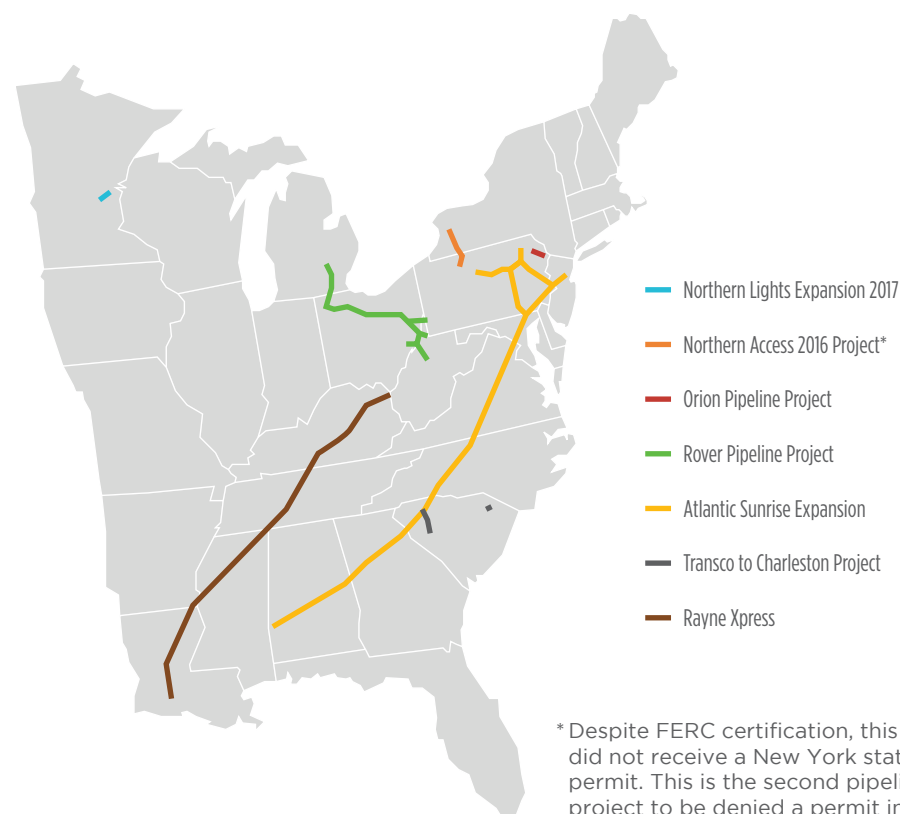
GAS PIPELINE DEVELOPMENT

- Canada is expected to build more than 2,000 miles of gas pipelines in 2017 and beyond, with most large projects focused on shipping from shale plays in Alberta and British Columbia westward toward proposed LNG liquefaction and export facilities on the Pacific coast
 - › Those pipelines remain subject to challenge by protesters, including First Nations
 - › And the ultimate fate of new LNG in Canada is uncertain: for example, in March, Shell shelved development of its Prince Rupert project
- The midstream investment outlook remains positive—one analyst noted that 4Q 2016 EBITDA for energy midstream MLPs has been coming in 3.4% better than estimates and 7.2% higher than 3Q 2016

FERC Hiatus? Hurdles to Getting New Pipelines Built

- The Trump administration has promoted infrastructure as a key policy priority
 - › Included in its focus are hydrocarbon pipelines, with the Keystone XL and Dakota Access pipelines as test cases for new, growth-oriented policy
- To date in 2017 (and before Chairman Bay resigned), FERC has approved seven projects totaling 7 BCF/day, concentrated in the eastern United States
 - › However, absent one more commissioner, FERC lacks a quorum to consider additional pipeline approvals
 - › Requests for rehearing and litigation over the final orders may impede development of these projects
 - › Judicial action on FERC and FERC staff authority to toll deadlines for rehearing requests is expected, pending seating of a full quorum
 - › Even with a full quorum, protesters—historically a rarity at FERC proceedings—are increasingly active in pipeline proceedings as part of the “leave-it-in-the-ground” movement
- Local opposition continues to be the most significant impediment to new pipelines, and a few pipelines are facing protest and litigation
- It remains unclear whether this opposition, even in pipeline-constrained areas like New England, will stymie development

U.S. Natural Gas Pipeline Projects Certificated in 2017



Source: EIA

SOURCES:

EIA; *Oil & Gas Journal*; PointLogic Energy; *The Wall Street Journal*; SNL Financial; *Natural Gas Week*; Natural Gas Intelligence; RBN Energy; Oppenheimer & Co.; ISO New England; ScottMadden analysis

“BLOCKCHAINS” AND ENERGY: WHAT’S THE POTENTIAL?

Distributed ledger technologies (DLT) could be transformative, but are they too complex?

Blockchain Is the Most Talked-About Example of DLT

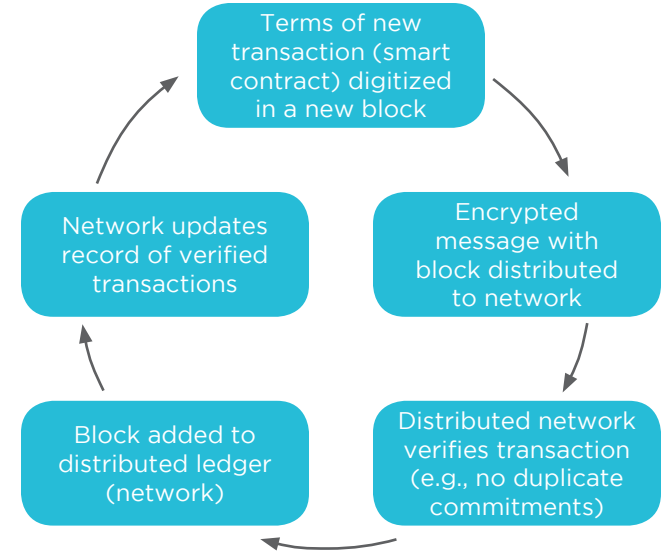
“ [A] blockchain is a data structure that makes it possible to create a digital ledger of transactions and share it among a distributed network of computers. It uses cryptography to allow each participant on the network to manipulate the ledger in a secure way without the need for a central authority.

-The Wall Street Journal

What Is Blockchain Technology and Why Does It Matter?

- Blockchain technology—a unique subset of DLT—is made possible by a novel combination of cryptography, economics, and shared computing. The technology first became known for its role in underlying the sometimes-troubled Bitcoin
- The key function of blockchain technology is the exchange of verified digital information and assets. Blockchains keep chronological records, including transaction histories, which can be concurrently accessed and agreed upon by participants and used to establish credibility and trust in transacting. This can mimic the function of credit checks, letters of credit, bank balance confirmations, certifications, and the clearing of transactions—without the third party

Blockchain Transaction Process



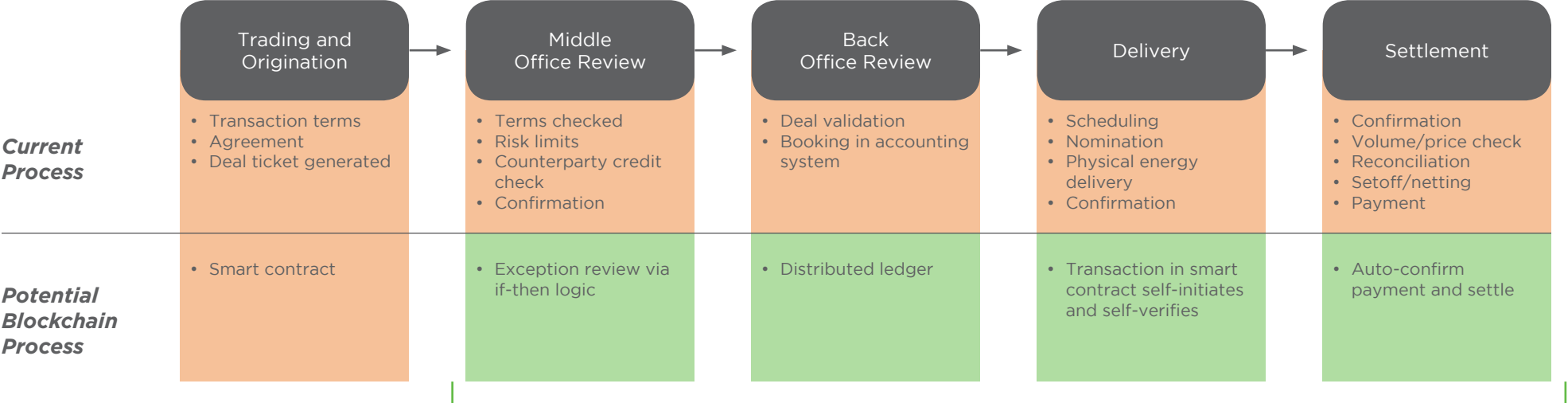
The Key Features of DLT/Blockchain Technology

	Current State	DLT Improvement
Distributed Ledger (Database)	<ul style="list-style-type: none"> • Centralized ledgers • Large intermediaries (banks, clearinghouses, etc.) • Trust in intermediaries required 	<ul style="list-style-type: none"> • Redundancy; fault tolerance • Distributed, unbroken record of transactions • Trust not required • Intermediaries not required
Smart Contracts	<ul style="list-style-type: none"> • Paper or electronic • Manual processing • Central validation 	<ul style="list-style-type: none"> • Automatic determination of payouts • Faster processing
Industrial-Strength Encryption	<ul style="list-style-type: none"> • A few, key point sources of vulnerability 	<ul style="list-style-type: none"> • Latest security technology • Distributed network greatly increases hack-resistance
Public or Private Network	<ul style="list-style-type: none"> • Large private networks 	<ul style="list-style-type: none"> • Potential for smaller interconnected networks, public networks
Accommodation of Large Volumes of Transactions	<ul style="list-style-type: none"> • Capacity dictated by speed of transaction processing, database 	<ul style="list-style-type: none"> • Capacity limited by distributed network and block complexity

“BLOCKCHAINS” AND ENERGY

- Much discussion has been about implications for insurance and banking, but blockchains can be used to facilitate any rule-based transaction, including those that are peer-to-peer or that involve smart devices and artificial intelligence
- Internet-of-things and “blockchain-as-a-service” offerings could revolutionize transactions, including those in energy. For example, if transaction costs are low enough, one end user could automatically sell excess solar power to her neighbor in a microgrid
- But blockchains could also be used for more traditional energy transactions like energy trading or EV charging. In fact, German and Austrian utilities are testing blockchain platforms for energy trading

Example Energy Trading Transaction Before and After Blockchain



Legend

- Manual Process (Orange box)
- Automated Process (Green box)

Potential enhancement in blockchain-enabled environment

- Manual processes automated
- Decentralized data warehousing
- Security
- Error reduction and enhanced auditability

Key Questions About Blockchain Technology in Energy Transactions

The Transactions

- How is delivery or fulfillment of a smart contract arranged and validated? For example, how would a peer-to-peer energy transaction be executed?
- Who sets the smart contract standards?
- Who are the stakeholders in such a peer-to-peer market?
- How many transactions does a blockchain-based transactive energy system need to be able to process per second?

The Technology and Ecosystem

- How complex can a blockchain system get, particularly as millions of blockchain-based transactions are added over time? Do the economic benefits of blockchain technology outweigh this potential complexity?
- What information needs to be included in the blocks, and what information could be added over time to create more value for participants?
- Given blockchains are highly reliant upon uniform standards (encryption, block development, etc.), will a distributed network neatly comply with all standards? What standards will emerge? Will distributed ledger be fulfilled by large cloud players like Google or Amazon, effectively switching from centralized clearinghouses to distributed oligopolies? Are there economies of scale in distributed transactions?
- How secure and private are distributed blockchains?

The Societal Implications

- Will society embrace peer-to-peer transactions, including energy transactions? What user interfaces will enable that?
- What are the economic incentives to be in a network, and what kinds of products, services, and applications might arise in this new paradigm?
- How will current legal and regulatory structure governing transactions adapt to a blockchain environment?
- What are the opportunities for mischief, fraud, and hacking with multiple distributed nodes, and how do you protect against that?
- What are the political and social implications of disintermediation of, e.g., banks, clearinghouses, and other well-capitalized intermediaries, as well as potential job losses in transaction processing?

Blockchains Could Potentially Change Society

But it is early days, and the hype is heavy. In the energy sector, conservative by nature, activity is likely to be limited to pilots and small-scale tests for the next several years. Look to the DOE, ISOs, and REV*-like distribution system platform operators to serve as the initial locus of these tests. Ultimately, the development of network governance and radically different legal and regulatory standards, and responses of potentially disintermediated parties, will dictate the speed and breadth of blockchain technology adoption.

NOTES:

*New York Public Service Commission's "Reforming the Energy Vision" docket

SOURCES:

GTM; Cleantech Group; World Economic Forum; *The Wall Street Journal*; industry news; ScottMadden analysis

SMART CITIES: WHAT ARE THEY, REALLY? AND WHAT IS THE UTILITY'S ROLE?

What is a “smart city”?

An Evolving Concept with Some Key Components

- In many ways, the smart city is still being defined and is today what the smart grid was a few years ago—a term that is broadly used but without a consistent definition
- The menu of potential projects, applications, and technologies may be broad and diverse
- Many smart city projects are still in the early (pilot) phases, and few of the newest technologies have been fully rolled out or implemented commercially
- Technical hurdles continue to limit integration among projects and aggregation and optimization of new sources of data
- While many models identify a comprehensive suite of capabilities, core to smart city infrastructure are the sectors, objectives, and technologies outlined in Figure 1
- In addition to these sectors, communications, healthcare, and education are also frequently referenced in smart city conceptual frameworks
- There are many technologies that can be considered elements of a potential smart city plan. Energy—given its technological maturity, pervasive application, and existing infrastructure—is often a good point of focus for city planners

ScottMadden’s Working Definition

A “smart city” is one that employs a network of digital sensors, information controls, Internet-of-things technology, and automation to create a system that improves quality of living by reducing costs, creating new and better services, improving sustainability, and helping the city grow and compete for businesses, institutions, and residents.

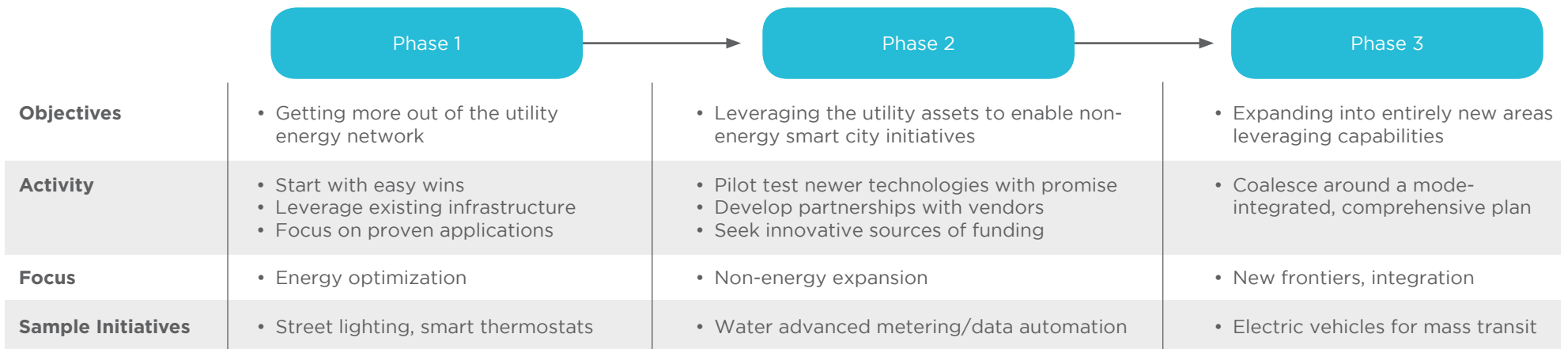
Figure 1: Smart City Core Infrastructure Components

Sector:	Energy	Transportation	Water and Waste	Buildings
Objectives	<ul style="list-style-type: none"> • Efficiency • Low cost • Low pollution • Low CO₂ emissions • Synergies with water and transport • Resilience 	<ul style="list-style-type: none"> • Time savings • Low cost • Efficient resource utilization • Universal access • Low emissions 	<ul style="list-style-type: none"> • Integrated system: water, flood control, agriculture, and sanitation • Resilience 	<ul style="list-style-type: none"> • Affordability • Healthy environments • Resilience • Comfort • Efficiency
Technologies	<ul style="list-style-type: none"> • Distributed renewables • Cogeneration • District heating and cooling • Efficient lighting • Smart grids • Microgrids and virtual power plants • Demand response • Energy efficiency • Energy storage 	<ul style="list-style-type: none"> • Multi-modal integration via technology • On-demand digitally enabled transport • Electric vehicle infrastructure • Traffic and congestion management • Autonomous vehicles • Parking management • Technology-enabled transportation pricing 	<ul style="list-style-type: none"> • Smart water meters • Sensor networks • District and building water re-use • Digital water distribution control and leak detection 	<ul style="list-style-type: none"> • Energy efficient and adaptive construction designs, technologies, and standards • Sensors, actuators for real-time space management • Energy management systems • Smart equipment and appliances • Advanced HVAC • Building retrofits

What Is the Opportunity for Utilities?

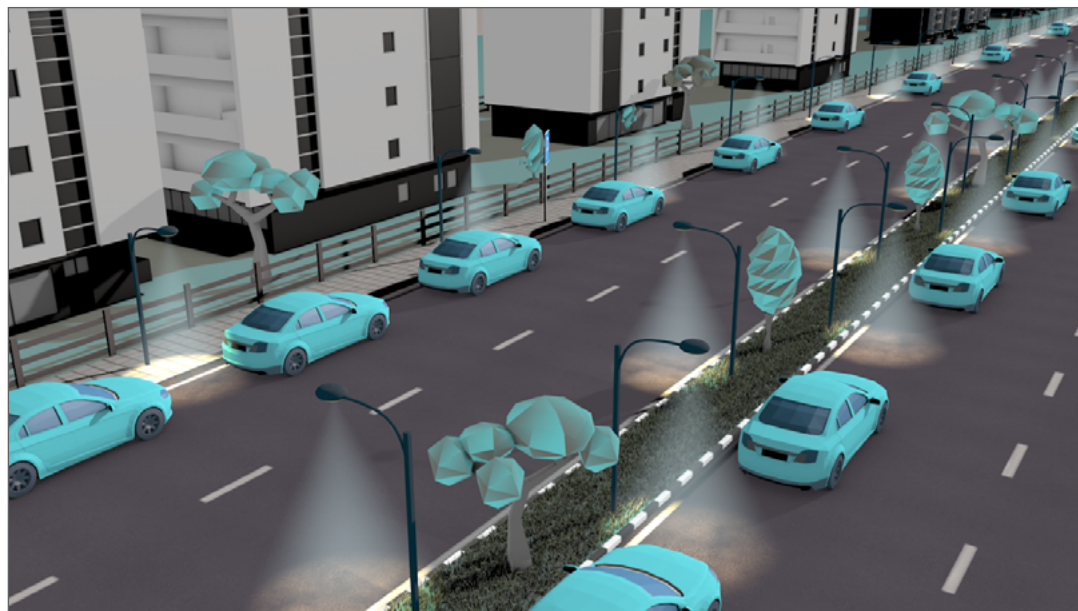
- As utilities consider their role in smart cities, they should first focus on the build-out of core assets and capabilities, emphasizing their advantage as incumbent network owners and operators, to find opportunities to get more out of the utility energy network
- By focusing first on quick wins with proven technologies that leverage the existing network, utilities can engage stakeholders and establish their role as a partner and leader in the process
- As opportunities and technologies continue to evolve, utilities will then be well-positioned to continue to leverage their assets and capabilities into new areas (see Figure 2)
- Phase 1 – Getting more out of the utility energy network
 - › Focus on existing technologies and assets such as smart meters
 - › Begin with proven solutions that add automation and controllability to devices like water heaters and street lights
 - › Deliver quick wins, demonstrating the ability to improve services and reduce costs
- Phase 2 – Leveraging utility assets to enable non-energy initiatives
 - › Broaden approach to consider initiatives beyond energy-focused projects
 - › Identify additional opportunities to leverage utility assets (including information and data resources) and workforces in new ways
 - › Consider further testing new capabilities on platforms implemented in the first phase
- Phase 3 – Leveraging utility capabilities to expand into entirely new areas
 - › Utilize strategy and a plan for identifying, piloting, and testing new concepts
 - › Consider expanding beyond the existing assets and the traditional energy network as new ideas beyond the “science experiment stage” and successful pilots
 - › Consider entirely new areas such as transportation and customer/citizen engagement

Figure 2: Smart City Phased Approach for Utilities



Entry Points for Utilities: Getting Started...

- A first killer app: smart street lighting
 - › Street lighting projects are a popular entry point into the smart city conversation because of their enormous potential to deliver a strong (and fast) return on investment but also as a platform for piloting future initiatives
 - › Street lights represent a substantial portion of city energy budgets, up to 40% by some estimates
 - › Smart street lights, according to those who sell them, can save 50%–70% of this cost by dimming when activity is low
 - › Lights can be remotely dimmed to reduce energy usage, and they can also be managed by smart devices that adjust lighting in response to traffic patterns and help identify roadway hazards
 - › Networked LED lights can provide not only energy savings but information about outages or other anomalies in the energy network
 - › Networked lighting systems are also seen as a viable “platform” on which to build future sensing, data gathering, and communications capabilities
 - › For example, networked lights can be connected, communicating with video cameras, parking sensors, environmental sensors, weather sensors, etc., through the same network infrastructure
- Utility grid communications infrastructure
 - › A ubiquitous physical and data network represents the backbone of almost all smart city initiatives
 - › Energy utilities possess a physical network with a ubiquitous footprint, underpinned by a data control network, funded by citizens who are utility customers, and in many cases being digitally upgraded in support of advanced metering infrastructure and grid transformation initiatives
 - › It may be more efficient and less expensive for cities to piggyback on the energy utility network already in place rather than build one from scratch



SOURCES:

Industry news; U.S. Dept. of Energy; Edison Electric Institute; Smart Cities Council; World Economic Forum; ScottMadden analysis

RATE AND REGULATORY ISSUES

DISTRIBUTED ENERGY RESOURCE INTEGRATION: NY AND CA— [SOMEWHAT] SIMILAR AIMS, [SOMEWHAT] DIVERGENT MEANS

Coming from different starting points, two states tackle—and encourage—accelerating distributed energy resource additions.

Common Areas of Focus, but Different Approaches

New York: *If You Build It, They Will Come*

California: *Make Use of What You've Got, Bring More*

- New York and California are investigating regulatory structures and system improvements that encourage addition of distributed energy resources (DERs) in light of carbon and clean energy policy objectives
- Each state is considering how to increase penetration of DERs, looking at key factors that impact their deployment:
 - › Interconnection
 - › Hosting capacity
 - › Planning
 - › Benefit-cost analysis
 - › Data sharing
 - › Use of demonstration projects
 - › Rate reform and utility incentives
 - › ISO interface and aggregation
- New York and California have seen different levels of DER penetration to date. This, along with somewhat different philosophies and visions of the change they seek, informs the approach each takes to regulatory model changes
 - › California already has high DER penetration, including nearly 600,000 residential solar photovoltaic (PV) installations, and it also has mandates for additional resources such as storage. It has fully deployed advanced metering infrastructure (AMI)
 - › In New York, DER penetration is about 90% less, with approximately 58,000 residential PV installations and limited AMI deployment
- Some common themes...
 - › Improve the interconnection process and expand hosting-capacity analysis
 - › Consider the impacts of DERs on the distribution planning process
 - › Develop processes that use DERs to offset traditional utility capital expenditures
 - › Develop analyses to compare non-wires alternatives (NWAs) to traditional infrastructure
 - › For planning, consider how best to share planning and system data with third parties

Demonstration Projects: Technology or More?

One key difference is the manner in which New York and California are approaching demonstration projects. The demonstration projects being developed in New York seek to demonstrate both technical and business model alternatives for DER integration. This expands scope not only to which technology works but how money is made and by whom. In California, by contrast, pilots are addressing specific technical questions.

DISTRIBUTED ENERGY RESOURCE INTEGRATION

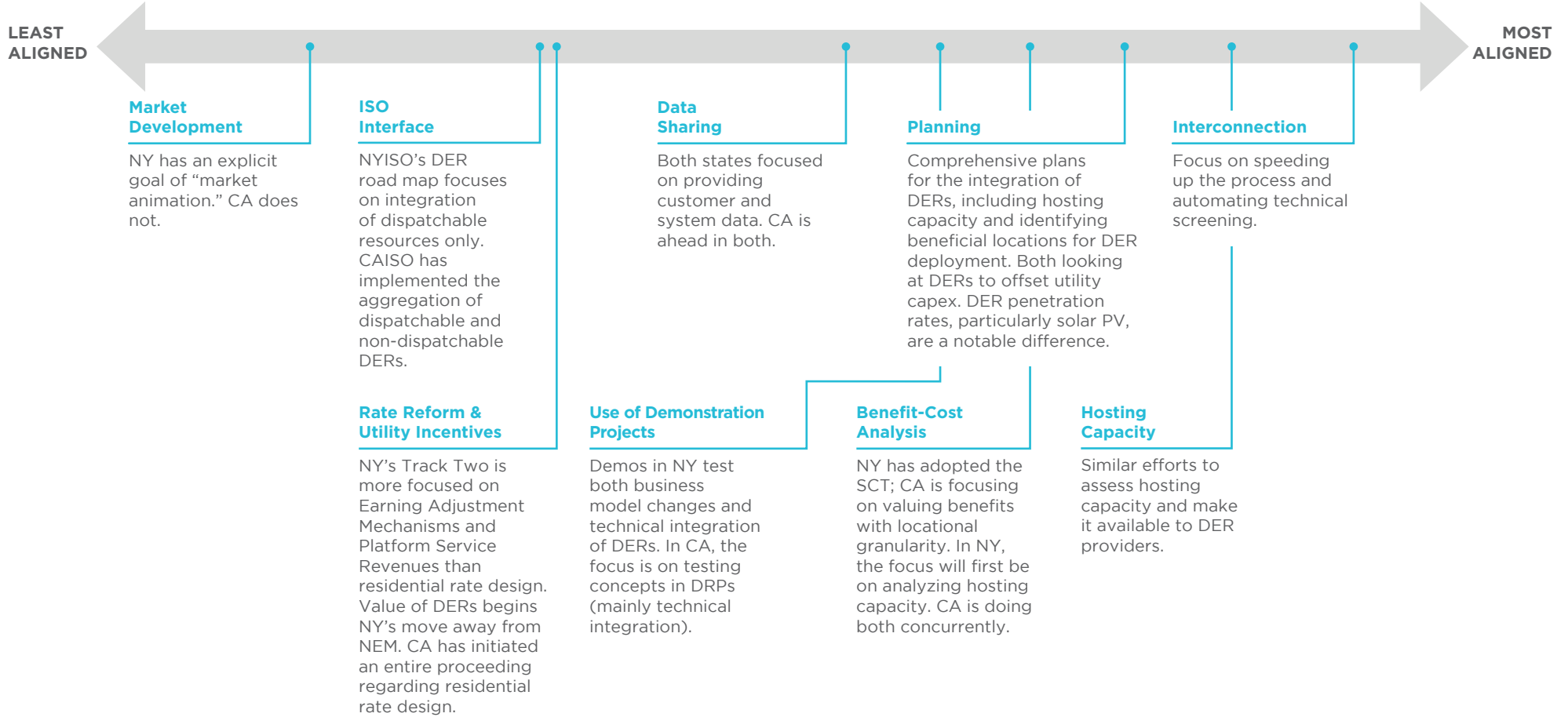
- ...But some important differences
 - › In New York
 - › DERs and a distribution-level market are seen as the solution to perceived flawed incentives in the existing regulatory compact
 - › There are myriad interlocking proceedings that address demonstration projects, large-scale renewables, rate reform, low-income issues, planning the grid, and more
 - › In California
 - › Faced with high levels of DER penetration already, the state is focusing on improved integration in support of clean energy goals
 - › The state is using a step-by-step approach through a series of legislative and regulatory actions that address discrete issues presented by DERs
- While the approaches differ, utilities in other states are watching to see how stakeholder impacts, grid impacts, and financial outcomes (including investment requirements) are unfolding

Key Elements of Grid Transformation in New York and California

DER Approach	New York	California
Interconnection	<ul style="list-style-type: none"> • Facilitate interconnection of DERs through streamlined process 	<ul style="list-style-type: none"> • Facilitate interconnection of DERs; help provide DER providers cost certainty
Hosting Capacity	<ul style="list-style-type: none"> • Preliminary analysis based on minimum loadings and equipment ratings; joint utility processes to expand 	<ul style="list-style-type: none"> • Utility-specific capacity analysis as part of Distribution Resources Plan (DRP) filings
Planning	<ul style="list-style-type: none"> • Focuses on more granular forecasting, probabilistic planning, and implementation of NWAs 	<ul style="list-style-type: none"> • Focuses on more granular forecasting, enhanced planning, and analysis to facilitate DER integration; pilot programs to use DERs to offset utility capex
Benefit-Cost Analysis (BCA)	<ul style="list-style-type: none"> • Benefit-cost framework based on the Societal Cost Test (SCT) approved; utilities have filed BCA handbooks in their Distributed System Implementation Plans (DSIPs) 	<ul style="list-style-type: none"> • Initial focus is on locational valuation; California considering SCT as a possible method to capture system-wide benefits and costs; utilities have filed Locational Net Benefits Analyses in their DRPs
Data Sharing	<ul style="list-style-type: none"> • Focuses on both customer and system data; system data to be provided to facilitate DER planning and interconnection 	<ul style="list-style-type: none"> • Primarily focuses on system data for the same reasons as New York; DRPs also outline data needed from DER providers
Use of Demonstration Projects	<ul style="list-style-type: none"> • Establishes criteria for demos; focuses on business models and technical pilots 	<ul style="list-style-type: none"> • Demos required to pilot methodologies outlined in DRPs
Rate Reform and Utility Incentives	<ul style="list-style-type: none"> • Proposed rate reform through Track Two and value of DER orders; changes manifested both in rate cases and separate proceedings 	<ul style="list-style-type: none"> • Successor to net energy metering (NEM) established; separate proceedings focused on aligning utility incentives to implement DERs
ISO Interface	<ul style="list-style-type: none"> • Road map going through stakeholder process to further integrate dispatchable DERs into wholesale market 	<ul style="list-style-type: none"> • Allows third parties to aggregate and bid dispatchable and non-dispatchable DERs into the wholesale market

DISTRIBUTED ENERGY RESOURCE INTEGRATION

California and New York DER Integration: A Continuum of Approaches



SOURCES:
 GTM Research and SEIA, *U.S. Solar Market Insight, Q3 2016*; Smart Electric Power Alliance and ScottMadden, Inc., *51st State Perspectives – Distributed Energy Resources Integration: Policy, Technical, and Regulatory Perspectives from New York and California* (Dec. 2016)

TAX REFORM: MIXED BLESSING FOR UTILITIES?

GOP-proposed tax reform could have potential negative earnings impacts for some companies.

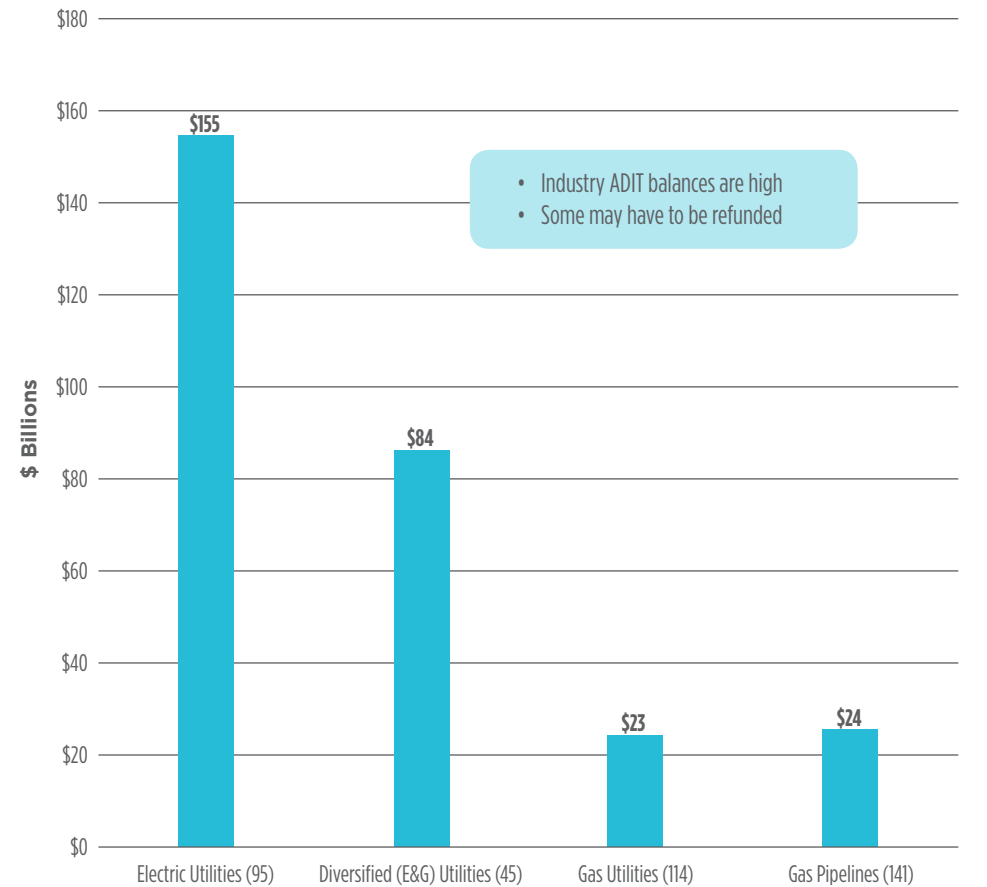
A Slate of Possible Alternatives

- Tax reform is second in line on the 2017 legislative agenda, behind the stalled attempt at healthcare reform
 - It will take time and is fraught with political challenges, so action will not come until the latter half of 2017 or 2018
 - There is some new handicapping on its likelihood of success, as Republicans still seek unity on key policy issues in the wake of stalled healthcare legislation
- Some key elements, like reduction in corporate income tax rates, the elimination of corporate interest deduction, and/or expensing of capex, are expected
- Because of the high leverage, unavoidable capital-intensive nature of utilities, along with unique regulatory accounting, some utilities hope for a carve-out, which may be difficult to achieve

Potential Macro-Impacts of Tax Reform

- Fiscal stimulus and tax reform combine to make other sectors appear comparatively more attractive in the capital markets than utilities
- Equity costs increase, linked to higher inflation and interest rates, the potential for increasing earnings volatility, and less favorable positioning relative to other sectors
- With lower income tax rates and reduced accumulated deferred income tax (ADIT) balances available to fund rate base, utilities may look to increasing amounts of equity and debt as sources of permanent financing
- Rate case activity may increase, with the effects of tax reform considered on a case-by-case basis

Regulated Operating Company ADIT Balances*

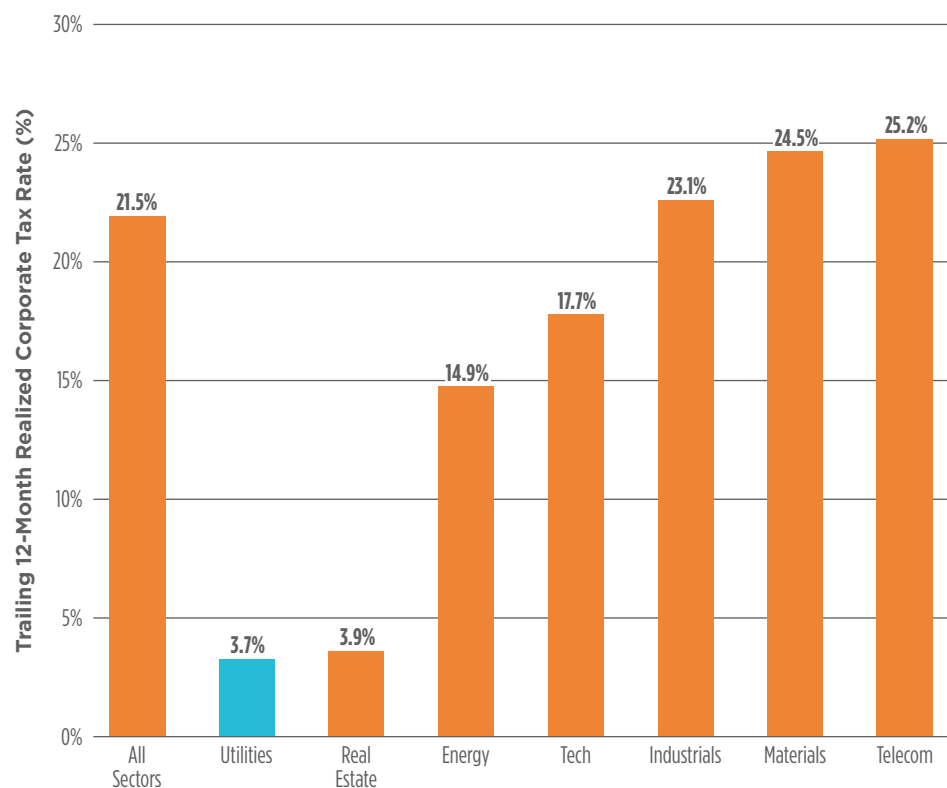


Source: SNL Financial (FERC Form 1 data); ScottMadden analysis

Potential Impacts on Rate-Regulated Utilities: The Devil Is in the Details

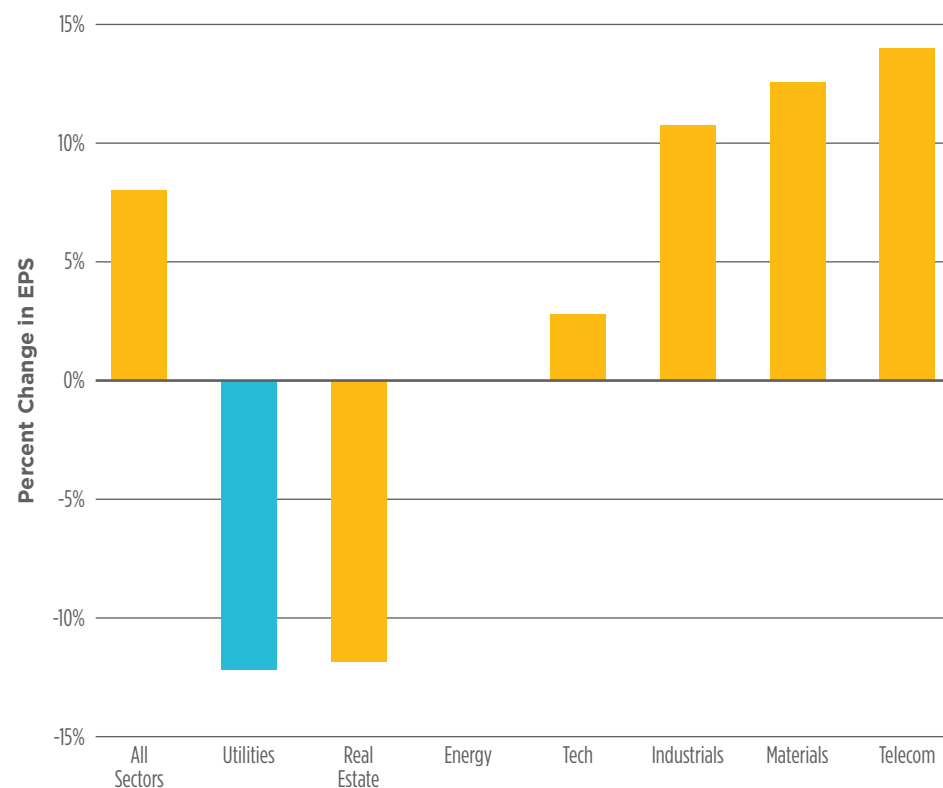
- Regulated utilities largely pass through any tax effects, subject to timing differences
- ADIT, the difference between book and tax-basis balance sheet treatment, would have to be partially refunded to customers since expected future tax liabilities would be reduced
- ADIT is essentially an interest-free loan from the government—in some jurisdictions treated like a zero-cost component of utility capital structure, but in most reducing financing costs and thus reducing rate base
- Revenue requirements and rates would have to be adjusted to reflect tax policy changes, likely in the next base rate cycle
- One positive: Utilities with capex needs could propose accelerating that spending, using headroom from reduced rates
- A key variable: Timing of any ADIT refund
 - › Normalization—refund over the remaining life of the relevant asset (versus immediate full refund of the expected difference in future tax liabilities)—would help. This treatment was used in the last major federal tax reform (1986)
 - › This would enable utilities to procure additional capital to offset the consequent balance sheet deficit and help soften cash flow impacts
 - › But state utility commissions will ultimately determine pace of refunds and other issues such as return on equity

Utility Low Tax Rates Could Become a Disadvantage



Source: Morgan Stanley

2017 Estimated EPS Impact at 15% Corporate Tax Rate (% Change)



Source: Morgan Stanley

TAX REFORM

Some Proposals Being Discussed and Potential Implications

	What's on the Table	What It Means	Helps	Challenges	Neutral	What to Watch
Reduced corporate tax rate	<ul style="list-style-type: none"> Competing proposals to reduce rates from current 35% to 15%, 20%, or 25% 	<ul style="list-style-type: none"> Lower tax burden, passed through in lower rates and refund of ADIT balances Tax credits, net operating losses (NOLs) may have less value with lower rates Some potential opportunity to maintain customer bill levels with incremental capex 	<ul style="list-style-type: none"> Developers with large tax equity investment; firms with large NOL balances or high ADIT balances 	<ul style="list-style-type: none"> Firms with low ADIT or NOL balances 	<ul style="list-style-type: none"> Firms with significant unregulated activity (e.g., IPPs) 	<ul style="list-style-type: none"> Modifications or carve-outs for regulated utilities Trade-offs to achieve revenue neutrality
100% expensing of capex in first year	<ul style="list-style-type: none"> Changes current 50% bonus depreciation 	<ul style="list-style-type: none"> Essentially "extreme" bonus depreciation Accelerated ADIT reduces rate base (and hence earnings) in near term 	<ul style="list-style-type: none"> Firms with significant, especially unregulated, investment plans 			<ul style="list-style-type: none"> Normalization vs. pass-through treatment Optional vs. mandatory application
Non-deductibility of interest	<ul style="list-style-type: none"> Trade-off for full expensing of capex Under one plan, can choose interest or capex deduction approach 	<ul style="list-style-type: none"> Renders firms neutral to debt vs. equity financing Some belief that cash flow reduction from loss of tax shield offset by depreciation cash flow 	<ul style="list-style-type: none"> Firms with large debt loads 			<ul style="list-style-type: none"> Impact upon relative cost of equity vs. debt capital
Net operating loss (NOL) treatment	<ul style="list-style-type: none"> Elimination of NOL carryback in exchange for lower rates 	<ul style="list-style-type: none"> NOLs can carry forward into future years only, no carryback 	<ul style="list-style-type: none"> Firms with large NOL balances 			
Border adjustment	<ul style="list-style-type: none"> Foreign profits not subject to domestic taxation VAT-like structure with no tax deduction for purchases of imports and no tax on export revenues 	<ul style="list-style-type: none"> NOLs can carry forward into future years only, no carryback 	<ul style="list-style-type: none"> Firms with significant capital programs or with imported energy 			<ul style="list-style-type: none"> Application of adjustment to energy commodities Reaction of free-trade advocates and international organizations like the World Trade Organization

Bottom Line

Potential elements of tax reforms have many moving parts with trade-offs among provisions. Evaluating tax reform implications will be firm specific, based on tax situation (credits, NOLs), business mix, current balance sheet, and anticipated future investment priorities. Rate case activity to account for these changes is inevitable—rigorous planning for those cases is critical.

NOTES:

*Balances are as of Q3 2016 except for gas utilities, which are as of fiscal year-end 2015

SOURCES:

Guggenheim Partners; Morgan Stanley; UBS Securities; Federal Reserve Bank; General Accounting Office; Edison Electric Institute; PriceWaterhouseCoopers; ScottMadden analysis

POTENTIAL TRUMP ADMINISTRATION POLICY CHANGES: WHAT DO THEY MEAN FOR ENERGY?

Potential policy reversals, shifts, and debates: Implications are being shaped but are still somewhat murky.

Rapid Action Expected, But Some Things Will Take More Than a Pen and a Phone

- The Trump administration and GOP-controlled Congress are moving to modify or reverse many Obama-era policies
- With a window of unified party rule through at least the end of 2018, expect swift action on many regulatory and legislative fronts, including energy and environment
- Key areas to watch will be those where the executive has more plenary authority
 - › Organization structure and allocation of agency resources and budgets
 - › Activities on federal lands and priorities of federal agencies
- Deregulatory activity may prove more difficult and time consuming, in some cases requiring new rulemakings and notice, and litigation will be inevitable
- There may be some potential for bipartisan collaboration in a few areas, such as renewables development, nuclear power, and transmission development

What the Pundits Are Saying

- “We believe the likely outcome [of efforts to reverse the Clean Power Plan] is not just the delay of the Clean Power Plan program, but more damaging to long-term growth prospects are the more structural impediments to future regulation.” - *UBS*
- “Environmental advocates involved in litigation...will ‘vigorously protest’ any efforts by incoming EPA leadership to reverse course on regulations.... Environmental advocates are gearing up to preserve the gains of the Obama era through lawsuits and petitions to the EPA to spur additional rulemaking or defend the regulations already in place.” - *Bloomberg BNA*
- “While we have yet to see any concrete proposals [for relief for nuclear], ideas we have heard suggested federal tax credits and possible direct intervention by DOE.” - *Deutsche Bank*
- “We continue to believe that the overall direction of policy affecting utilities will be determined more by economic factors and by state policy priorities than by federal direction.” - *Deutsche Bank*

SOURCES:

UBS; Deutsche Bank; KeyBanc; ABA; Bloomberg BNA; The Hill; Law360; *The Kansas City Star* (Trump team priority list of Emergency & National Security Projects); ScottMadden analysis

Potential policy changes vary by sector, as do their potential impacts.



ENVIRONMENTAL POLICY

DEREGULATION | FUNDING |
CHANGES IN MISSION | FEDERALISM



Proposals and Themes

- Elimination of or stripped down Clean Power Plan
- Elimination of oil & gas operations methane emission rule
- Elimination of the Waters of the U.S. jurisdictional expansion
- Re-evaluation of cost-benefit criteria and valuation
- Devolvement of some environmental regulatory responsibility to the states
- Rationalization of climate monitoring responsibility (NOAA not NASA, etc.)
- Withdrawal from Paris climate change agreement
- Freeze on new regulations and “2-for-1 rule”



Potential Impacts

- Longer life for some marginal coal-fired generating units
- Coal-to-gas switching will continue recent trend as gas production and takeaway capacity increase as a result of other policies, absent some gas price dislocation
- States with higher climate-related focus (e.g., CA, the Northeast) will continue to ratchet emissions compliance, with patchwork of rules from region to region



Conventional Wisdom

- Endangerment finding likely remains; CPP might then be narrowed to “inside the fence line” performance with greater flexibility for states
- Difficult administrative process to undo rules, especially major ones
- Environmental groups are expected to sue EPA, others to force regulation where there are judicial or statutory guidelines



Things to Watch

- Organizational and budgetary decisions at EPA
- Federal approach to defense of Obama-era EPA regulations in litigation
- EPA/DOJ approach to pending litigation and court response
- Challenge to the use of co-benefits in cost-benefit analysis



FOSSIL GENERATION

RESEARCH | DEVELOPMENT



Proposals and Themes

- Increased spending on clean coal projects
- Relaxation of mining rules (e.g., waste placement)
- End of moratorium of coal leasing on federal lands



Potential Impacts

- Likely minimal impact on new clean coal plant development
- Coal production may increase, although may be more for export or metallurgical use



Conventional Wisdom

- Commitment to spend on advanced fossil technology is not clear, as early utility experience has been challenging
- Nothing the administration can do will undo what market is doing



Things to Watch

- DOE budget priorities



NUCLEAR POWER FUNDING | PROCESS IMPROVEMENT



Proposals and Themes

- Reconsideration of nuclear waste repository, including Yucca Mountain
- Streamlining of process of developing and licensing new reactors
- Some discussion of federal tax credits and intervention by DOE



Potential Impacts

- Potential life extension for most units
- New nuclear may still await the start-up of new units under construction; financeability remains an issue



Conventional Wisdom

- Bipartisan issue, as nuclear plants have employment and zero-emissions benefits
- Limited financial support from DOE, given conflicting strategic intentions for the agency



Things to Watch

- Changes in NRC process and priorities
- Discussion of tax credits or extensions and included technologies
- Westinghouse bankruptcy



NATURAL GAS DEREGULATION | EXECUTIVE ACTION | FUNDING | FEDERAL LAND USE



Proposals and Themes

- Bias toward pipeline and other project approvals under more traditional processes
- Opening, re-opening some federal lands and offshore areas to oil & gas E&P
- Infrastructure funding



Potential Impacts

- Continuation of gas pipeline capacity expansion, potentially tempered by state and local resistance in some regions



Conventional Wisdom

- This will be a natural-gas-friendly administration, given personnel choices, the economic potential of inexpensive shale gas, and a desire for energy independence



Things to Watch

- FERC composition and amenability to hydrocarbon infrastructure development
- Prospective EPA/FERC cooperation
- State NIMBY reaction to new pipelines, e.g., NY



TAX REFORM CHANGE DEDUCTIONS | EXPENSING RULES | LOWER RATES



Proposals and Themes

- Reduction in corporate tax rate
- Expensing of capex
- Elimination of interest deduction
- Border adjustment for certain goods



Potential Impacts

- Degradation of rate base
- Refunding of portion of accumulated deferred taxes
- Adverse cash flow impacts for utilities with high levels of debt (reduction of tax shield)
- With lower tax flow-throughs, potential increased rate headroom for capex
- Potential positive for domestic manufacturing and industrial sector
- With reduction in tax rates, tax equity investors, key for renewables projects, may demand increased rate of return



Conventional Wisdom

- Tax package expected in second 100 days of Trump administration, although healthcare outcome may have slowed action pending consensus



Things to Watch

- Pace of committee activity on tax package
- Prevailing proposed plan: House Republican package, Ryan plan, or Trump outline
- Revival of healthcare legislation

POTENTIAL TRUMP ADMINISTRATION POLICY CHANGES

**RENEWABLE ENERGY**

FUNDING/SUBSIDIZATION

**Proposals and Themes**

- No specific proposals

**Potential Impacts**

- Tax credits sunset, creating a flurry and then a cliff in development activity

**Conventional Wisdom**

- Bipartisan issue, as wind and solar resources exist in both red and blue states
- Likely no changes to renewable tax credits, which are expected to sunset
- State renewable portfolio standards (RPS), corporate purchasing programs likely to have a greater effect on development

**Things to Watch**

- State progress on and changes to RPS

**ENERGY EFFICIENCY**

DEREGULATION

**Proposals and Themes**

- Slow or stop further, more stringent efficiency standards
- Limit, reverse, or eliminate EPA's Energy Star program

**Potential Impacts**

- Products and equipment complying with existing standards likely unaffected

**Conventional Wisdom**

- Unclear whether DOE would want to prioritize repeal of final regulations issued since May 2016

**Things to Watch**

- Interest or willingness of Congress to act on efficiency legislation
- Development of state policy or incentives to encourage greater efficiency penetration, levels

**GRID**

INFRASTRUCTURE SPENDING

**Proposals and Themes**

- Executive order expediting environmental review and approvals for "high-priority infrastructure projects" (including U.S. grid)

**Potential Impacts**

- Increased spending on power grid: President's pre-inauguration list included several grid and modernization projects, e.g., Champlain Hudson Power Express and TransWest Express Transmission projects
- Continued industry focus on cybersecurity, although federal coordinating organizations remain in flux

**Conventional Wisdom**

- Cybersecurity approach remains unclear, but Trump administration appears to adopt some Obama-era suggested approaches
- Infrastructure package expected in second 100 days of Trump administration

**Things to Watch**

- Pace of committee activity on infrastructure spending package
- Degree of alignment or diversion between Democrat and Republican infrastructure proposals and reaction of fiscal conservatives
- Final executive order on cybersecurity

ALTERNATIVE/PERFORMANCE-BASED RATEMAKING: THE ANSWER FOR A NEW ERA?

Slow demand growth, grid modernization, and renewable and distributed energy objectives encourage fresh regulatory thinking.

Changing Business Environment, Changing Regulatory Paradigms

- Slower load growth, declining cost of renewable and distributed energy resources, and slow economic growth have placed pressure on traditional unit sales-based, cost-of-service ratemaking
- Sending a volume-based price signal, and using it to recover largely fixed costs plus capex to accommodate peak usage, is not economically efficient
 - › Sustained growth has masked this in the past, but it can become dysfunctional when volume is flat
- Meanwhile, utilities must still invest in grid modernization to accommodate multi-directional power flows, increased resilience and cybersecurity needs, efficiency measures, and other policy objectives, as well as resource intermittency
- So, regulators and advocates are seeking the right economic incentives to balance efficient deployment of capital, incentives to innovate, regulatory lag, retention of service quality at reasonable cost, and rate base expansion
- States are looking at alternative ratemaking approaches, including performance-based ratemaking (PBR), to encourage consideration of third-party options, reduce frequency of rate cases, and decouple cost considerations from load changes





Lessons from Old School Performance-Based Ratemaking and Today's PBR

- PBR gained currency in the 1990s as the electric industry was restructuring. Although not uniformly adopted, it provided incentives to improve cost and reliability improvements. But it faced criticisms:
 - › Performance was rewarded that should have been expected from the utility anyway
 - › Review process was perceived as “not transparent”
 - › Threshold effects were exhibited, i.e., more investment early in the three- to five-year review cycle and slowing costs right before price cap reviews
- More recently, mechanisms like decoupling, trackers, and adjustment clauses have been applied in various jurisdictions, but new PBR frameworks are also being tested in a number of states
- New metrics include not only reliability, but also usage (efficiency), participation/engagement, innovation, and environmental performance
- States with strong policy goals for efficiency, renewable, and distributed energy—e.g., CA, MA, and NY—are looking at incentives, although some of those may be different from “true” PBR. For example, New York’s proposed Earnings Adjustment Mechanisms encompass four categories:
 - › System efficiency (achieving peak reduction and load factor improvement targets)
 - › Energy efficiency
 - › Customer engagement and information access (availability of tools and opt-in rates and their use)
 - › Interconnection (ease with which third parties can connect to the grid)

PERFORMANCE-BASED RATEMAKING

- The United Kingdom has a performance incentive mechanism termed RIIO (Revenue = Incentives + Innovation + Outputs), which established a revenue cap over a long-term (eight-year) window (see Figure 3). Utilities can increase earnings as long as they don't exceed the cap. Importantly, the U.K. energy sector is restructured, the energy commodity is not price regulated, and utilities, by and large, cannot provide DER and non-network services
- One key question for the U.S. PBR alternatives that are being considered is whether third-party competition in emerging services (like the provision of DER) weaken revenue protection and incentives afforded to utilities in exchange for price caps

Figure 1: Selected Jurisdictions Looking at or Employing PBR

State	PBR-Related Activity
<p>Missouri <i>Investigating PBR*</i></p> 	<ul style="list-style-type: none"> • The Missouri legislature has been looking at altering its electric utility regulation framework • In December 2016, the Missouri PSC initiated proceedings to examine a new, “narrowly tailored” adjustment to existing regulation to encourage grid modernization • In late December, a Missouri Senate interim committee recommended: <ul style="list-style-type: none"> › A new regulatory framework for electric utilities, including a PBR approach › Metrics that create incentives for grid modernization, reliability, and customer service › An annual rate review process that more closely matches revenues with costs • Legislative and regulatory action is pending in 2017
<p>Oklahoma <i>Gas PBR in Place</i></p> 	<ul style="list-style-type: none"> • PBR for gas utilities allows earnings sharing between ratepayers and shareholders for earnings outside of a deadband • No full decoupling, but some utilities can recover via rider lost contribution to fixed costs due to efficiency or weather
<p>Texas <i>Not Needed Right Now</i></p> 	<ul style="list-style-type: none"> • In late 2015, the Texas legislature directed the Texas PUC to analyze alternative rate mechanisms in other states and report back by early 2017 • A report was prepared and reviewed in late 2016 • PUC staff stated that “no significant evidence suggests that the current ratemaking system is in major need of repair, and in fact, existing authorized streamlined methods of recovery are achieving their intended purpose and working reasonably well” • Commissioners recognized utility concerns about regulatory lag (especially in non-ERCOT regions) but balanced that with concerns about over-earning • Importantly, Texas has retail energy choice (encouraging cost control and product offerings) and the current Texas regulation includes cost trackers
<p>Massachusetts <i>Programmatic Focus Possibly Expanding</i></p> 	<ul style="list-style-type: none"> • Massachusetts has in place a programmatic performance incentive mechanism for energy efficiency <ul style="list-style-type: none"> › An advisory council establishes targets for each utility every three years › Incentives are based on savings (kWhs and kW) and cost-effectiveness/value › Incentive payouts based on performance: threshold (75% of target), design (100%), and exemplary (125%) • In January 2017, Eversource Energy proposed a grid-wise performance plan with two major components: a PBR mechanism and a Grid Modernization Base Commitment (GMBC) <ul style="list-style-type: none"> › Under PBR, rates would be adjusted annually subject to a revenue cap in lieu of capital cost recovery › Its GMBC commits Eversource to \$400 million in grid investment over five years › Other features of the Eversource proposal include customer class consolidation, optional TOU rates, and a “minimum monthly reliability contribution” for net metering customers

PERFORMANCE-BASED RATEMAKING

Figure 1 (Cont'd): Selected Jurisdictions Looking at or Employing PBR



State	PBR-Related Activity
<p>Hawaii <i>PBR Legislation Proposed</i></p> 	<ul style="list-style-type: none"> • Bills are pending and have been proposed in the Hawaii House and Senate, respectively • Titled the Hawaii Ratepayer Protection Act, each directs the PUC, by 2020, to “establish performance incentives and penalty mechanisms that directly tie electric utility revenues to a utility’s achievement on performance metrics” • Metrics proposed include: <ul style="list-style-type: none"> › Exceeding renewable portfolio standards › Electric rate affordability and ratepayer volatility risk › Electric service reliability › Customer satisfaction › Access to utility system information** › Quickly integrating renewables, including customer projects › Timely competitive procurement processes › Fair compensation for utility employees**
<p>Illinois <i>Formula Ratemaking +</i></p> 	<ul style="list-style-type: none"> • To encourage distribution infrastructure investment (including AMI) and avoid regulatory lag, the Illinois legislature enacted in 2011 the Energy Infrastructure Modernization Act (EIMA), which put in place annual performance-based formula ratemaking • Allowed ROE is simple using market-based numbers, and no rate design or cost allocation issues are addressed in the annual filings • Illinois regulators also review performance on metrics submitted by utilities, including: <ul style="list-style-type: none"> › Frequency and duration of customer interruptions › Overall improvement in exceeding service reliability targets › Reduction in the number of estimated bills › Opportunities for minority-owned and female-owned businesses • Regulators assess ratable improvement on metrics over a 10-year period (over baseline values) • Failure to achieve incremental goals over a given period can lead to a decrease in ROE of up to 38 basis points • It is unclear what succeeds EIMA after the 10-year program sunsets

Figure 2: A Typical, Traditional Revenue Cap PBR Formula

Formula	Definitions
<p>A typical revenue cap PBR formula, without sharing mechanisms or “z” factors which adjust for cost drivers outside the control of the regulated entity:</p> $R_t = R_{t-1} (1 + RPI_t - X) (1 + \alpha \Delta D_t)$	<p>R_t = Authorized revenues in year t = 1,2,3...t, the t years of the regulatory period</p> <p>RPI_t = Retail price index in year t</p> <p>X = Productivity factor</p> <p>α = Economies of scale factor, between 0 and 1, that represent that regulated costs, and therefore revenues, increase proportionally but more slowly than company cost drivers</p> <p>ΔD_t = Increment in year t, in per unit, of the selected cost driver(s) such as units of supplied energy, or number of customers, or length of the network, or some combination of them</p>

PERFORMANCE-BASED RATEMAKING

Figure 3: RIIO Output Categories and Incentive Mechanisms***

Output Category	Incentive Mechanism(s)
Safety	<ul style="list-style-type: none"> No financial incentives on safety within the Ofgem RIIO framework Safety has a strong reputational incentive and is subject to criminal fines for breaches
Customer Service	<ul style="list-style-type: none"> Broad Measure of Customer Service (+/- 1.5% base revenue in total): <ul style="list-style-type: none"> Customer satisfaction survey (+/- 1%) Complaints (-0.5%) Stakeholder engagement (+0.5%)
Network Availability and Reliability	<ul style="list-style-type: none"> The Interruption Incentive Scheme (IIS) is the primary incentive on interruptions to supply (+/- 2.5% return on regulated equity) The delivery of health indices is also incentivized with a positive incentive to deliver additional work where merited, rather than just a penalty for under delivery (2.5% of value over or under delivery) Potential penalties for inefficient non-delivery of load indices (2.5% of value of under delivery) Guaranteed Standards restoration standard where compensation paid for interruptions that exceed the timescales set (12 hours in normal weather) Worst served customer allowance for set improvements accessible on an as-required basis
Connections	<ul style="list-style-type: none"> Time to Connect incentive (+0.4% base revenue) Incentive on Connection Engagement (-0.9% base revenue) Broad Measure of Customer Service for minor connections customers (+/- 0.5% base revenue)
Environmental Performance	<ul style="list-style-type: none"> Loss reduction discretionary award across all Distribution Network Operators in three tranches Undergrounding allowance for Areas of Outstanding Natural Beauty and National Parks Business Carbon Footprint is a reputational incentive using a league table and baseline Oil leakage and sulfur hexafluoride (leakage from switchgear) are reputational incentives based on reporting
Innovations	<ul style="list-style-type: none"> Network Innovation Allowance (up to 1% of revenue per annum) Network Innovation Competition (\$90M per annum for the industry in the first two years of RIIO-ED1) Innovation Roll-out Mechanism

Source: Maryland PSC Staff

NOTES:

DER means distributed energy resources; *other states investigating PBR include PA, MD, MN, IL, MI, and NH; **in House bill but not Senate bill; ***RIIO-ED1 set the outputs that the 14 electricity Distribution Network Operators need to deliver for their consumers and the associated revenues they are allowed to collect for the eight-year period from April 1, 2015 to March 31, 2023

SOURCES:

SNL Financial; NARUC; U.K. Office of Gas and Electricity Markets; Maryland and Texas utility commissions; industry news; Ameren investor presentation (Jan. 12, 2017); Advanced Energy Economy; *Public Utilities Fortnightly*; Foley Hoag; Blue Planet Foundation; Hawaii legislature and PUC; Maryland PSC Staff, *Report on Performance Based Ratemaking Principles and Methods for Maryland Electricity Distribution Utilities* (Jul. 1, 2014) (citing Gómez, Tomás. "Electricity Distribution." *Regulation of the Power Sector*. Ed. Ignacio J. Pérez-Arriaga. London: Springer, 2013)

CLEAN TECH AND ENVIRONMENT

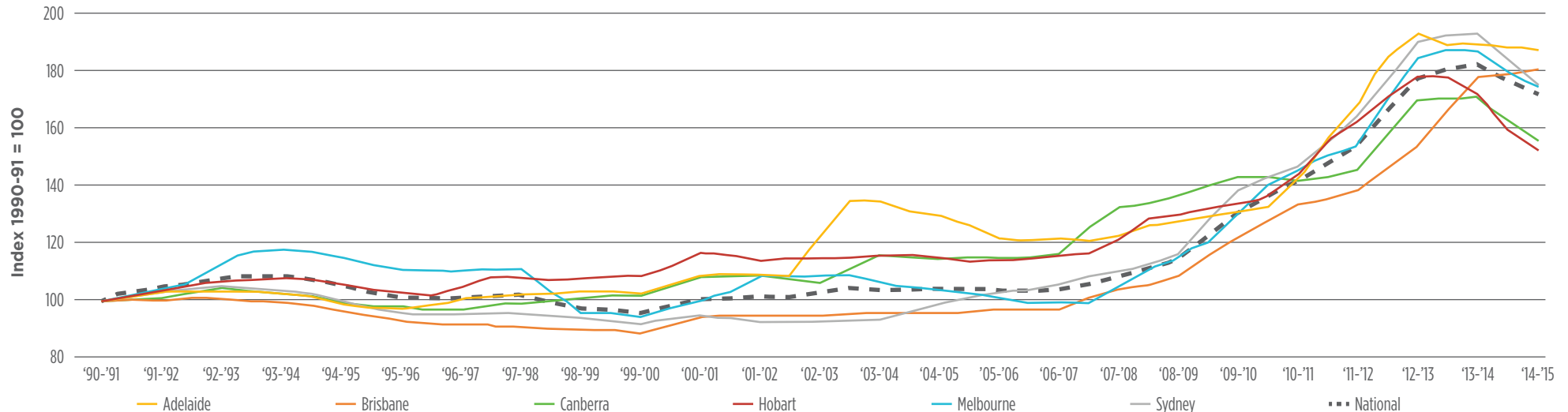
A LOOK DOWN UNDER: LESSONS LEARNED ON THE GROUND FROM THIS GLOBAL LEADER IN DISTRIBUTED SOLAR

SEPA and ScottMadden fact-finding mission reveals Australian utilities successfully integrate huge amounts of solar photovoltaic (PV), yet face unintended consequences.

Not Just Vegemite: How Australia Became a Global Leader in Distributed Solar PV

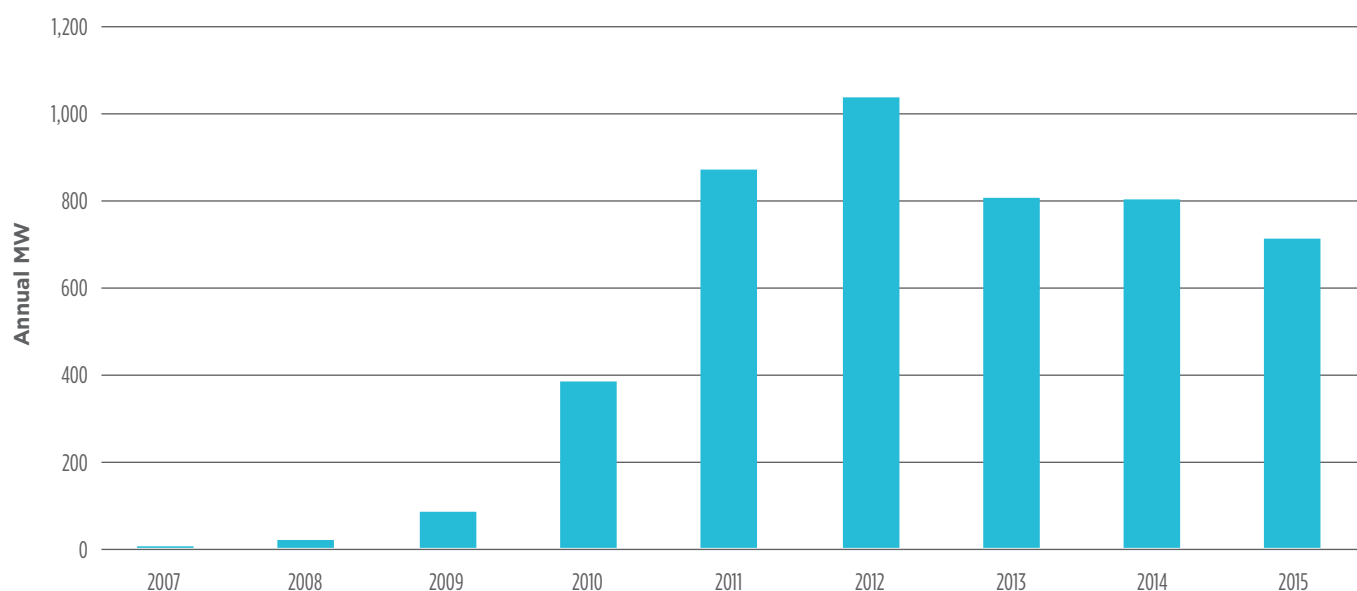
- More than 1.5 million solar PV systems are installed in Australia; the overwhelming majority are distributed rooftop systems
- Solar market penetration is highly variable: 65% of homes in some suburban neighborhoods and 30% of dwellings in the state of Queensland have solar PV systems
- The booming solar PV market is the result of several converging drivers:
 - › Increasing electricity prices: Electricity infrastructure, coupled with high financing costs increasing the rate of return on capital expenditures, rapidly drove up residential prices (see graph)
 - › Introduction of generous incentives: Early feed-in-tariff programs were as high as 46 cents per kilowatt hour (60 cents in \$AUD)
 - › Declining installation costs: A global decline in PV panel prices, combined with crews being able to install multiple systems a day, drove down soft costs for solar PV systems
- Australians have begun to view rooftop solar PV as a discretionary purchase, similar to installing granite countertops in the United States

Retail Electricity Price Index* (Inflation Adjusted) for Australian Capital Cities



A LOOK DOWN UNDER

Annual and Cumulative Installed Small Solar** Capacity in Australia (MWs)



Cumulative MWs by Year

2007	6 MWs
2008	25 MWs
2009	110 MWs
2010	495 MWs
2011	1,367 MWs
2012	2,406 MWs
2013	3,213 MWs
2014	4,015 MWs
2015	4,727 MWs

Source: Clean Energy Council, *Clean Energy Australia Report 2015*

Utilities Successfully Integrate PV, but Lose Metering in Regulatory Transition

- Distribution utilities found the electric grid to be resilient and capable of accommodating high penetrations of distributed solar PV
- Integration has been managed with creative approaches and low-tech solutions: For example, controlling hot water load serves as a “solar sponge” by absorbing peak solar production midday
- Rising retail electricity rates created customer backlash and resulted in further regulatory moves to contestability, including rules that will require the distribution utility to compete to retain metering services with customers—an unintended consequence

Key Lessons: Clear Value Proposition and Customer-Focused Culture

- Key takeaways from the Australia experience are that electric utilities in the United States should:
 - › Understand and communicate the value proposition of large capital investments. A project becomes a losing proposition if regulators or customers perceive it as gold-plated or unnecessary
 - › Foster a company culture that is firmly focused on the customer. This focus will enable an electric utility to maintain good customer relationships during regulatory changes. As observed in Hawaii as well as Australia, a passive approach cedes the influence to other voices. If you’re not at the table, you’re on the menu

NOTES:

*Price index, deflated by the consumer price index for all groups; **“Small solar” includes up to 100 kW; 2007 includes pre-2007 installations

SOURCES:

SEPA; ScottMadden; Australian Energy Regulator, *State of the Energy Market 2015*; Clean Energy Council, *Clean Energy Australia Report 2015*; Australian PV Institute; Energex; Australian Energy Council

A NEW DAY DAWNS: INNOVATIVE SOLAR PPAS CAN BE A WIN-WIN SOLUTION FOR EXCESS SOLAR POWER

Smart Electric Power Association (SEPA) and ScottMadden explore alternative PPA structures in Hawaii

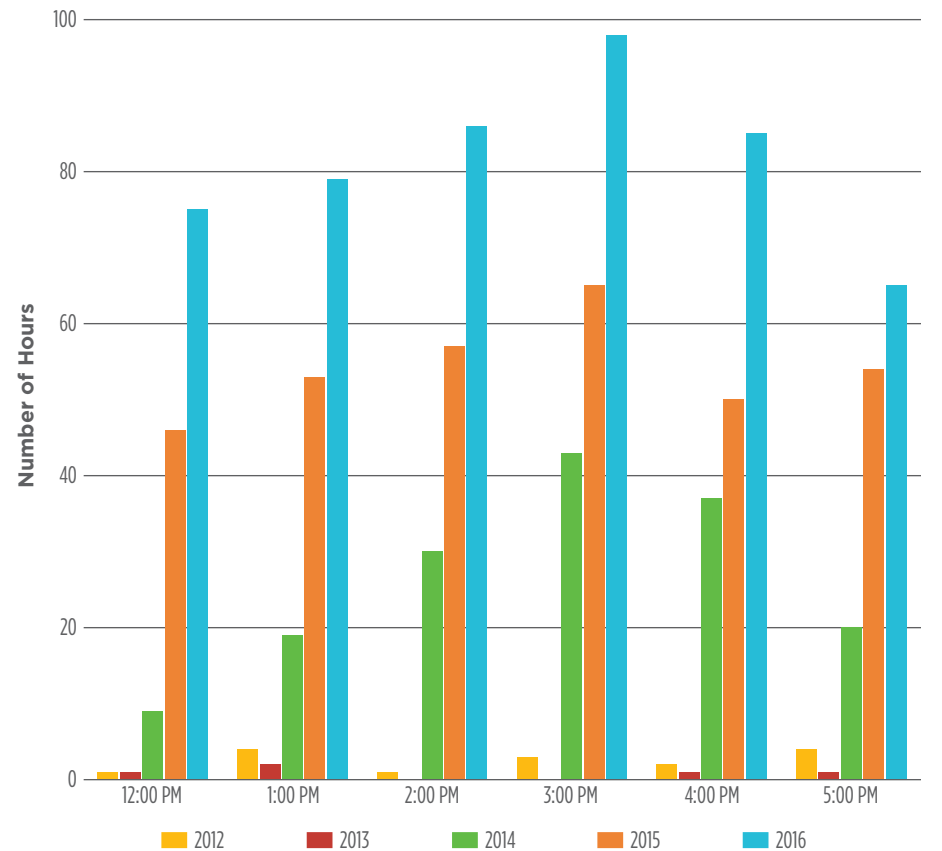
The Anatomy of a Solar Power Purchase Agreement (PPA)

- PPAs have been vital to the growth of solar capacity as they are a requirement to secure project financing and typically include:
 - › Price for purchase and sale of electricity: The rate that will be paid for electricity; may include an annual escalator
 - › Term: Length of contract, which can generally range from 15 to 30 years
 - › Environmental attributes and incentives: Ownership of renewable energy certificates or tax incentives
 - › System repair and maintenance: Party responsible for maintaining and operating the solar system
 - › Curtailment: Circumstances when the solar system must reduce output, usually related to grid operations
 - › Force majeure: External circumstances that prevent parties from meeting contract obligations

The Solar PPA: Tried and True or Rigid and Outdated?

- Operational and market challenges continue to arise with the expansion of solar. The problem comes as solar output peaks at noon, but load peaks later and/or earlier. What happens when electricity supply exceeds demand due to solar?
 - › Hawaii: Utility-scale renewables are curtailed by vintage, with the newest contracts shutdown first. As a result, renewable developers must price curtailment risk into their customers' prices
 - › California: Hour-ahead prices began turning negative during midday beginning in 2014. This has become more frequent in subsequent years signaling over-supply. Curtailment has also increased dramatically in recent months
 - › North Carolina: PURPA-qualifying facilities may receive a 15-year contract at avoided cost. The rapid expansion of solar has prompted a growing debate around "duck curve" impacts and the long-term viability of the model
- In these markets, the traditional solar PPA may quickly become rigid and outdated as traditional PPAs are used to manage conditions for which they were not designed

Figure 1: Frequency of Negative Prices in CAISO Trading Hubs

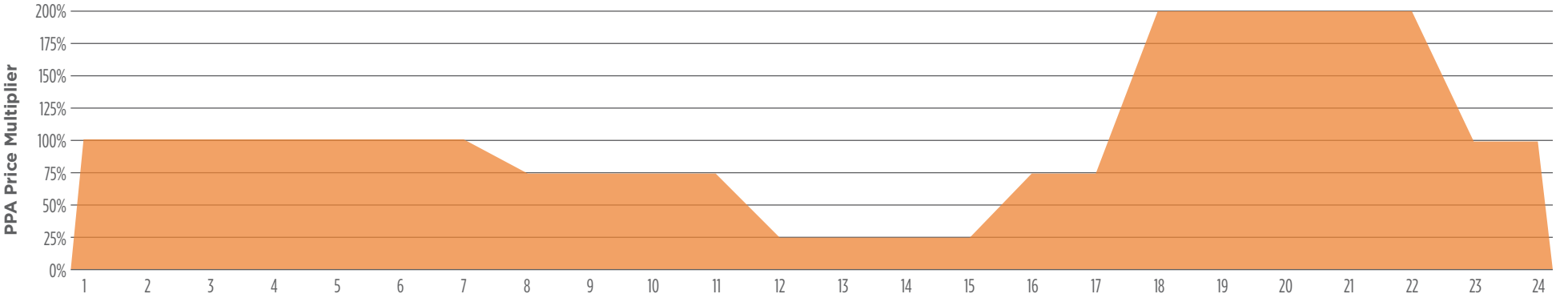


Source: SNL

Revamping the Solar PPA with Innovative Alternatives

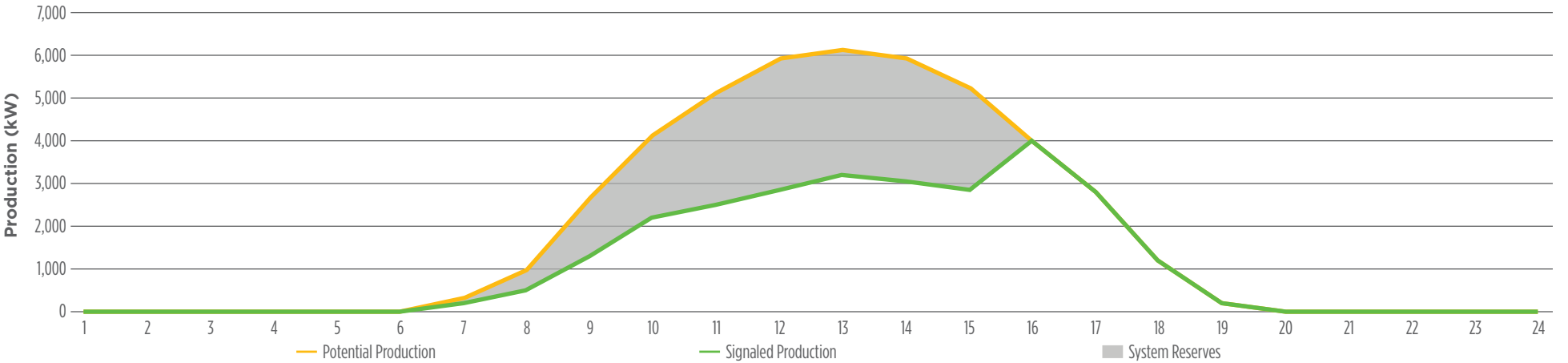
- The increasing penetration of solar provides a unique opportunity to innovate solar PPAs in order to better accommodate today’s market and operational conditions
- Recently, SEPA and ScottMadden considered alternative PPA structures for the Hawaiian Electric Companies. The analysis considered the impact on curtailment of the following:
 - › Capacity and Energy: Pricing includes capacity (\$/MW-month) and energy (\$/MWh) components. The capacity payment reduces curtailment risk that otherwise must be priced into bids, artificially increasing the price of energy
 - › Time-of-Day Pricing: Pricing for energy is low (or even negative, see Figure 1 on previous page) during low-load periods and high during peak periods. In response, time-of-day pricing assigns a price multiplier for each hour of the day (Figure 2)
 - › Renewable Dispatch Generation: Pricing includes fixed monthly payment to ensure the project can obtain financing and a variable component (\$/MWh) to cover O&M costs. The utility controls output on a real-time basis, which allows undelivered available energy to provide system reserves or other ancillary services (Figure 3)

Figure 2: Illustrative Time-of-Day Hourly Price Signal



Source: SEPA; ScottMadden

Figure 3: Creating System Reserves from Renewable Dispatch Generation



Source: SEPA; ScottMadden

Key Questions for Solar PPA Innovation

- PPA contracting models examined by SEPA and ScottMadden address a fraction of the innovation possible for solar PPAs
- Innovative PPA models can allow new solar projects to provide additional value to the electric grid, thereby reducing price risk and increasing flexibility
- In return, the financial arrangements can allow solar projects to remain profitable, even if operating below maximum capacity
- The table below lists key questions that should be considered when designing alternative PPA structures

PPA Component	Key Questions
Variable Energy Pricing	<ul style="list-style-type: none"> • Will energy pricing vary by time of day? Day of week? Month or season? • Will energy prices be tied to market prices?
Capacity and Ancillary Services	<ul style="list-style-type: none"> • What capacity or ancillary services will be provided to the electric grid? • Under what condition will capacity or ancillary services be provided? • How should the solar system be compensated for capacity or ancillary services? • What outages are permitted without penalty?
Curtailement	<ul style="list-style-type: none"> • Can PPA structures make planned curtailment financially viable for solar assets while reducing overall system costs? • Can PPA structures reduce the amount of unplanned curtailment? • How should curtailment risk be shared between system owners and the electric utility?
Industry Standards	<ul style="list-style-type: none"> • Does the alternative PPA structure require any special technical specifications that must be met before interconnection to the grid?
Operational Control	<ul style="list-style-type: none"> • Can the electric utility see the output originating from the solar system? • Can the electric utility control the output from the solar system?
Ease of Administration	<ul style="list-style-type: none"> • Is the PPA structure overly complicated or cumbersome? • Does the PPA structure require new processes or procedures for the electric utility?

NOTES:

PPA means “power purchase agreement”; PURPA is the Public Utility Regulatory Policies Act, which requires electric utilities to purchase output of “qualified facilities” at the utility’s “avoided cost” - i.e., the cost a utility would incur if it chose to either provide the energy itself (by building new capacity) or to purchase the energy from nonqualifying facilities. Additional detail for each model can be found on our website in the full report: SEPA and ScottMadden, Inc., *Proactive Solutions to Curtailment Risk: Identifying New Contract Structures for Utility-Scale Renewables* (Jan. 2017).

SOURCES:

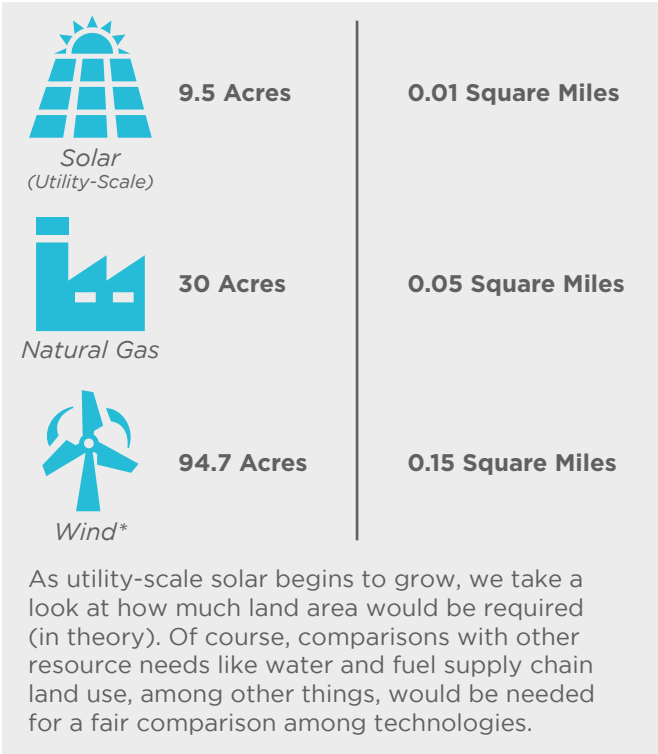
SEPA; Platts; SNL; ScottMadden analysis

THE INDUSTRY IN CHARTS: HOW BIG IS A MEGAWATT?

A thought experiment: how much land does it take to make electricity?

Different Generation Technologies... Different Footprints

Land Use per MW by Resource

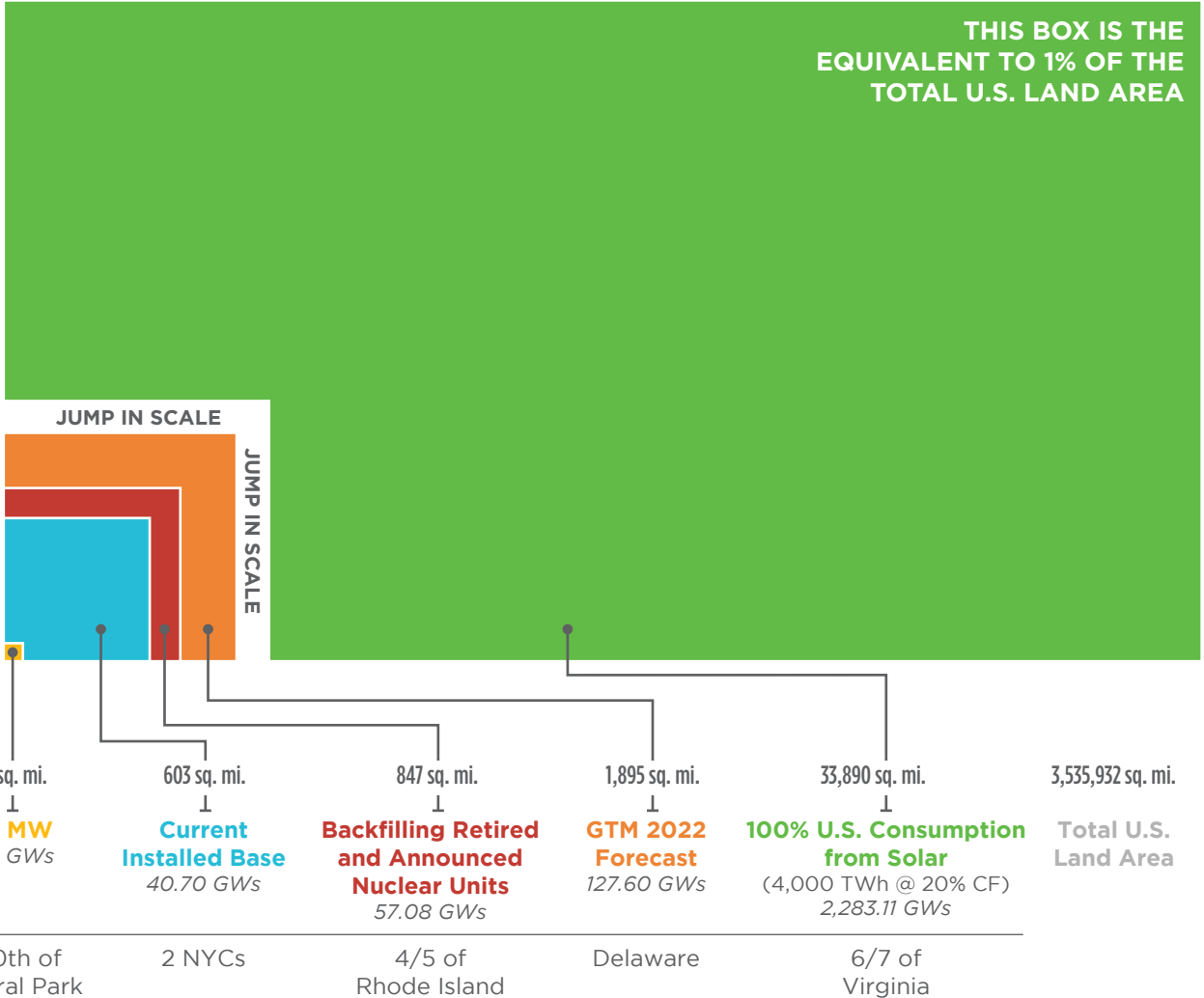


NOTES:
Assumes utility-scale solar operating at 20% capacity factor; does not account for time of solar radiance, only a MW-equivalent; *wind land use represents leasing only; does not mean that other use (e.g., farming) is not available and co-located on acreage.

SOURCES:
NREL; GTM Research; Leidos (for Natural Gas Supply Association); EPRI; ScottMadden analysis

Scaling Up Solar: What's the Footprint?

Land Usage of Solar at Various Levels of Market Penetration



Equivalent Size (roughly) of:

RECENT INSIGHTS: AVAILABLE AT SCOTTMADDEN.COM

ScottMadden posts energy and utility industry-relevant content and publications on a regular basis. The list below is a sample of recent insights prepared by our consultants.

Clean Tech & Sustainability	<ul style="list-style-type: none"> • <i>EDGE Chats: The Outlook for Clean Tech</i> • <i>Proactive Solutions to Curtailment Risk: Identifying New Contract Structures for Utility-Scale Renewables</i>
Energy Technology	<ul style="list-style-type: none"> • <i>Beyond Renewable Integration: The Energy Storage Value Proposition</i> • <i>NARUC Urges State Regulators to Allow Utilities to Include Investments in SaaS in Rate Base, Unlock the Potential of Cloud Computing</i>
Fossil Generation	<ul style="list-style-type: none"> • <i>The Flexible Coal Plant - How Some Coal Plants Are Transitioning to Peak Load</i> • <i>An America First Coal Plan: Will Changes in U.S. Policy Favor Coal?</i>
Grid Transformation	<ul style="list-style-type: none"> • <i>New York Regulators Evaluate DER Integration Plans; Find Several Areas Wanting</i> • <i>Distributed Energy Resources Integration: Policy, Technical, and Regulatory Perspectives from New York and California</i>
Natural Gas	<ul style="list-style-type: none"> • <i>New Federal Pipeline Safety Law Expands PHMSA's Responsibilities</i>
Nuclear Power	<ul style="list-style-type: none"> • <i>Illinois Future Energy Jobs Bill Focuses on Nukes, but Will Also Have Large Impacts on the Grid</i>
Public Power and Electric Cooperatives	<ul style="list-style-type: none"> • <i>Four Strategic Priorities for Public Power</i> • <i>Enhancing Cybersecurity: A Briefing for Public Power</i>
Regulation and Rates	<ul style="list-style-type: none"> • <i>President Trump Signs Wide-Reaching Executive Order Directing Agencies to Review Existing Energy Regulations</i> • <i>Regulatory and Legislative Changes Affecting Rate-Case Strategies</i>

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ENERGY PRACTICE: SCOTTMADDEN KNOWS ENERGY

About ScottMadden

ScottMadden knows energy from the ground up. We have worked in every kind of company, business unit, and function in the sector. We understand that each client's challenge calls for a unique solution. So we listen carefully to you and personalize our work to help you succeed—by solving the right problem in the right way and delivering real results.

We have supported 20 of the top 20 energy utilities—and hundreds of others, large and small. Our industry-leading clients trust us with their most important challenges. They know that chances are, we have seen and solved a similar problem. Our consultants have earned this confidence through decades of experience in the field and are ready to share industry-leading practices and management insights.

We can be counted upon to do what we say we will do, with integrity and tenacity.

Stay Connected

ScottMadden is proud to join the Smart Electric Power Alliance (SEPA) in a fact-finding mission on October 1-6, 2017, to explore the renewable energy market and grid modernization efforts of Belgium and Netherlands—as well as the greater European Union.

We look forward to presenting learnings and insights from the trip. If you are interested in receiving a copy of our key findings, please contact us at info@scottmadden.com.

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